Qianqian Rui. Incident Management Process and Remedy Action Request System Analysis for Technical Support. A Master‘s Paper for the M.S. in I.S degree. July 2010. 99 pages. Advisor: Professor Stephanie W. Haas

Among many available frameworks and international standards for technical support service, Information Technology Infrastructure Library (ITIL) is one of the earliest and most popular frameworks, being widely followed and implemented all over the world in both private and public sectors. Many supporting tools are designed and developed based on the processes recommended by ITIL. However if the processes are not followed by the actual business practice then such supporting tools might not fulfill the business demand as desired. This paper uses Remedy® Action Request System as an example tool to identify the possible gaps between the ITIL Incident Management process and actual business processes, and then uses the data extracted from Remedy® to evaluate an ITIL based sample SLA to demonstrate potential deficiencies caused by business deviation from ITIL processes. Countermeasures are also given based on business scenarios.

Headings:

ITIL Framework

Incident Management

Service Level Management

BMC Remedy® System Analysis

INCIDENT MANAGEMENT PROCESS AND REMEDY ACTION REQUEST SYSTEM ANALYSIS FOR TECHNICAL SUPPORT

by
Qianqian Rui

A Master's paper submitted to the faculty
of School of Information and Library Science
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of Science in
Information Science.

Chapel Hill, North Carolina

July, 2010

Approved by:

_____

Prof. Stephanie W. Haas

Table of Contents

List of Tables

List of Figures

1. Introduction

Technical support, as one important section of the discipline of Information Technology (IT) service, nowadays become more and more important in the business practices given the dependency business have upon IT activities[15]. During years of practice certain IT models have been well established and followed all over the world for technical support.

Technical support primarily aims for timely trouble shooting and problem solving associated with products such as computers, software systems, and electronic goods. Due to the improvement of the technology as well as other factors, for example, cost saving and business extension, technical support now covers a wider scope of services, including asset management for the related product or service, customer relationship management. Managing all the incidents[1], assets, and customer information during support became a critical aspect of the service, hence systems are developed to assist the processes and build the repository of the service provided, such as records of incidents.

Technical support can be delivered, depending on the situation, by different technologies, from help desks to self-service web pages. For a given type of technical support there are normally customized systems for such type of support ready in the market. BMC Remedy® offers the market-share and growth leading

[1] Incident: In the context of technical support, incident refers to an event that is not part of the standard operation which may cause business failure or reduce business efficiency.

software products that have tailored applications for businesses sizing from small to cross-continental[2].

Given the importance of technical support to stable business operation, being able to define and measure the Quality of Service (QoS) is crucial for both technical support service vendors and customers[38]. Definition and measurement of QoS can be assured through negotiated contracts for "increasing accountability and providing strict guidelines to the … services to be provided"[13, page 185]. In the IT service industry, this kind of contract is called Service Level Agreement (SLA). SLAs take the service received by the customers as the subject of the agreement. Figure 1 shows an overall organizational demand for the above mentioned services and the focus of this paper is marked in light pink color.

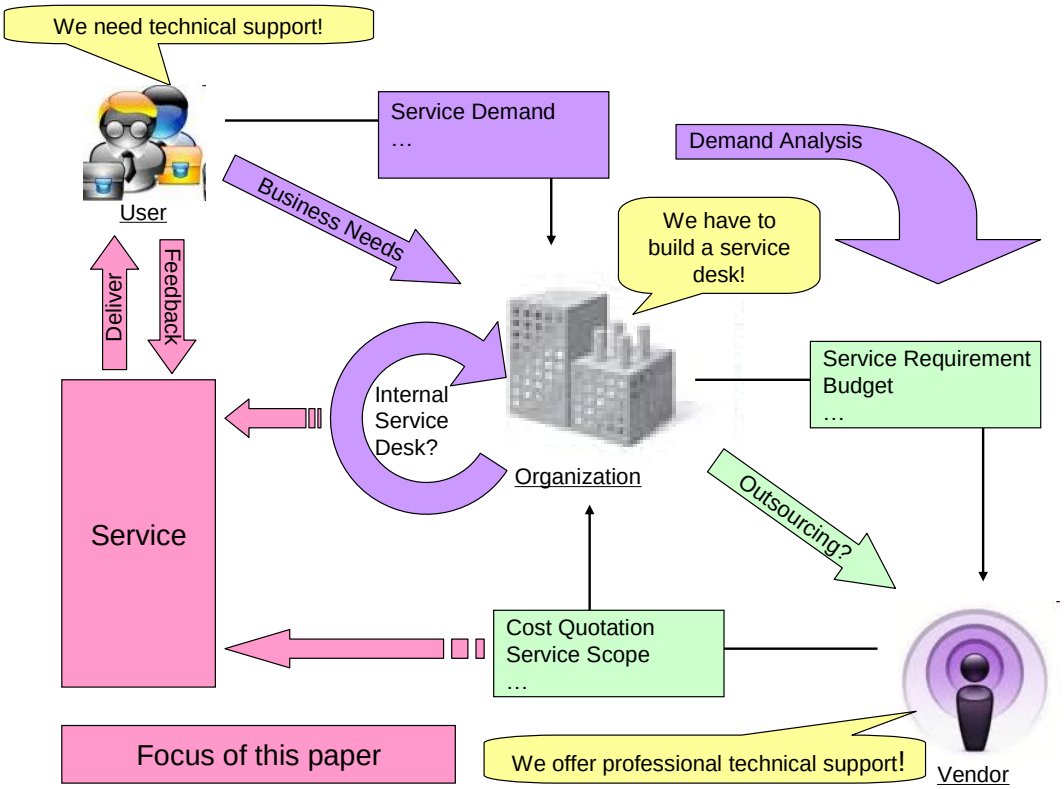


Figure 1: Organizational Technical Support

Incident management, the process of “restore normal service operation as quickly as possible and minimize the adverse impact on business operations” [8, page 86], is highly visible to business and hence one of the first to-be-implemented processes in technical support. Incident management systems, such as Remedy® Action Request System, which are used during the incident management process to record and track the lifecycle of incidents, can be a good source of quantitative data for evaluation of SLA adherence. An example of Incident Management and SLA in a process design based on ITIL is shown in Figure 2.

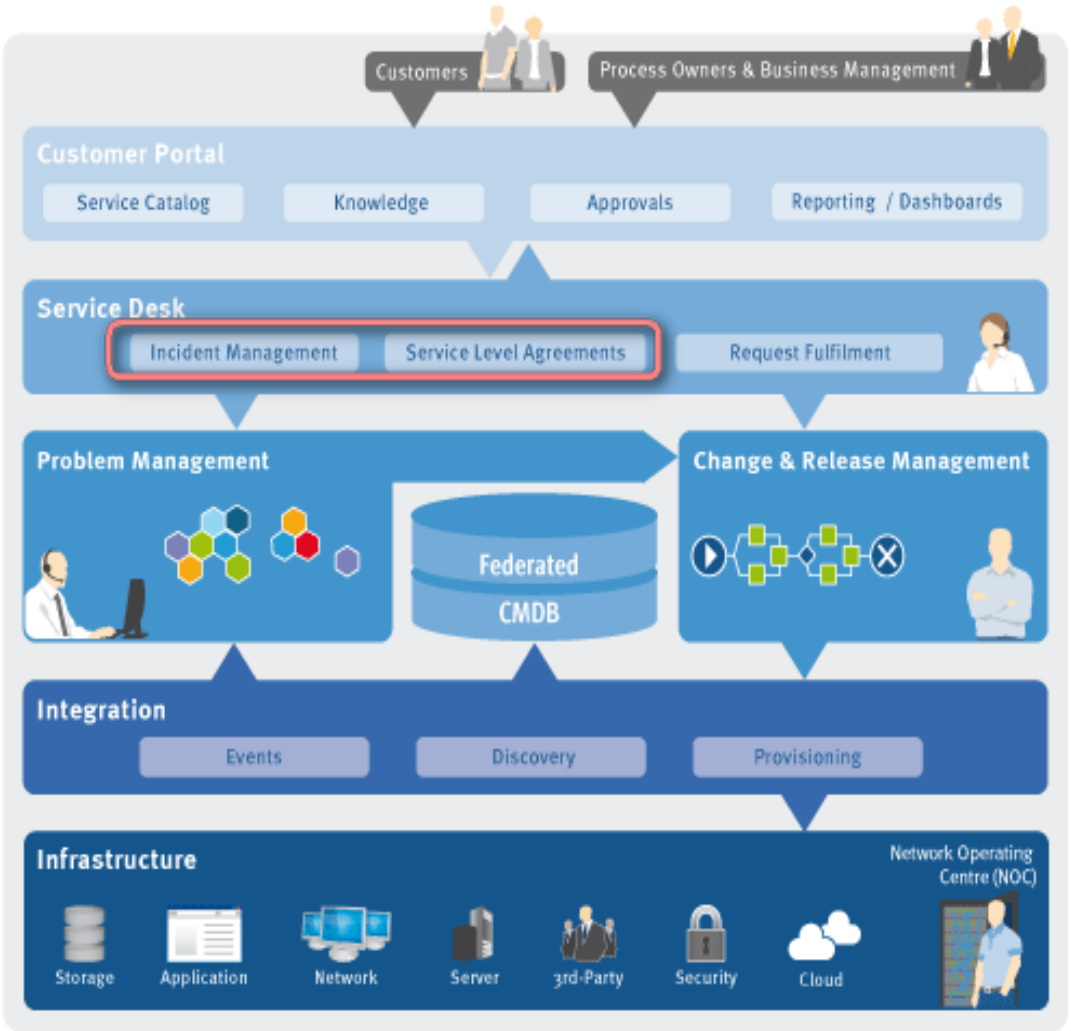


Figure 2: Incident Management and SLA in a Sample ITIL Process Design[47]

1.1 Research Question

With well established frameworks such as IT Infrastructure Library (ITIL), International Organization for Standardization / International Electrotechnical Commission 20000 (ISO/IEC 20000) and Control OBjectives for Information and related Technology (COBIT), many systems or applications have been designed and used for delivering or assisting technical support services.

ITIL was developed more than 15 years ago by the United Kingdom (UK) government to document IT Service Management best practice, with the "involvement of industry experts, consultants and practitioners" [23, page 9]. Given the early recognition and significance of ITIL, the framework has become the de facto standard around world for both private and public sectors [23]. BMC Remedy® designed and built their IT supporting systems closely based on the framework of ITIL. The company is well recognized in the market of technical support service.

However, ITIL only offers a framework; the actual implemented business processes could vary from the framework, or have specific procedures for certain service handling. When business processes deviate from the framework on which BMC Remedy® based its product, meaning that the intended system processes from BMC Remedy® are not closely followed by users, deficiencies arise and reduce the usability of the system. Consequently, such deviation may a) make it harder to use the data provided by the system for SLA adherence evaluation and/or b) make the data inaccurate.

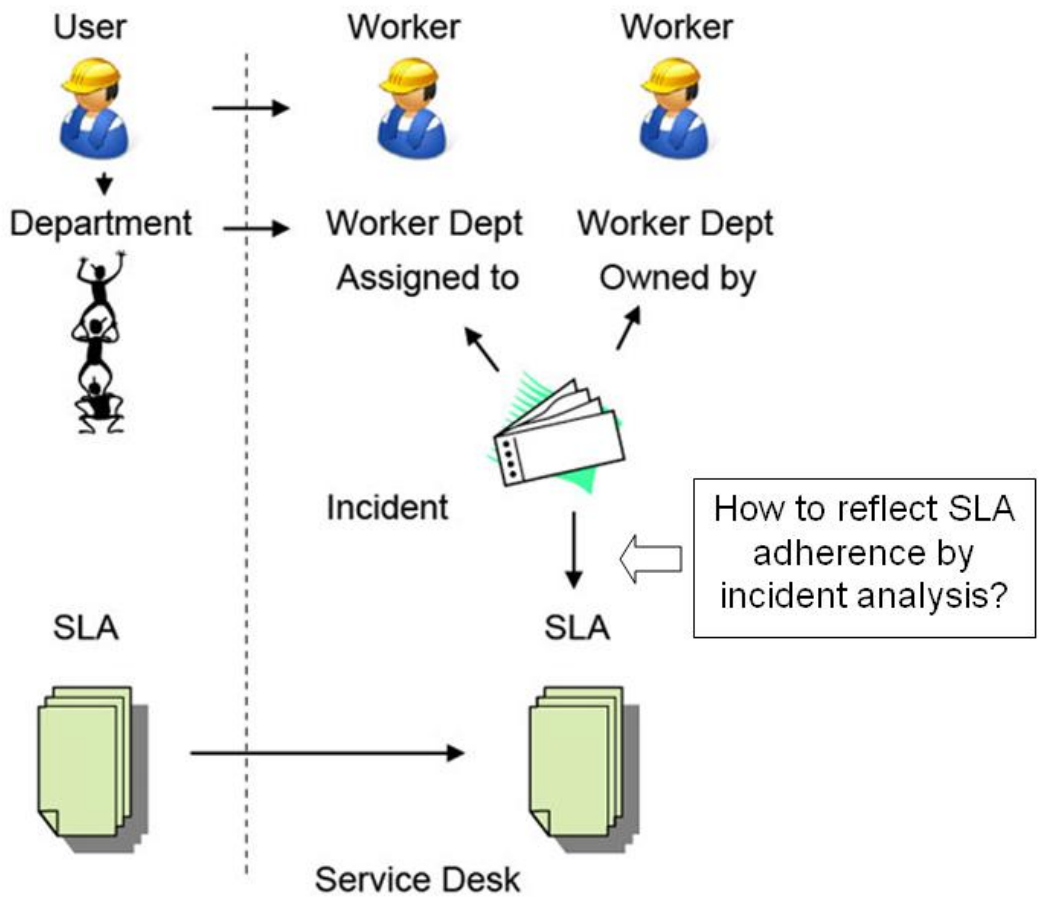


Figure 3: Incident Analysis and SLA Adherence[16]

Incident management is a major component of ITIL and a core practice of technical support service, and thus also faces these problems. This paper examines the ITIL framework best-practice business process for incident management and compares it to the BMC Remedy® Service Desk: Incident Management (hereafter referred to as Remedy®) system process for incident tracking and processing. It then proposes possible system improvements as well as a prototype for proper reporting of service level adherence, as demonstrated in Figure 3.

1.2 Problem Statement

Technical support work is "non-routine and time critical"[10, page 416], during

which “One man’s routine of work is made of the emergencies of other people”[18, page 316]. Therefore one key aspect of tools for technical support is “determining the proportion of missing functionality versus erroneous operation breakdowns”[10, page 430]. For example, a tool can be lean and with limited functions, perhaps omitting some that are truly necessary. Or a tool may include as many functions as possible, resulting in complexities that might lead to erroneous operation. Possible problems of Remedy® therefore could be in the following list:

I. Adherence to the ITIL framework makes it less flexible for various businesses to adapt to;
II. Certain system features are not efficient enough to support the business incident tracking practice because of the tools;
III. Too many features inherited from ITIL framework which confuse users during operation;
IV. Inability to provide sufficient data for service level adherence evaluation if desired processes are not followed.

1.3 Objectives

To address the problems listed above, improvement measures can be suggested both from system functionality perspective and system process perspective. This paper also aims to come up with a prototype report for service level evaluation based on the improved functionality and process.

Objectives of this paper are:

I. Describe the best-practice framework process recommended by ITIL;

II. Describe the ITIL framework reflected in Remedy® for technical support;

III. Describe how the service performance should be evaluated based on the framework and the possible data that can be drawn from Remedy® for the evaluation;

IV. Compile a sample report for the SLA adherence evaluation based on the data that can be drawn from Remedy®;

V. Demonstrate possible deviations of actual business processes from the framework and the impact on extracting data from Remedy® for SLA adherence evaluation;

VI. Suggest measurements for business process and system process integration, as well as possible system improvement.

1.4 Scope

Incident Management deals with users directly, serving as the single or first point of contact for the support processes, therefore it is easier to demonstrate its value to business as the representative of support services. Remedy®, adhering its architecture to ITIL best practices, is the market leader in the service desk business, with 26.7% of the globe market share in 2006[9]. Hence the scope of this paper will be restricted to the Incident Management process and the Remedy system that is used for the Incident Management processes, focusing on incident tracking and handling.

Precautionary incident management, for instance user education and scheduled maintenance, is out of the scope of this paper. Remedy® does not

support such kind of incident management process. However certain data extracted from Remedy® can also be used for precautionary purposes. This will be discussed in Chapter 6 on SLA evaluation.

1.5 Study Significance

Technical support for many organizations is critical given that sufficient support keeps smooth and stable business performances. Defects in IT systems could reduce work efficiency, and in the worst case, result in huge financial or reputation loss; effective support hence does not only try to get the incidents solved as quickly as possible but also seeks to minimize the fallout from incidents, through proper disaster recovery mechanisms. The ability to evaluate the support service level is consequently also critical for both service providers and customers. Consider the resolution percentage of incidents as an indicator for service level performance; it helps both the service provider and the customer to reach an understanding of the capability of the service provider to solve incidents. Low percentage probably represents a failure of service and could be used as a basis for service cost negotiation. The data can be drawn from the incident tracking systems by calculating the ratio of the number of resolved incidents over the number of recorded incidents. Such data, if it can then be automatically summarized by the systems, will increase the service level assessment ability for both service providers and customers.

This study looks at the possible insufficiency of Remedy® caused by the deviation of business process from the ITIL framework, and tries to come up with corresponding suggestions for enhancing functionality and improving practice,

and eventually to better reflect and report the service level based on the data in the system. Such improvement and reports can help both vendors and customers of the service to better evaluate the QoS for service sustain and future improvement.

2. Literature Review

2.1 Common Framework and Standards for Technical Support

Over its lifetime, the IT industry has developed a number of frameworks and standards to address the growing needs of management and practice. Three of the common ones used for technical support are ITIL, COBIT and ISO/IEC 20000.

ITIL:

To provide standards for the discipline of IT services in both public and private sectors, starting from the 1980’s United Kingdom's Office of Government Commerce (OGC) developed a set of documentation named Information Technology Infrastructure Library (ITIL), which consists of comprehensive, consistent and coherent concepts and best practices for IT Service Management and can be tailored for use in most IT organizations. Figure 4 shows the high-level ITIL framework architecture.

Figure 4: The ITIL Framework[17]

COBIT:

In 1996, Information Systems Audit and Control Association (ISACA) and the IT Governance Institute (ITGI) released the first version of The Control Objectives for Information and related Technology (COBIT), with the mission "to research, develop, publicize and promote an authoritative, up-to-date, international set of generally accepted information technology control objectives for day-to-day use by business managers and auditors"[28, Control Objectives for IT: COBIT®]. It is originally created as an audit framework then it later matured to an overall IT management framework [23]. COBIT functions as an overarching framework for IT governance, providing "common language to communicate goals, objectives and expected results to all stakeholders"[19, COBIT Framework for IT Governance and Control]. Since its first release COBIT has now evolved to version 4.1, including 34 processes to cover over 210 control objects. The overall framework is shown in Figure 5 below.

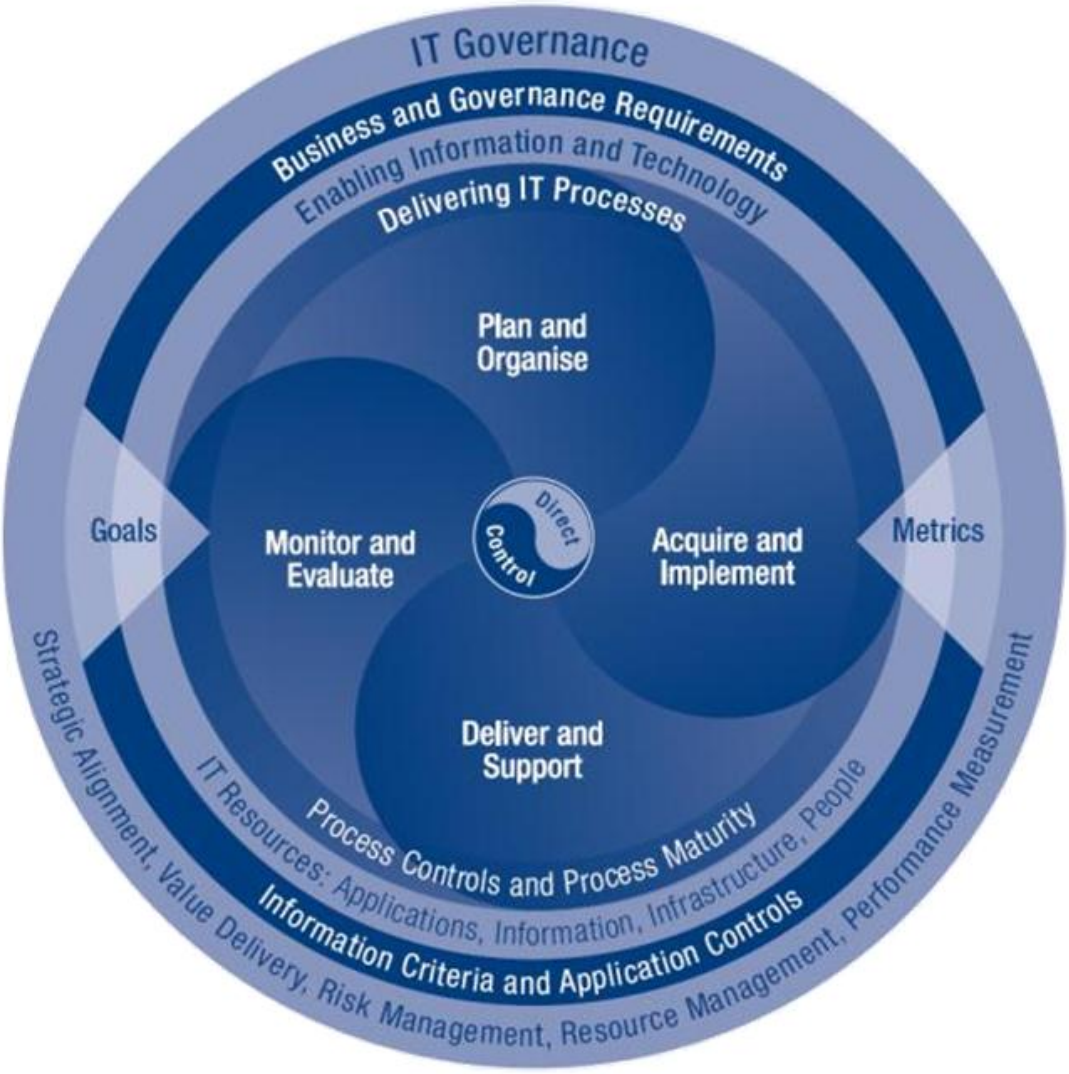


Figure 5: The COBIT Framework [19]

ISO/IEC 20000:

ISO/IEC 20000, as shown in Figure 6, is the first international standard specifically aimed at IT Service Management developed by the British Standard Institution (BSI Group) in 2005. It has been aligned with the ITIL process approach and "describes an integrated set of management processes for the effective delivery of services to the business and its customers" [26, What is ISO/IEC 20000?]. Unlike ITIL and COBIT, which are frameworks, ISO/IEC 20000 provides documented standards for auditors to assess the delivery of IT service

management processes. It also defines the requirements for service providers to deliver services with acceptable quality.

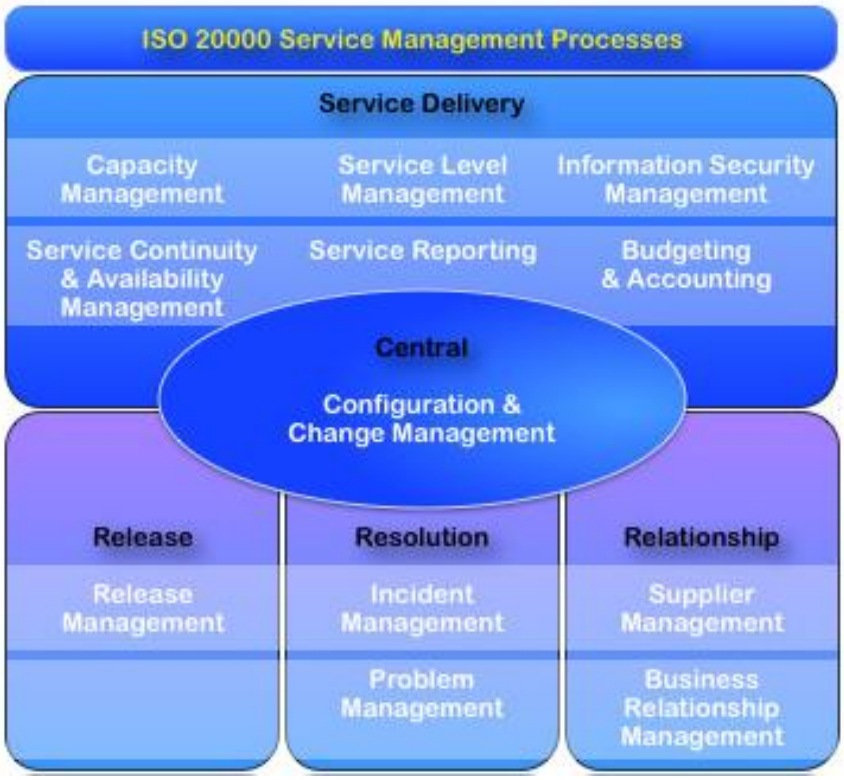


Figure 6: The ISO/IEC 20000 Standard [31]

Given the number of choices of frameworks and standards available, organizations "can face uncertainty in understanding which framework, method or standard of practice they need in order to excel at managing IT services" [39, page 145].

Among the above mentioned three frameworks and standard, ITIL is commonly regarded as strong in describing concept and processes to outline how IT services should be delivered. COBIT is well recognized for its controls and metrics[48]. ISO/IEC 20000 is designed to reflect the best practice contained in ITIL but at the same time support other frameworks and standards such as Microsoft Organizations Framework [34]. Some work has been done to map ITIL, COBIT and

ISO/IEC 20000 into a more integrated and powerful practice with proper audit control [23,24] and security. However given the early entrance to the market and longer years of practice ITIL has already been adopted by many organizations as a proven methodology[11]; therefore this paper focuses on the ITIL framework, on which Remedy® based its process.

2.2 ITIL Framework

The core guidance of ITIL (Version 3) is broken into five topics as shown in Figure 7:

- Service Strategy
- Service Design
- Service Transition
- Service Operation
- Continuous Service

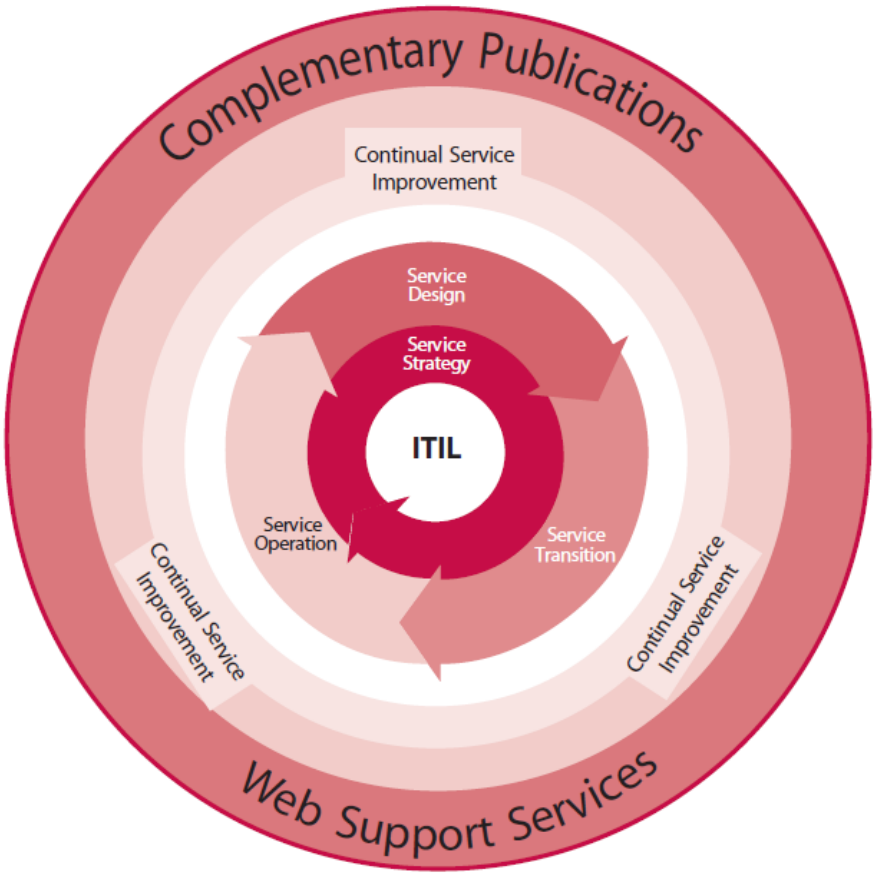


Figure 7: ITIL Core Topics [39]

In the center of the service lifecycle defined by ITIL is Service Strategy, which offers guidance about how to set objectives and expectations towards IT services. Service Strategy aims to help organizations to think and develop a long-term strategy for better investment, and covers processes such as Service Portfolio Management, Demand Management, IT Financial Management, and Supplier Management. With Service Strategy in place organizations should be able to not only handle the risk and cost of the services more effectively but also have a more distinctive performance[39].

Service Design follows the Service Strategy, turning the strategies into practical blueprints for service implementation. It provides details of guidelines

about the design of services, service processes and service capabilities to meet the business demand[39]. The key processes covered in this section are: Aspects of Service Design, Service Catalogue Management, Service Requirements, Service Design Models, Capacity Management, Availability Management, and Service Level Management.

Service Transition provides guidance for the “development and improvement of capabilities for transitioning new and changed services into live service operation”[39, page 12]. It is related to Service Asset and Configuration Management, Service Validation and Testing, Evaluation, Release and Deployment Management, Change Management, and Knowledge Management. These processes encompass the realization of the Service Design, with controlling of risks and introducing of Knowledge Management System for decision assisting.

The realization of the objectives defined in Service Strategy and planned in Service Design is ultimately carried out during Service Operation. It offers guidelines about the delivery of agreed services by the following processes: Event Management, Incident Management, Problem Management, Request Management, Application and Technical Management. Together with the methods and tools, two major control perspectives are given for the Service Operation: proactive and reactive, which guide managers and practitioners to maintain stability of the service and at the same time allow changes in the service delivery.

Continual Service Improvement (CSI) aims to guide organizations through incremental or large-scale changes to the service quality and business continuity.

For CSI the measurement and control are defined for improvements to align the services to changing business needs. A Plan-Do-Check-Act model is used to build a close-loop system for receiving inputs for improvements. Processes covered by CSI are: Service Level Management, Service Measurement and Reporting, and Continual Service Improvement

ITIL organized the above described core guidelines into an evolving life cycle as shown in the figure above. Practice fundamentals, principles, lifecycle processes and activities, supporting organization structures and roles, technology considerations, practice implementation, challenges, risks and success factors, examples and templates are given for each phase of the cycle, with Complementary Publication and Web Support Services as assisting tool to provide information about relevant publications, glossaries, and interactive knowledge center.

2.3 Incident Management Process

As mentioned before, the ability to handle incidents is a core function of technical support service. Professionally issues are called “incidents” and the process of handling them is referred to as Incident Management.

The definition of Incident Management used by ITIL is the process through which IT support organizations manage to restore normal service operation as quickly as possible and with minimum disruption to the business[39]. The target is not to solve the problem from root but to find a solution or workaround in a minimum time[3]; further investigation of incidents can be then handled in the

background once user have at least a temporary solution and are to continue work.

There are six components defined by ITIL for Incident Management:

- Incident detection and recording
- Classification and initial support
- Investigation and diagnosis
- Resolution and recovery
- Incident closure
- Ownership, monitoring, tracking, and communication

The process is a stream-lined workflow and usually has very clear history records of how an incident is handled and by whom; the supporting systems for Incident Management are also mostly, if not all, work-flow or thread based[45]. This kind of system architecture fits naturally into the business process of incident handling, because “information technology must be integrated with the design of the process it supports”[15, page 392]. On the other hand, it restricts ad-hoc types of support, such as collaboration or intervention. Details will be analyzed in the following chapter.

2.4 Service Level Management and Service Level Agreement

Service Level Management is implemented for measuring the level and quality of support services. A pre-defined agreement called Service Level Agreement (SLA) contains service targets for service providers (in this case the support technicians) to meet. SLAs can be service-based, which means the agreement is

made upon providing specific services, such as high-speed LAN, telephony, etc. There are also customer-based SLAs that aim to provide services to a specific group of customers, for example all the users in one company. Some organizations as well choose to maintain multi-level SLAs for corporate level, customer level and service level, to keep the SLAs at a manageable size and avoid duplication of content in different copies of SLA[32]. No matter how the SLAs are structured, they should contain a mutual understanding for the service to be reached. Certain parameters can be mutually and unambiguously used to measure the service levels. For example, the performance of the support team can be reflected by data such as response time[2] and resolution time[3]; and performance of systems or infrastructure can be measured the percentage of time they are available for use. Post-service extraction and analysis of such data, the parameters for SLA, is then an important function which is expected from the applications used for technical support as a major tool for SLA adherence evaluation[38]. A sample SLA provided by ITIL as general guidelines can be found in Appendix 1: ITIL Sample SLA.

2.5 Technology for Service Desk and Incident Management

For efficient and effective support service, ITIL recommend organizations to have certain incident managing/logging tools, and even a full toolset if needed. Particularly for Incident Management, ITIL list ***workflow or process engine*** and ***automated escalation*** as must-have components to allow the pre-definition and control of the incident management processes. Workflow or process engine is a kind of software application that manages modeled processes, in this case the

[2] Response time: the time technicians need to response to an incident, (definition of starting point varies).
[3] Resolution time: the time technicians need to find a solution to an incident, (definition of starting point varies).

workflow of incidents resolution; automated escalation is needed for automatically escalate incident from one support level to another to meet the defined response or resolution time. “***Easy-to-use reporting facilities***” to allow incident metrics to be produced is also mentioned by ITIL for service operation[8].

As a major product in the market of support service tools, Remedy® is designed to manage workflow as its main job[7]. It also contains objects called “Escalations” for automated hierarchic escalation triggered by a defined rule or pre-set date/time[1]. A reporting function is also available, allowing customer to define report criteria[1] as needed Basically Remedy® aligned itself with the best practice recommended by ITIL. Functions and architecture of Remedy® will be described with details in the following chapters.

3. ITIL Service Management, Incident Management and Service Level Management

3.1 ITIL Service Management

In the ITIL framework, IT services were categorized into the following two management sets [39].

Service Support: This part of the ITIL structure ensures that users are properly supported to carry out their business functions; for example the IT configurations are identified and recorded for users, processes are defined and described, issues and incidents are taken care of. The support is performed by the following components:

- Service Desk. Service Desk is the single-point-of-contact to users for service support; it serves as the entry point of the support process by accepting issues from users and creates incidents accordingly When an incident is solved the solution/workaround is also passed to users by the Service Desk.
- Incident Management. it is the process of quickly handling incidents to minimize the interruption of business and restore normal operation.
- Problem Management. Problem Management aims to diagnose the root causes of incidents and prevent reoccurrence of similar incidents.
- Change Management. If changes are needed to the IT infrastructure resulted from incident handling, Change Management should be in place for standardized procedure of change implantation.

- Release Management. With Release Management the introduction of new releases of software and hardware can be integrated to the existing infrastructure in a controlled manner, avoiding confusion of versions and licenses.
- Configuration Management. This process is established for proper tracking of all the configuration changes in the system for record keeping and future reference.

Service Delivery*:* compared with Service Support, Service Delivery focuses on how to ensure the adequate delivery of support service by integrating the following components:

- Availability Management. The objective of Availability Management is to maintain the availability of services at a reasonable cost.
- Capacity Management. This is the practice to optimize the match between IT resources and business demands.
- IT Service Continuity Management. This section is targeted to setup proactive preventive measures for possible disasters and also recovery measures in case of disasters.
- Service Level Management. To ensure the quality of delivered services, Service Level Agreements (SLAs) are made to measure, monitor and report the service achievements.
- Financial Management for IT Services. Financial Management is the calculation of budget and cost of IT services to ensure IT infrastructures are purchased at a reasonable price and services are delivered at an affordable cost while meeting the business needs.

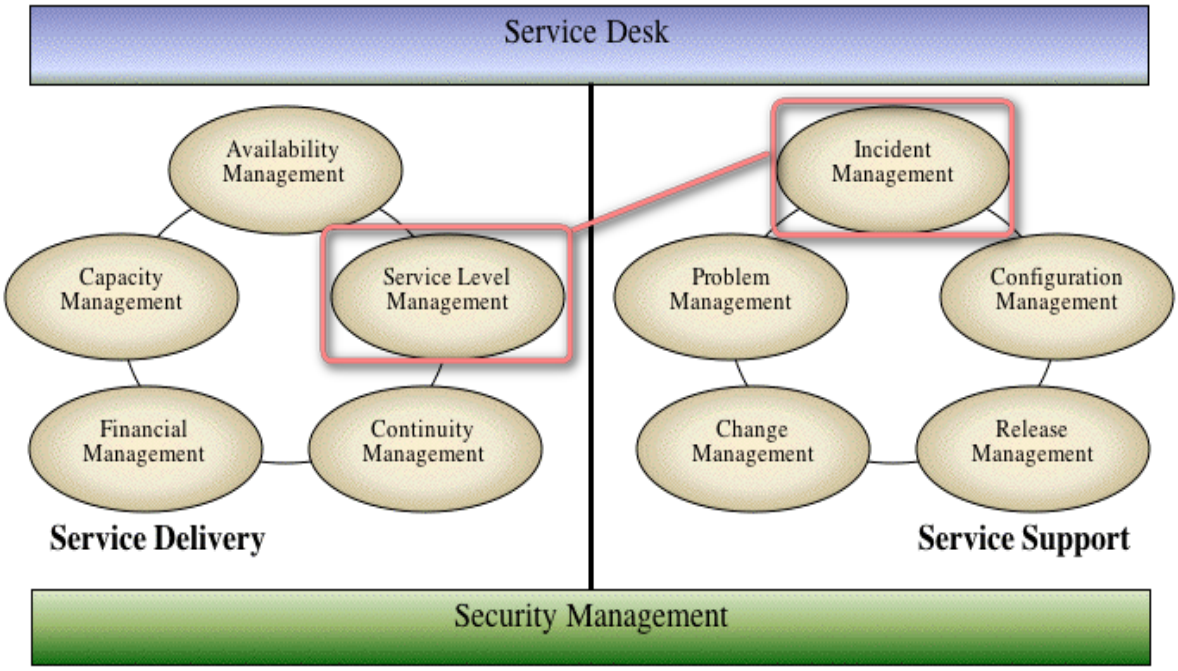


Figure 8: ITIL Model[25]

Technical support overall requires the combination of both Service Support and Service Delivery. However the concern of this paper focuses more on Service Support, assuming the proactive Service Delivery activities have already been fulfilled. Service Level Management which will also be partially analyzed in this paper, given SLA is a major measurement definition document for the quality of service. Figure 8 shows the ITIL model for Service Support and Service Delivery, as well as the focus of this paper on Incident Management and Service Level Management.

3.2 ITIL Service Desk

Under the conceptual name of Technical Support, ***Service Desk*** is the physical "place" the support actually takes place. ITIL use the term to refer to the "functional unit made up of a dedicated number of staff responsible for dealing with a variety of service events"[8, page 198]. Service Desk serves as the single point

of contact for technical support to users/customers. Issues raised by end users are received by Service Desk which then initiates the incident handling process upon receiving issues. In practice the function of Service Desk is implemented under various names, for example help desk, call center, or contact center

Call Center. As implied by the name, call centers provide support via centralized supporting offices by receiving and transmitting phone calls. This type of support mainly aims to serve the customers who are geographically distributed, with product support or information inquiries. Such centers can also be extended to handle faxes, emails, live chats or even traditional communication means such as letters, and in this case is called a ***contact center***.

Help Desk. Typically the responsibilities of help desks include providing information and assistance for troubleshooting issues raised by users, as well as maintaining hardware, software, and infrastructure. Large help desks are often divided into different teams to deal with different topics or special aspects of issues[34]. A typical labor force division for help desks, for example, might be:

- Deskside support. Troubleshoots issues with desktops, laptops and peripherals (e.g. blackberry devices).
- Network support. Provide support for network utilities and software such as fire wall.
- Server support. This team is responsible for server related services such as Network Shares, Email configuration and account management.

- Application support. Support for customized application software in the organization can be provided by a support team..
- Other support. Depends on the support scope, some help desks also cover service for office equipments, such as phone systems, printers, scanners, fax machines, etc.

Self-service Help Center. To reduce labor and overhead costs, some organizations build portals to technical knowledge databases to enable troubleshooting in a self-service manner. Most such portals are web-based, with search functions and indexed question-and-answer lists for users. Some portals are semi-interactive, that based on users' feedback it can further limit the number of returned hits[4]. MS Office online is an example of a self-service portal (http://office.microsoft.com/en-us/help/default.aspx). For further support, contact information is normally also available in the portals in case users are not able to solve the problem based on the searched results returned by the database.

Conceptually, Call Centers, Contact Centers and Help Desks are the similar to Service Desks, however the latter have a broader range of services and user-centric approach, such as Asset Management for IT services and Procurement Management for infrastructure, which enables a more integrated Service Management infrastructure with business processes[43]. In the ITIL framework, Service Desk is universally used instead of other titles.

[4] Hit: in the context of Computer Science, hit(s) refers to the result(s) of a search in a data repository, such as a database or the entire internet.

3.3 Service Desk Types

Service desks can be structured and deployed many ways, depending on the need and other restrictions such as security and cost.

3.3.1 Local Service Desk

Local Service Desks are located close to or within the user community they serve, as shown in Figure 9. The advantage of this kind of Service Desks is the visibility of the Service Desks and convenient communication between the Service Desks and users. However, as pointed out by ITIL, it is normally organizationally costly and not efficient to have a group of staff located in one place and waiting to deal with coming incidents[8].

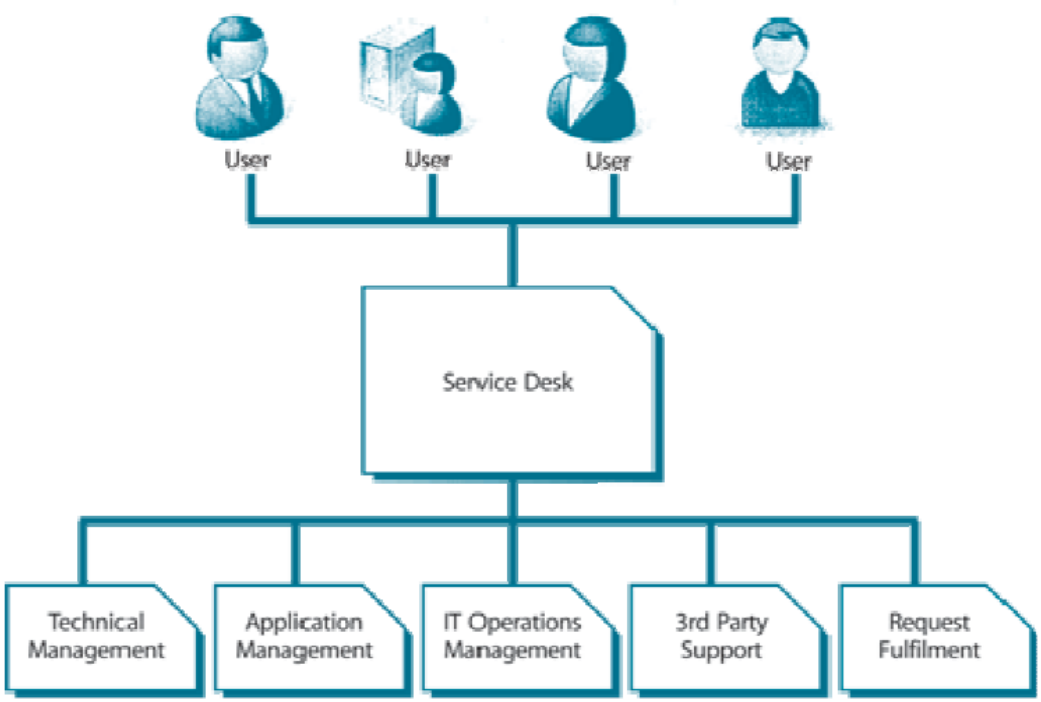


Figure 9: Local Service Desk [8]

3.3.2 Centralized Service Desk

It is in general more efficient and cost-effective to have centralized services instead of having Service Desks located locally in different sites. In this way the overall needed technicians will be less compared with local Service Desk organization; and since on average the frequency of occurred events is higher, technicians could be able to gain a higher skill levels by getting more chances to solve incidents. A sample structure of centralized Service Desk is shown in Figure 10.

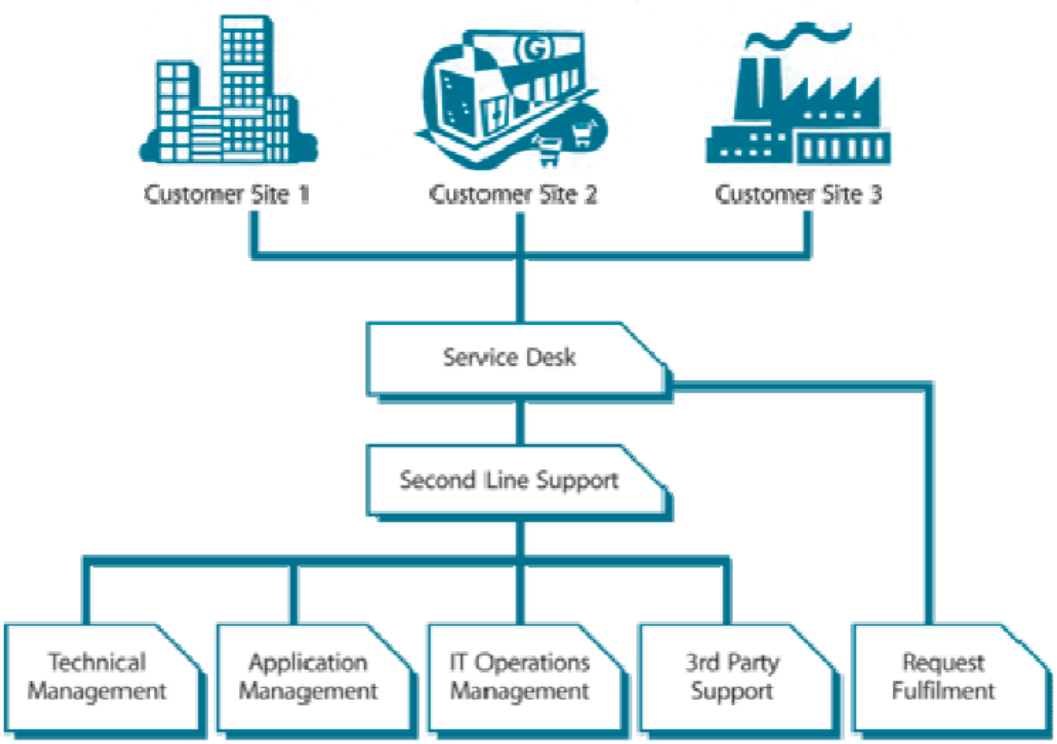


Figure 10: Centralized Service Desk [8]

3.3.3 Virtual Service Desk

Technologies such as the Internet make it possible to have a single and centralized Service Desk organization although the technicians are physically located in different places, even different countries, like presented in Figure 11. On

one hand, a virtual Service Desk greatly reduces the cost but on the other hand, it may have a higher requirement for security and uniformity of service quality[8].

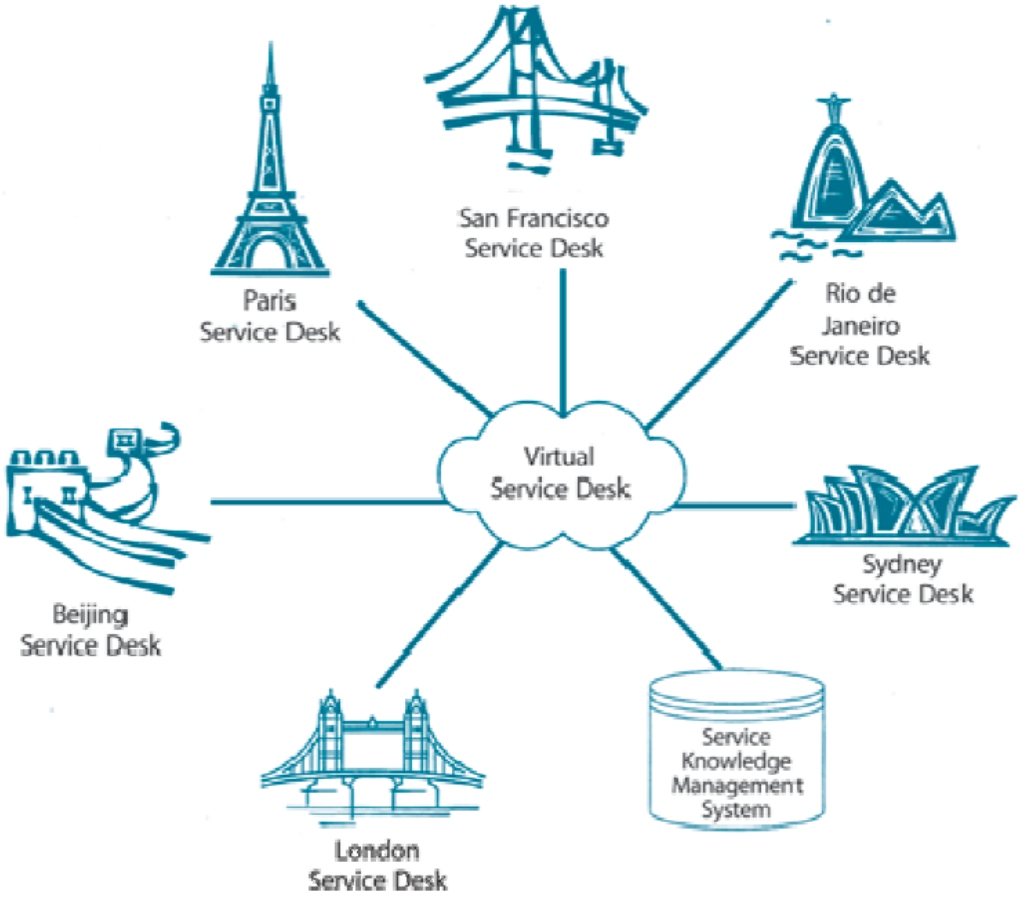


Figure 11: Virtual Service Desk [8]

3.3.4 Follow the Sun

The idea of 24-hour follow the sun service support is very intriguing to some international organizations which have customers to serve all day long. It is possible to have several service locations spread in different time zones to provide service one after another so that can cover 24 hours a day. Similarly to virtual Service Desks, this kind of Service Desk also has high requirements for security, collaboration and service quality uniformity.

3.3.5 Specialized Service Desk Groups

If certain kind of incidents occur more frequently or need more attention, there can be a specialized Service Desk group dedicated them for faster solution. For example, resetting passwords is one of the most frequently occurred incidents in Daimler Northeast Asia, hence the support team have assigned specialized technician(s) to deal with resetting password specifically and the support hotline have a code devoted for resetting password (+86-10-8417-3333).

Different ways of organizing Service Desks not only pose different needs for structure and infrastructure but also have impact on Service Level Agreement construction and evaluation. For example, for virtual Service Desks it is very important to draft the SLA considering culture terms, user demand and time differences. And when evaluating the SLA adherence of virtual Service Desks, impact from such factors should also be accounted for; take user demand as an example, technicians serving the market in United States of America and technicians serving the market in Mexico might deal with different volume of incidents, but not necessarily mean the ones dealing with more incidents per day should be evaluated for better service quality.

3.4 Support Models

Depending on the business need and taking into consideration factors such as cost and efficiency, organizations can choose to either build their own support team or outsource it to third party. For either choice they then need to decide how to structure the support team and how much responsibility to assign to the team. After establishing the support organization, measures for evaluating the support

service level would also need to be defined.

IT engineers can be a very expensive resource for some levels of expertise; asking them to sit there all day and respond to problems which can be solved by re-booting the computer is something businesses would like to avoid. However there are cases so complex that they need very proficient IT engineers. To better serve the business and users, technical support is often organized into several levels, each of which specializes in a specific level of technical assistant expertise[33]. ITIL recommended a three-level support organization for incident handling[8]. However, the actual implementation of support levels depends on the business demands such as service expectations and budgets.

Level 0 Support:

Although not part of the standard support levels, Level 0 does exist in practice. Before users approach help desk technicians, there can be other resources for them to consult. Self-service help desk portals are one of these. Users can be formally divided into end-users and key users based on their proficiency and familiarity with the application. End users are advised to contact key users for trouble-shooting before raising the question to technical support. Reasons for doing so may include the dispersed locations for users and technicians. Geographically, users (key users and end users) are closer together and speak the same “language” thus helping to clarify the questions more quickly. If the question is beyond key-users’ ability to answer then there is help desk to turn to. In this situation it is not only more efficient but also less expensive if issue handling by technicians is charged case-by-case.

However building self-service portals requires integrated resources and sometimes professional databases or knowledge bases; and having key users also requires professional training. Given such restrictions the Level 0 Support is only applicable for certain business scenarios.

Level 1 Support:

Level 1 Support is the initial point of contact of users to the technical support process. Technicians in this level gather information about the issue from users, and identify the cause of the issue (if possible), by analyzing the symptoms reported. Once the diagnosis is done, an incident will be created in the incident tracking systems for further resolution. If the issue is straight-forward and simple then it might be solved right at this level. The target for the first level support is to handle 70-80% of the reported issues[29]. However the technicians in this level are not required to have competency for troubleshooting complex problems: most of their routine tasks come from on the following areas:

- User authorization and authentication: maintain user accounts and authorization for systems and applications;
- Office equipment: maintain the equipment and educate user to use equipments such as desktop and laptop computers, printer, scanner, fax machine, etc.
- Application: install/uninstall software applications, troubleshoot basic application problems;
- Infrastructure: identify, and if possible, solve simple issues in the infrastructure level, such as setting up either net cable connections,

ensure power supply, fix common printer failures (for example paper jam),

Level 2 Support:

Issues not able to be solved by Level 1 support are escalated to Level 2 support. The second level technicians provide more in-depth and professional support on advanced incident resolution. Before a Level 2 support technician works on solving an incident, he/she should review the incident that has been assigned from Level 1, double check the validity of the incident and figure out if there has been prior similar occurrence that can be used as reference to reduce workload and improve efficiency. Typical support work from level 2 is: software repairing, testing, database diagnoses and so on. If issues still cannot be solved at this level, Level 3 support will be involved.

Level 3 Support:

For common practice this level is normally the highest level for technical support. Technicians in this level are experts in the field and should be able not only to solve issues but also to foresee future issues and develop new features if required. Similar to Level 2 support, once an issue is escalated to this level it should be reviewed by the technician first for validation and then for further handling. A solution is usually expected from this level; however there might be rare cases where an incident is too complex, or cannot be solved without changing the basic architecture of the product,. If so, then Level 3 support will need to figure out a workaround and contact the original developers of the product for solution.

Level 4 Support:

As mentioned, there can be circumstances in which original developers of products need to be involved for trouble-shooting; therefore, although not common, the fourth level exists but is outside the organization. Technicians in this level know the product better than any other, and also are able to modify the product better than any other. Nevertheless due to organizational complexity and costs, this level of support will be established only for large, expensive and mission critical products.

3.5 ITIL Incident Management Process

"Incident", as defined by ITIL terminology, refers to "an unplanned interruption to an IT service or reduction in the quality of an IT service. Failure of a configuration item that has not yet impacted service is also an incident, for example failure of one disk from a mirror set" [8, page 376]. Incident Management is then the process to deal with incidents. The process flow of Incident Management suggested by ITIL is shown in Figure 12.

3.5.1 Basic Concepts for Incident Management

ITIL introduced some basic concepts as the prerequisite for Incident Management, enumerating ***Timescales***, ***Incident Models***, and ***Major Incidents.*** Major Incidents are treated in a separate procedure to reduce overall timescale [8].

Timescales. Timescales should be agreed upon for every stage of incident management, based on the targets within SLA (for instance, most commonly, response time and resolution time for each level of support and for each incident

model). These timescales can then be used for escalations.

Incident Models. This is a series of pre-defined “standard” steps for handling a particular type of incident which occurs more often than average, for instance, resetting a password. The models should be also reflected or defined in the tools used for incident handling[8], so as to achieve certain automation in the process to reduce time and efforts. Take Remedy® for example, incident models are defined as templates in the system, so that certain fields such as category and priority of incidents are automatically filled out, saving the time of technicians from doing it manually.

Major Incidents. Major Incident is defined as “the highest category of impact for an Incident”, which “results in significant disruption to the business” [8, page 379]. A separate procedure should be established to handle such kind of incidents for faster resolution with more attention to avoid huge impacts or undesired long resolution time. Criteria for being a major incident are reflected in incident prioritization matrix, which will be described later during the incident management process workflow.

3.5.2 Incident Management Workflow

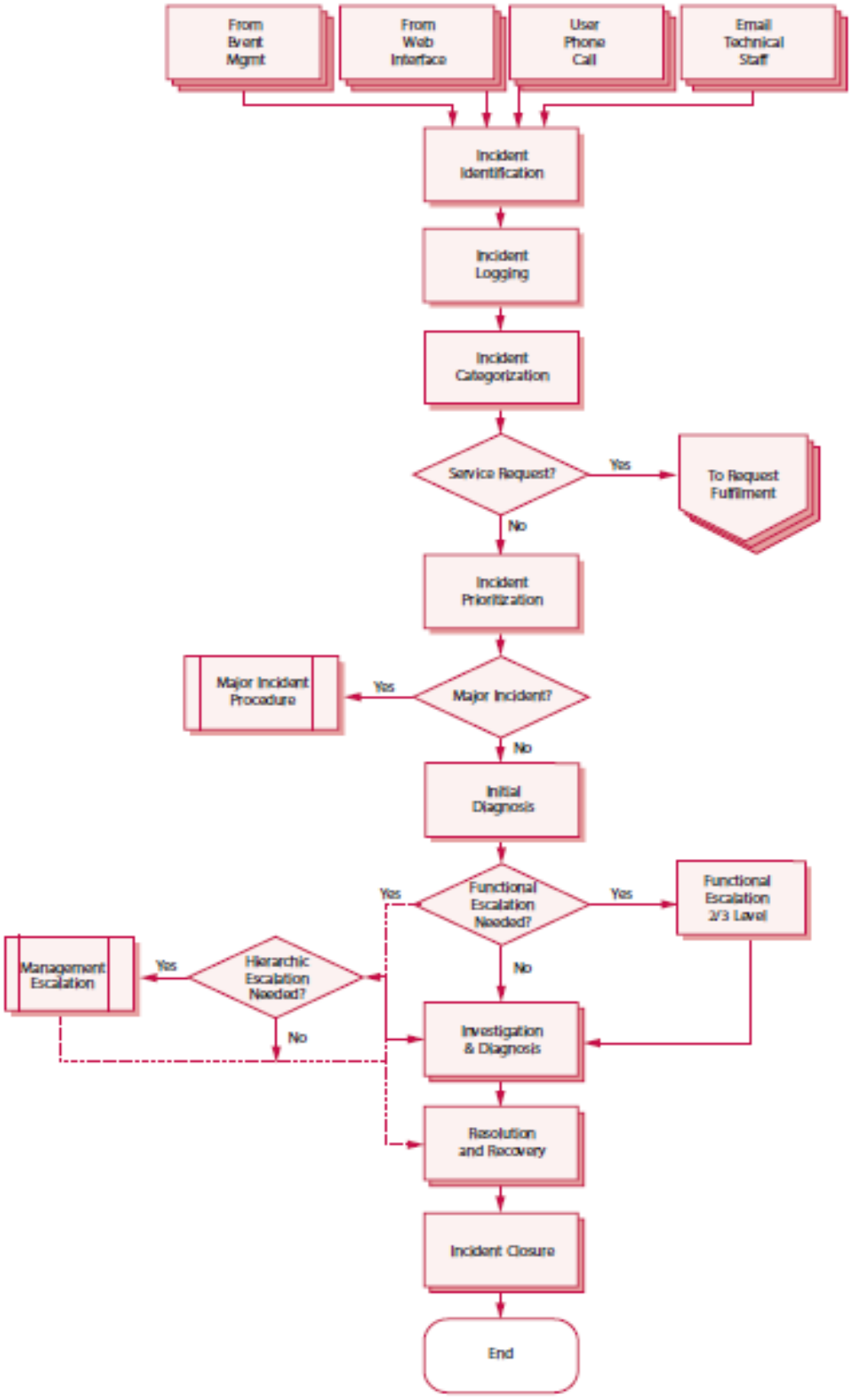


Figure 12: ITIL Incident Management Process Workflow[39]

The ITIL Incident Management Workflow is displayed as in Figure 12. The process starts when the Service Desk receives an issue report. An issue can be raised via phone, via email or other means by users to Service Desk. It can also be reported by technical staff; for example, if they notice something unusual during the routine network monitoring they may raise it as an incident. Another source of issue reports is from Event Management, which is “any detectable or discernible occurrence that has significance for the management of the IT Infrastructure or the delivery of IT service and evaluation of the impact a deviation might cause to the services” [8, page 67]; typically events are notifications created by an IT service, such as planned maintenance events.

Step 1: Incident Identification

Upon receiving a call/email from users, Service Desk must first identify whether it is a valid incident. A user may call the Service Desk to report issues not related to technical support or simply request information. In this case technicians should be able to make a judgment if it is an incident, and decide whether to initiate the incident management process.

Step 2: Incident Logging

Logging of all incidents is required as a must by ITIL, and certain relevant information about the incident should be recorded so that a full historical record is available for future reference. Such information may include[8] the elements as shown in Table 1:

Element	Time of Record	Updatable?
Unique reference number	Upon creation	N
Incident categorization (often broken down into between two and four levels of sub-categories)	Upon creation	Y
Incident urgency	Upon creation	Y
Incident impact	Upon creation	Y
Incident prioritization	Upon creation	Y
Date/time recorded	Upon creation	N
Name/ID of the person and/or group recording the incident	Upon creation	N
Method of notification (telephone, automatic, e-mail, in person, etc.)	Upon creation	Y
Name/department/phone/location of user	Upon creation	Y
Call-back method (telephone, mail, etc.)	Upon creation	Y
Description of symptoms	Upon creation	Y
Incident status (active, waiting, closed, etc.)	Upon handling	Y
Related Configuration Item	Upon handling	Y
Support group/person to which the incident is allocated	Upon handling	Y
Related problem/Known Error	Upon handling	Y
Activities undertaken to resolve the incident	Upon handling	Y
Resolution date and time	Upon resolution	N
Closure category	Upon resolution	N
Closure date and time	Upon resolution	N

Table 1: Incident Record Elements

Step 3: Incident Categorization

Categorization of an incident is introduced for accurate allocation of incidents to technicians, as well as for future reference and analysis. For example, incidents can be categorized as “Hardware”, ”Software”, ”Authorization”, ”Security”, so that each type of incident can be assigned to a specific support group. There is no “standard” categorization of incidents suggested by ITIL, given that each organization can be unique and may have different support organizations so a one-size-fit-all categorization might not help. Steps for assisting to identify suitable categorization, though, are provided as guidance, including brainstorming sessions attended by management and support team, reviewing history records of incidents as reference, and trial period of the support service for limited or full blown of functionality to see how well the support team performs.

Step 4: Incident Prioritization

This is an important aspect of incident management, which determines how much attention the incident will get and how it will be handled. Prioritization of incidents normally depends on both the urgency of the incident and the level of impact it may cause[8]. ITIL recommended providing clear guidance about incident levels to the support staff so that incidents can be handled uniformly. However ITIL also noted that priority of incidents may be dynamic, for instance a high priority incident can be assigned with lower priority once given a workaround, which can reduce the impact of the incident and consequently make it less critical. An example of incident priority is shown in Table 2.

			Impact	
		High	Medium	Low
	High	1	2	3
Urgency	Medium	2	3	4
	Low	3	4	5

Priority code	Description	Target resolution time
1	Critical	1 hour
2	High	8 hours
3	Medium	24 hours
4	Low	48 hours
5	Planning	Planned

Table 2: Sample Priority Coding System [8]

While prioritizing incidents, if an incident is recognized as a Major Incident, then the separate Major Incident handling process should be initiated to deal with the incident, instead of following the standard process.

Step 5: Initial Diagnosis

An initial diagnosis is expected from the Service Desk technician upon receiving an incident, especially when the incident is reported by users via phone and the users are on hold for a possible answer. Technician should try to discover the full symptoms of the incident in this stage and determine what has gone wrong and how to further deal with it.

Step 6: Incident Escalation

Functionally, once it is clear that an incident cannot be solved by one level of support technicians, it should be escalated to the next level as soon as possible. The rules of escalation are normally regulated by the SLA.

Even if an incident is being dealt with at the right support level, it might be necessary to inform higher management about the situation, in the event that the incident is of great impact (for example Priority 1 incidents).

Rules and timescale for escalating the incident from one level to another should be regulated in SLA. If not, then they have to be agreed upon by both service providers and the customers. Such agreements need to be embedded within the tools used for support service[8].

Step 7: Investigation and Diagnosis

To solve an incident, investigation and diagnosis will be needed. ITIL offered the following list of actions as guidelines[8]:

- Establishing exactly what has gone wrong or being sought by the user
- Understanding the chronological order of events
- Confirming the full impact of the incident, including the number and range of users affected
- Identifying any events that could have triggered the incident (e.g. a recent change, some user action)
- Knowledge searches looking for previous occurrences by searching previous Incident/Problem Records and/or Known Error Databases or manufacturers'/suppliers' Error Logs or Knowledge Databases.

Details of such activities should be documented in the incident record by the supporting tool for historical record completeness and future reference.

Step 8: Resolution and Recovery

Once a resolution to an incident is identified, it should be properly tested then applied. Recovery actions could be taken by user or the technician, depending on the scenario. However the resolution and recovery is implemented, the incident record should be updated accordingly with all relevant information and details. With resolution and recovery, the incident should be passed back to Service Desk for final closure.

Step 9: Incident Closure

Incidents can be closed with a full resolution and users' acceptance of resolution and agreement to close. Service Desk technicians should check the closure categorization (whether the initial categorization of incident is right), user

satisfaction (whether users are satisfied with the solution, whether users are satisfied with the efficiency of technicians handling the incidents, and whether users are satisfied with the attitude of technicians during interacting), and incident documentation (if the documentation is complete) before the formal closure. An incident can be reopened in case it recurs; however it would be wise to have pre-defined rules about “if and when an incident can be re-opened”[8, page 100].

3.6 ITIL Service Level Management and SLA

To ensure that IT services can be delivered with an agreed level of quality, Service Level Management (SLM) is recommended by ITIL for service contract negotiation, service target documentation and service monitoring as well as reporting. The negotiated contract, Service Level Agreement (SLA), contains the targets and quality measurements for the expected service, which should be a mutual understanding between the service provider and receiver.

The emphasis on SLA is that it ought to be mutually beneficial for both parties instead of “used as a way of holding on side or the other to ransom” [32, page 111]. To be mutual and valid, conditions that cannot be monitored or measured should not be included in SLAs, else it would result in disputes or a “blame culture” [32, page 111].

Once an SLA is documented and agreed upon, both the service provider and customer should monitor the service performance against SLA, to validate the proposed targets for the service.

Reporting mechanisms are also a valid part of SLA, defining report intervals

and formats for SLA monitoring and evaluation. Such periodic reports “incorporate details of performance against all SLA targets, together with details of any trends or specific actions being undertaken to improve service quality”[32, page 123]. Gathering the resource and compiling the reports can be very time-consuming, therefore “the extent, accuracy and ease with which automated reports can be produced” [32, page 123] is mentioned by ITIL as a criteria for selecting the supporting tools.

For incident handling, it is essential that the “targets included in SLAs are the same as those included in Service Desk tools and used for escalation and monitoring purposes”[32, page 119], else the contractual parties could end up measuring something other than what has been agreed within SLA. In this case it would be hard to judge whether the SLA targets have been met or not. Proposed metrics for monitoring and reporting the efficiency and effectiveness of the Incident Management Process by ITIL are listed below.

Service Status:

- Total numbers of Incidents (as a control measure for the overall incident handling capacity)
- Breakdown of incidents at each stage (e.g. ”Assigned”, ”WiP”, ”Closed”, etc.)
- Number of major incidents and their percentage to total number of incidents

Operation Performance:

- Size of current incident backlog

- Mean elapsed time to achieve incident resolution or circumvention, broken down by impact code
- Percentage of incidents handled within agreed response time (incident response-time targets may be specified in SLAs, for example, by impact and urgency codes)
- Number of incidents reopened and as a percentage of the total
- Number and percentage of incidents incorrectly assigned
- Number and percentage of incidents incorrectly categorized

Capacity Analysis:

- Percentage of Incidents closed by the Service Desk without reference to other levels of support (often referred to as ‘first point of contact’)
- Number and percentage of the incidents processed per Service Desk agent
- Number and percentage of incidents resolved remotely, without the need for a visit
- Number of incidents handled by each Incident Model
- Breakdown of incidents by time of day, to help pinpoint peaks and ensure matching of resources.

Cost Management:

- Average cost per incident

These metrics will be used in the following chapters as the base for SLA adherence evaluation.

4. Remedy® Incident Management

Remedy® aligned its product process as close as possible with ITIL. The Incident Management process of Remedy® thus follows the ITIL Incident Management framework design.

4.1 Ticket

An incident is reflected as a "**ticket**"[5] in the Remedy® system. A ticket contains "information about support interventions made by technical support staff, or third parties on behalf of an end user who has reported an incident that is preventing them from working with their computer as they would expect to be able to" [46, Ticket (support)]. Handling an incident then is reflected in the Remedy® system as the process of handling a ticket.

Table 3 lists the information that ITIL considers essential for an incident record; the corresponding data fields of a Remedy® ticket are given in the second column. The data fields are also marked by ID in Figure 13 and Figure 14 with the Remedy® Incident Management interface.

[5] These tickets are so called because of their origin as small cards within a typical wall mounted work planning system when this kind of support started Operators or staff receiving a call or query from a user would fill out a small card with the users details and a brief summary of their request and place it into a position (usually the last) in a column of pending slots for an appropriate engineer, thus determining the staff member who would deal with the query and the priority of the request

ID	ITIL Incident Record Information	Remedy® Ticket Data Field
1	Unique reference number	Ticket ID
2	Incident categorization	Classification, Component, Component Type
3	Incident urgency	Priority
4	Incident impact	Priority
5	Incident prioritization	Priority
6	Date/time recorded	Timestamp
7	Name/ID of the person and/or group recording the incident	Owner (First Name, Last Name, etc.)
8	Method of notification	Source
9	Name/department/phone/location of user	Caller (First Name, Last Name, , Department, Email, etc.)
10	Call-back method	Notification Via
11	Description of symptoms	Short Description, Details
12	Incident status	Assign, Work In Progress, Sleep, Solve, Close
13	Related Configuration Item	Activities CI
14	Support group/person to which the incident is allocated	Assignee
15	Related problem/Known Error	Ref. No.
16	Activities undertaken to resolve the incident	Activities, Log Diary
17	Resolution date and time	Timestamp
18	Closure category	Classification, Component, Component Type
19	Closure date and time	Timestamp

Table 3: Mapping of ITIL Incident Record Information and Remedy® Ticket Data Field

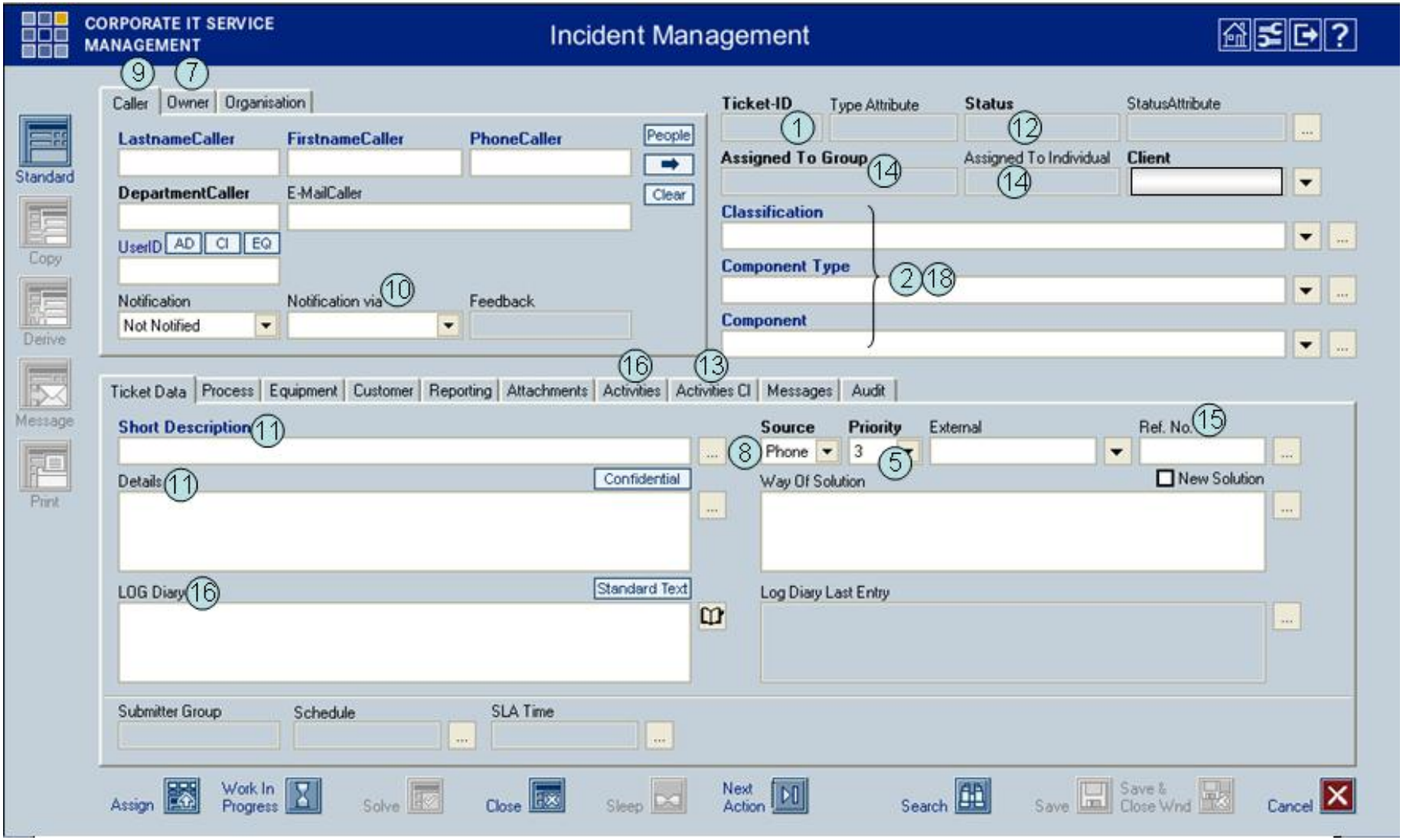


Figure 13: Sample Remedy® Ticket Information Fields 1

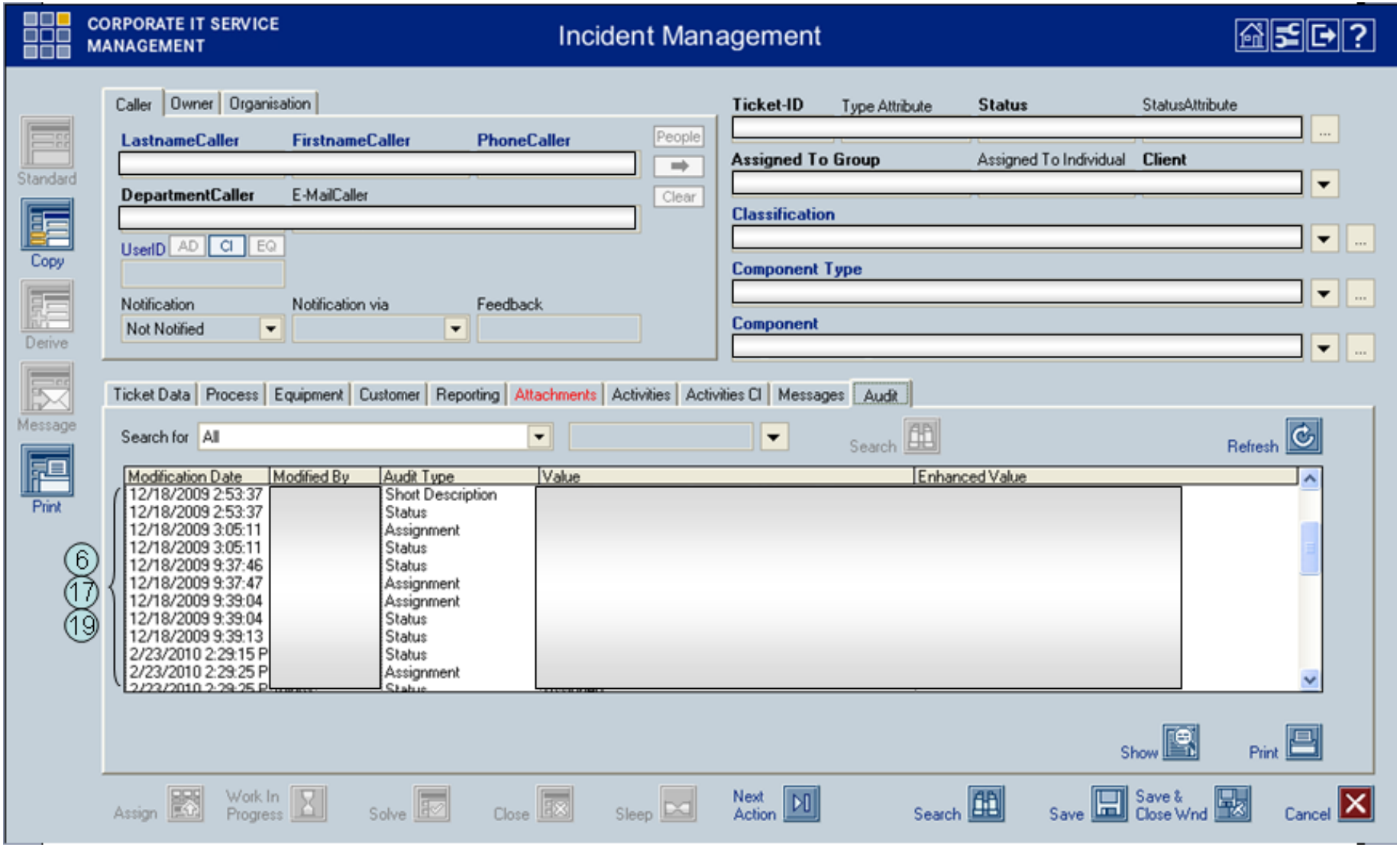


Figure 14: Sample Remedy® Ticket Information Fields 2

Classification, Component, Component Type. This is a sample three level classification of incident defined by the support organization, as illustrated in Figure 15. The three data fields are normally filled with pre-defined values for uniformity, depending on the demand of the users or organization of support team.

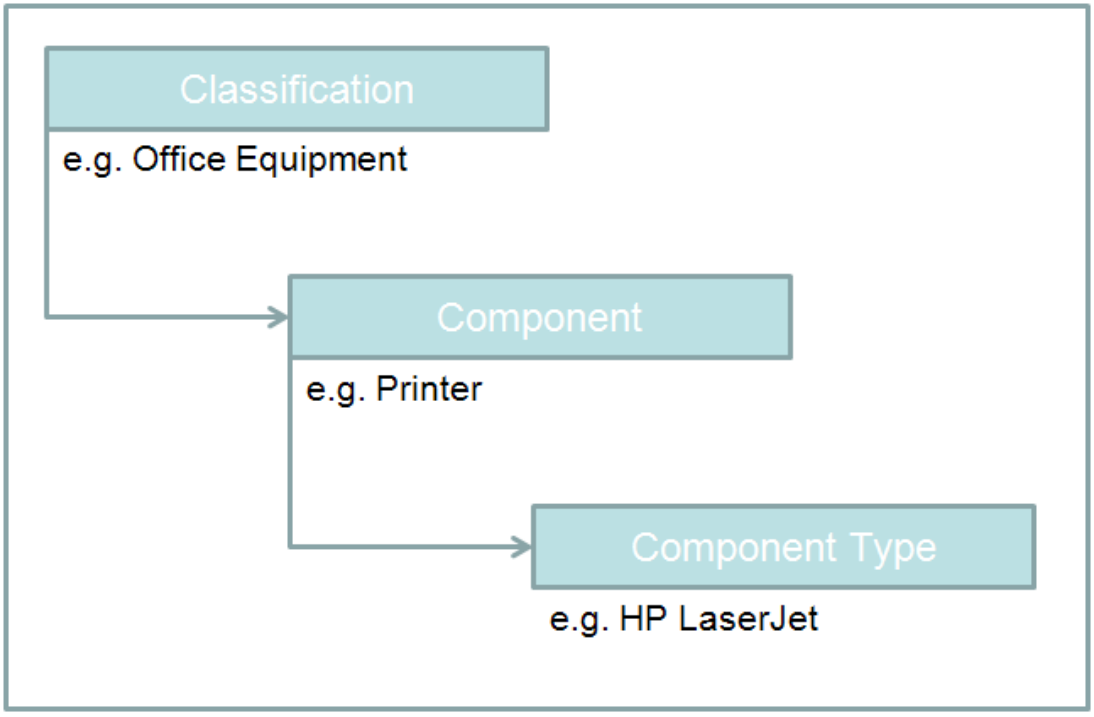


Figure 15: Sample Remedy® Three-level Classification

Priority. Priority of a ticket reflects the agreed priority matrix in SLA, which is determined by incident urgency and incident impact. Figure 16 shows an example of a four-level priority.

Priority Code	Impact
Priority 1	Impact across several business units or entire organization. Critical business processes halted until resolution.
Priority 2	Impacts an individual business unit or workgroup. Critical business processes halted or hindered until resolution.
Priority 3	Impacts an individual, or single business process. Workaround available.
Priority 4	Provides capability that doesn't yet exist. Business processes currently in placeremain until resolution.

Figure 16: Sample Ticket Priority Matrix [42]

Timestamp. For every activity upon a ticket, Remedy® can record the timestamp of when the activity takes place. For example, Ticket Closure date and time will be recorded by the system when the status of the ticket is changed to "Closed".

Owner. This field refers to the owner of a ticket, normally the one who logged the ticket.

Caller. This field refers to the raiser of a ticket, normally the user who reported the incident.

Status. Process of handling the ticket is mirrored as the status of the tickets, which can be "Assigned", "Work In Progress" (WiP), "Solved", "Closed" or

“Sleep”. A possible flow of status is shown as in Figure 17 below:

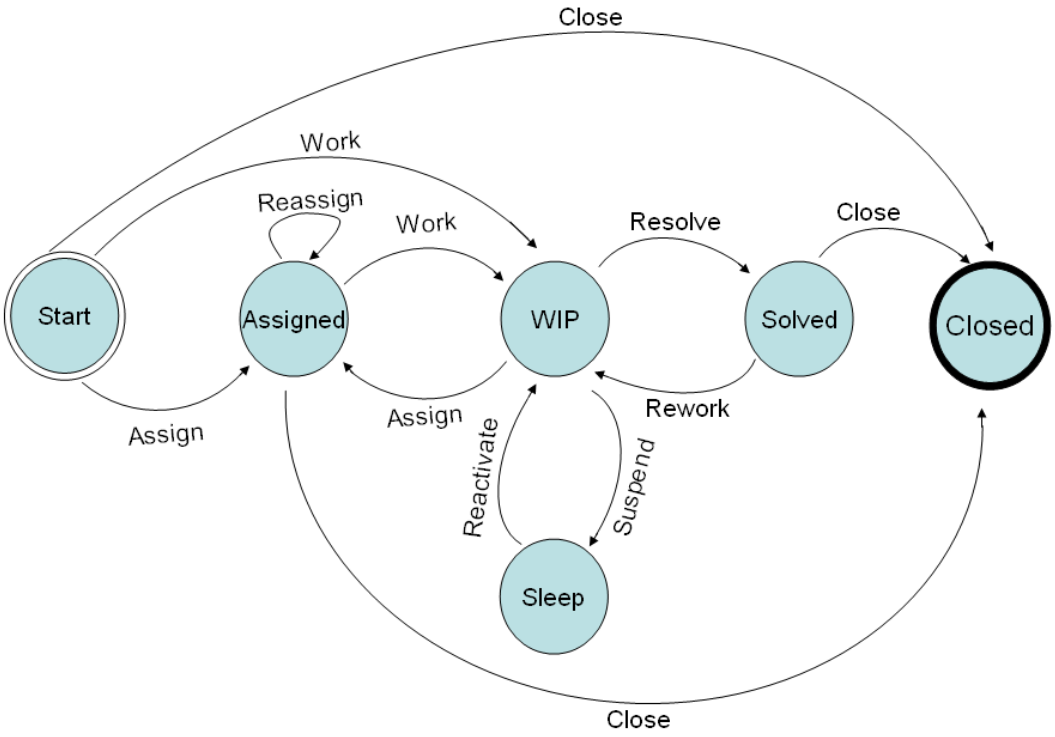


Figure 17: Sample Ticket Status Flow

Log Diary. This is a text field that allows technicians to input any text for communication or history recording.

4.2 Ticket Handling

The ticket handling process in Remedy® can be mapped with ITIL Incident Management Process step by step.

Step 1: Incident Identification

Upon receiving a call/email from user, the technician has to judge whether the user is reporting an incident, or making a service request. If it is an incident, then in the Remedy® system the technician opens a ticket

by choosing “Incident”; otherwise, the technician chooses “Request”.

Step 2: Incident Logging

By opening a ticket, the technician added a record to the ticket database. Remedy® provides standard templates for Incident Models These templates have certain fields already filled out for a given type of frequent incident. When a technician encounters one of these incidents, using the standard templates not only saves time tin completing the ticket information but also reduces human errors such as assigning the wrong categorization.

Step 3: Incident Categorization

The technician should fill out the Classification, Component, Component Type of the ticket, or choose the corresponding template type.

Step 4: Incident Prioritization

The technician needs to choose a pre-defined priority for the ticket depending on the urgency and impact of the incident.

Step 5: Initial Diagnosis

The technician who logged the ticket will perform an initial diagnosis of the incident, noting down anything that is helpful for solving the incident in the Log Diary. Normally, doing initial diagnosis means someone is actually working on the ticket, hence the status of the ticket should be changed to “Work In Progress” by clicking on the status button of “WiP”.

Step 6: Incident Escalation

If the technician dealing with the ticket cannot resolve it within the target timescale, then he/she must “Assign” it to the next support level.

Step 7: Investigation and Diagnosis

The process of investigation and diagnosis of tickets can also be documented in the Log Diary.

Step 8: Resolution and Recovery

Once a resolution is given, the status of a ticket should be set to “Solved” by the technician and waiting for owner to set the status to “Close”. The resolution method should be logged in the field of “Way of Solution”.

Step 9: Incident Closure

The owner of a ticket is responsible for contacting the caller of the ticket and reach for an agreement to close the ticket. Once the caller can accept the resolution and agree to close, the technician should change the status of the ticket to “Close”.

Normally Steps 1-6 are performed by one technician. With escalation (assign the ticket to other people/group) the technician involves more people in the incident handling process. An example flow chart of the process is shown in Figure 18.

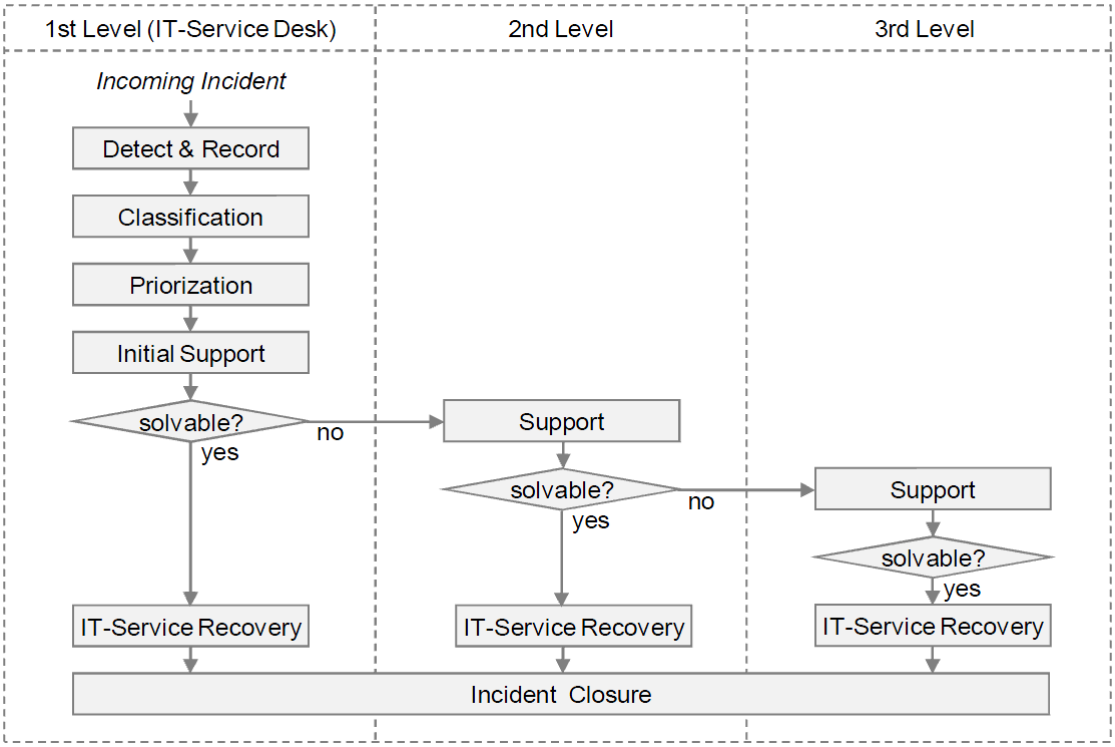


Figure 18: Sample Ticket/Incident Handling Flow Chart [5]

5. SLA Reporting and Deficient Business Scenarios

5.1 Reporting Methods

To examine the service level and report on SLA adherence with regard to Incident Management, certain data need to be extracted from Remedy® as the basis of the analysis. There are two ways of extracting data from Remedy®: **Searches** and **Reports**.

The Search feature can give some simple statistics based on given parameters such as time, categories or status; for example how many tickets of a specific category have been closed during the past month. The built-in Report function is also available for both Remedy predefined reports (e.g. Dashboard Reports) and custom reports[6]. Figure 19 shows some examples of how to get statistical data from Remedy®.

Data need	Method
Quick count of tickets for a Group, an Individual, Dept, CTI, etc.	**Search** - A Search to bring up the records queried for and display the total number of records.
Quick count of tickets for certain parameters (as above) restricted to a specified date range.	**Search** - A Search, making use of the Advanced Search bar to enter a date range.
To generate a "data dump," to include fields of your choosing and to permit export and further manipulation outside of Remedy.	**Search** - A Search to generate desired records, in conjunction with an ad-hoc report - **best to use with Remedy User client.**
Ongoing need to obtain and analyze different sets of data.	**Search** - With ad-hoc reporting. If you have the time to learn the ad-hoc reporting function in Remedy, this would be best solution if you have an ongoing need to generate user-defined reports with varying parameters.
Quick count of tickets based on a parameter that is **not** found on main Help Desk Case or Task form, such as a calculation (e.g. tickets that have been opened for a certain length of time).	**Report - Remedy User** client only.
Data generated in a pre-defined report format, grouped and sorted appropriately, with summary fields, etc. - i.e., data already in presentation format.	**Report - Remedy User** client only.

Figure 19: Sample Search and Report function of Remedy® [6]

For the metrics ITIL proposed for monitoring Incident Management process (refer to Chapter 3.6), most of the data can be drawn from Remedy® either by searches (example as in Figure 20) or reports (example as in Figure 21), without much manual calculation.

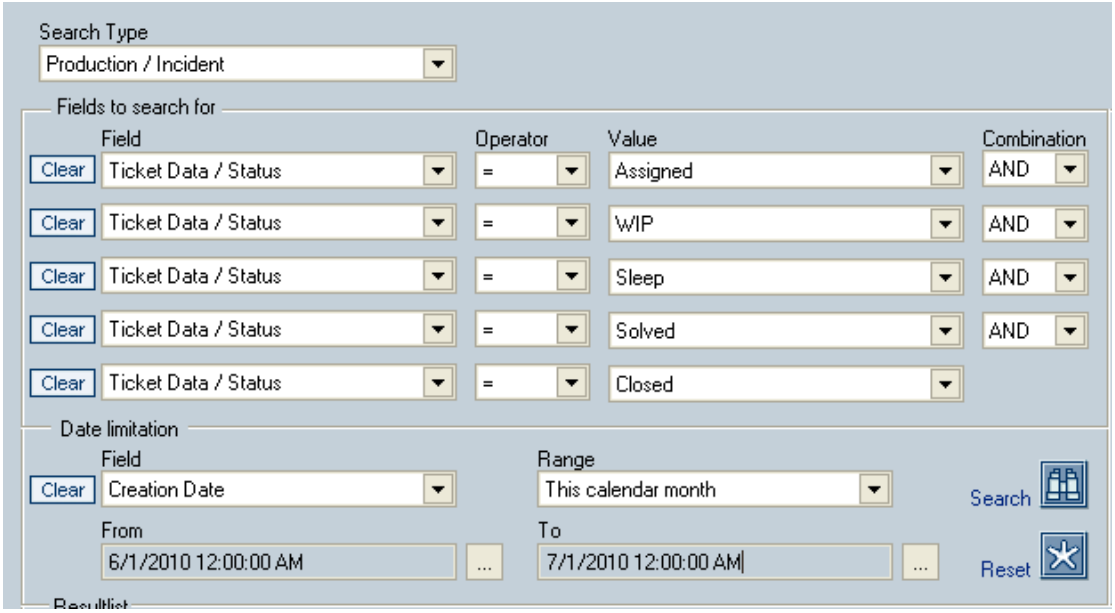


Figure 20: Sample Remedy® Search Function

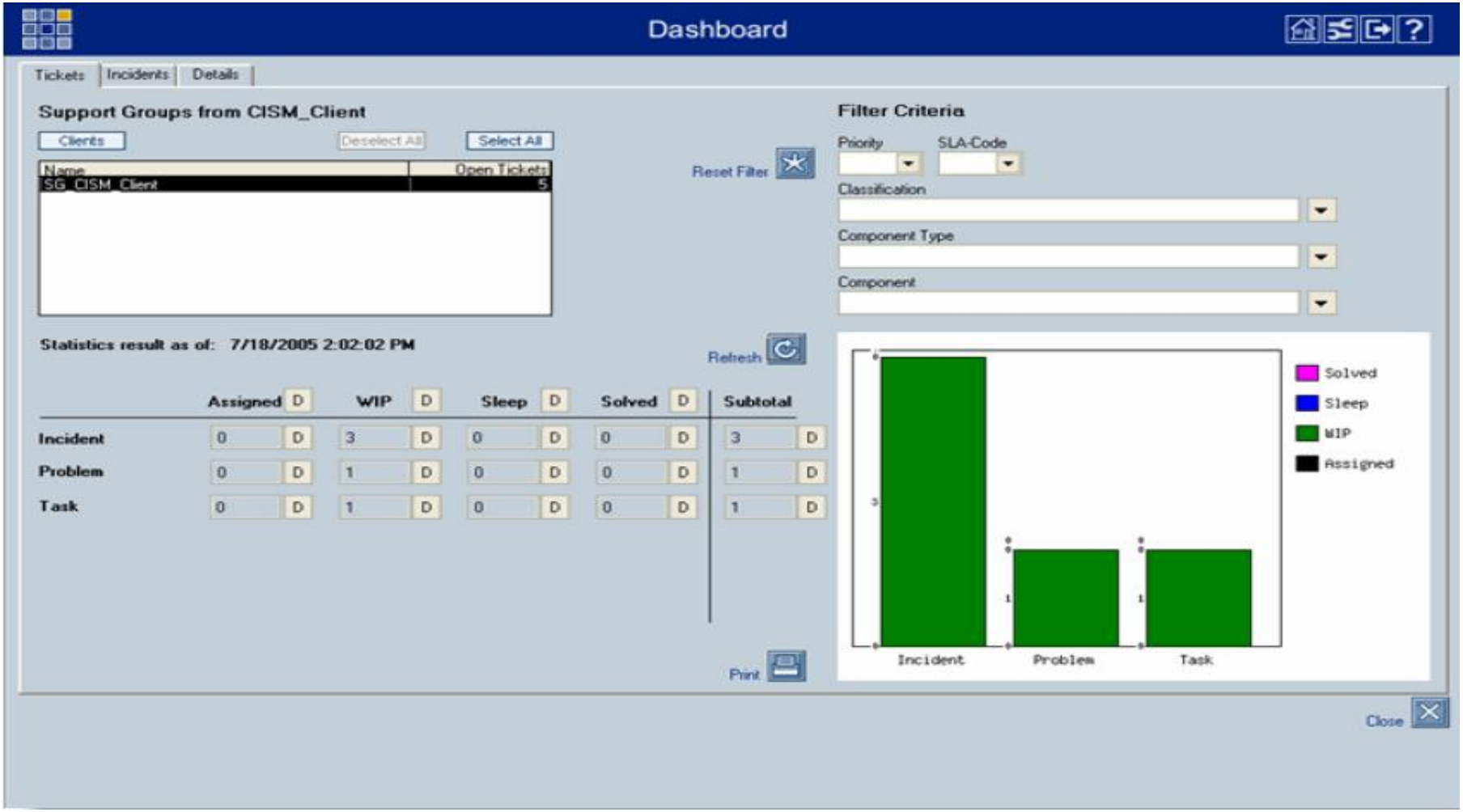


Figure 21: Sample Remedy® Dashboard Report

Another Remedy® product, BMC Remedy Service Management Suite, contains a module for Service Level Management in which SLA data (for example response time, resolution time, escalation rules) can be defined. The SLM module has an interface with the Incident Management module therefore reports comparing incident handling to SLA criteria can be automatically generated. Since Remedy Service Desk: Incident Management and Remedy Service Management Suite are two different products, it is not necessary for organizations to purchase both. The scope of this paper is restricted to the functionality of Remedy Service Desk: Incident Management only; auto reporting and calculation not available in this product will be given manual analysis method in Chapter 6.1.

A sample list of data fields in Remedy® that can be used for SLA data calculation is listed in Appendix 2.

5.2 Deficient Scenarios and Counter Measures

If the tickets were correctly logged following the process described in the previous chapters, the data extracted from Remedy® would be sufficient for SLA reporting. However if the actual business practice does not closely map to the standard process flow, then the data may not reflect the desired information, or could need significant manual manipulation for accurate reporting. Some examples of such deficient business scenarios are illustrated below, together with counter measures to identify how to modify the Remedy® data or process to align them as close as possible to a common calculation method for SLA reporting as discussed in Chapter 6.

Scenario A: Abandoned Calls

When users report an incident by phone and are asked to hold while the Service Desk technician searches for resolution, some of them may drop off the call before getting an answer.

ITIL recommends to fully log all incidents, so if such incidents are logged in Remedy® the ticket would be marked as Closed directly after creation. However during SLA reporting, these kind of tickets, have to be eliminated for certain calculations depending on management requirements, for instance requesting statistics upon all incidents excluding abandoned calls to evaluate the average efforts spent by technicians on each incident.

Consider the metric “percentage of Incidents closed by the Service Desk without reference to other levels of support” for example. Abandoned calls do not reflect the ability of Service Desk technicians to solve issues; therefore they should not be included. In contrast, for the “number and percentage of the incidents processed per Service Desk agent”, abandoned calls should be counted in because they are also part of the workload of support technicians.

Counter Measures:

Define a standard template for abandoned calls, with the StatusAttribute or any designated field marked as “Abandoned Call”. When drawing from Remedy® this field can be used as a search criterion to eliminate or include the counting of abandoned calls. This way also saves the time for support technicians to fill out the ticket form manually since some data fields can be automatically filled in templates. During SLA evaluation the number of abandoned calls can also be

reported, since high call abandon rate may suggest long time for users to be held on the line, which could resulted by lack of technicians or untimely handling of incidents.

Scenario B: Hypogenous Support Staff

If in the support groups there are external support service suppliers involved, their performance would need to be evaluated against the SLA negotiated separately for the external supplier, independent of the overall SLA for the performance of support team as a whole. If the external support technicians only exist in one support level, as demonstrated in Figure 22, the calculation of SLA reporting data would be pretty much the same as the calculation for overall data, but with an extra restriction to the search results to external support groups.

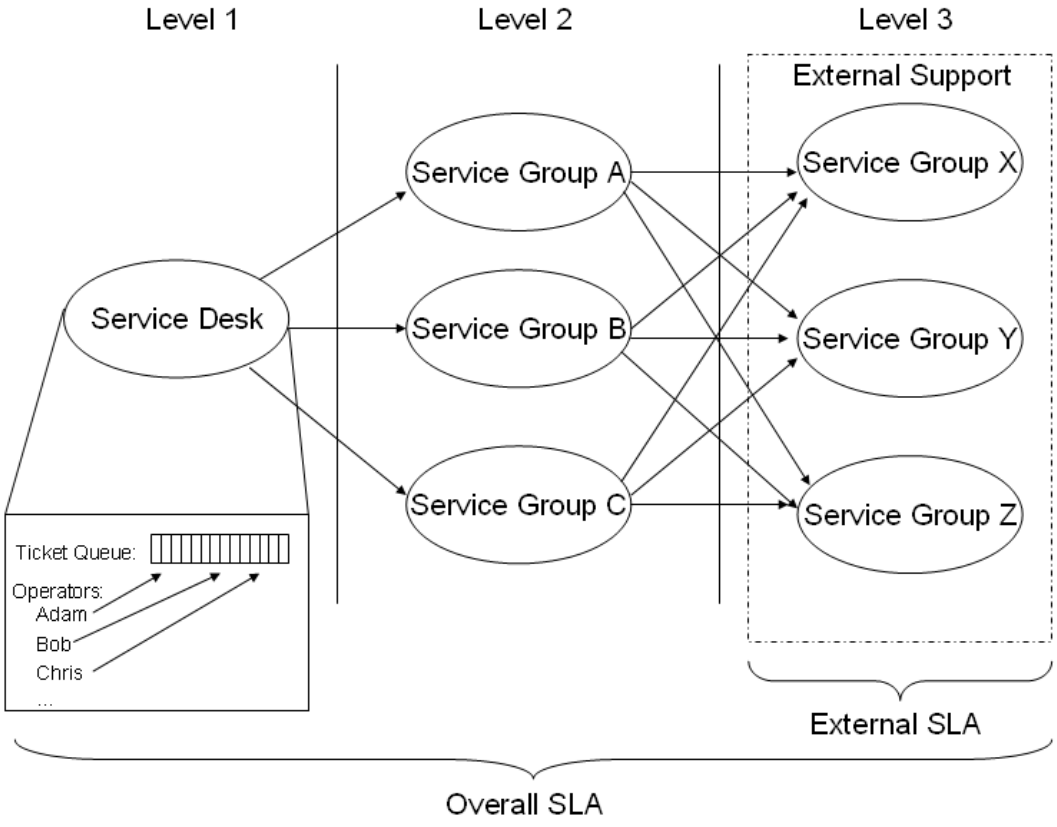


Figure 22: Sample Support Organization with External Service Members 1

If the external support technicians are distributed in different support levels, as shown in Figure 23, the calculation of some SLA reporting data would require additional manual manipulation. The mixture of internal and external processing of tickets makes it hard to differentiate the effort on each team of support technicians. In the case shown in Figure 23 for example, Service Desk routed a ticket to Service Group C (which is external) and later escalated to Service Group X (internal). When the ticket was resolved, the resolution consisted of the efforts of both groups. Therefore resolution time of tickets by third party is not possible to derive without overwhelming manual calculation of each timestamp associated with assignment of a ticket between the internal and external groups

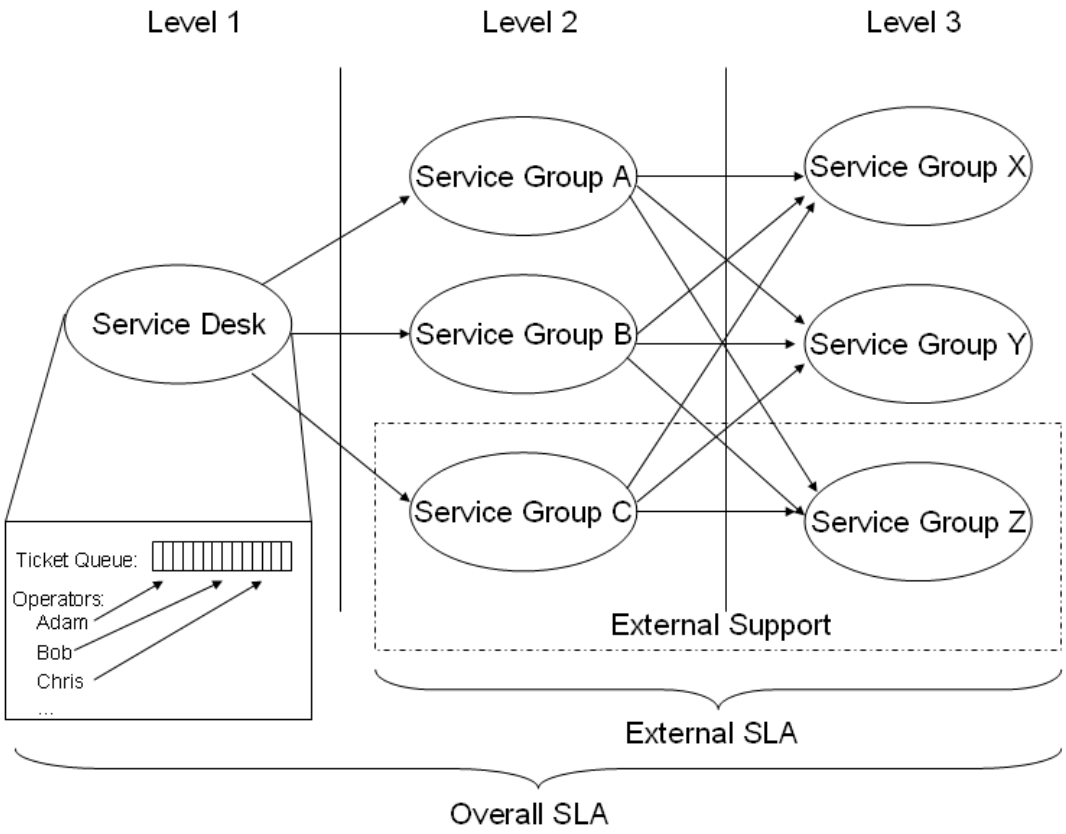


Figure 23: Sample Support Organization with External Service Members 2

Counter Measures:

In this case, the SLA should take into consideration that certain commonly used data do not apply to some external support services, for instance resolution time. Instead, response time and incident resolution rate per technician are more pertinent indicators.

When extracting the reporting data, the results have to be restricted to specific groups if needed. For example, to report on the total tickets handled by the whole support team, the number can be obtained by adding up the tickets of all status. If the tickets are restricted to the ones that have been assigned to the external support groups (in the example shown in Figure 22, the Group X, Y and Z) then the number reflects the total tickets that have been handled by the external support groups.

Scenario C: Third Party Involvement

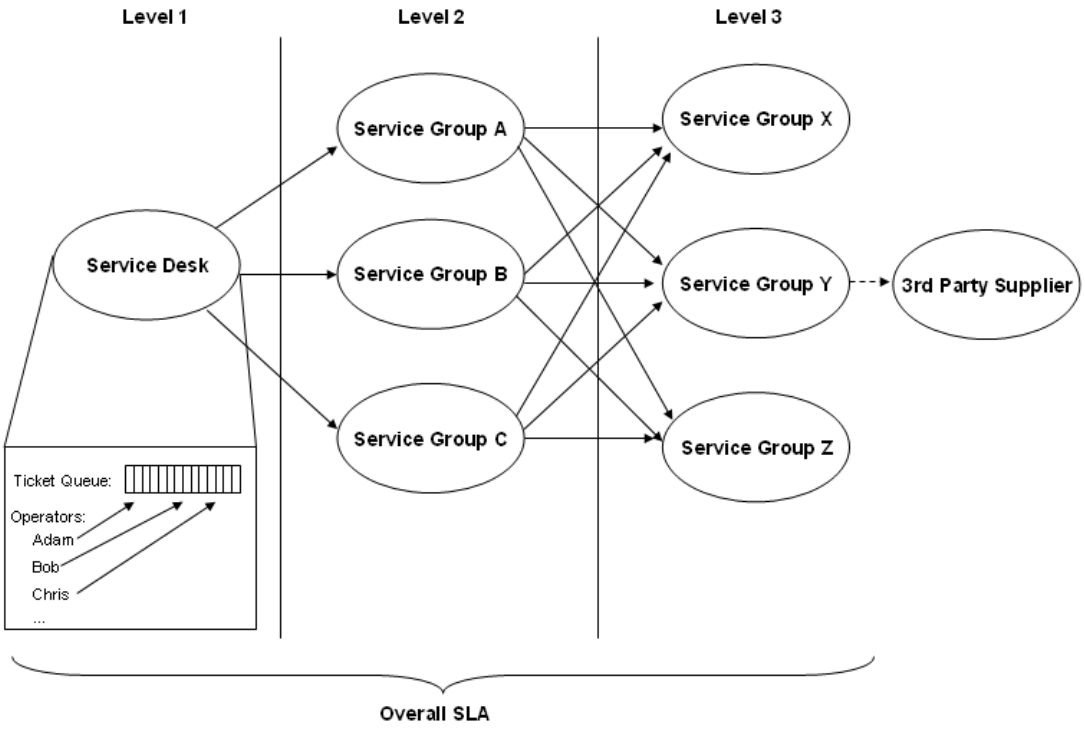


Figure 24: Sample Support Organization with Third Party Involvement

Sometimes support groups depend on third parties for service, or to provide infrastructure for the service, as shown in Figure 24. Suppose that a HP server is broken and the incident has been raised to Level 3 Support, who found that the CPU of the server needs to be changed. Level 3 Support then contacts HP to fix or change the CPU, however they will have no control over the service level of HP. Support service in this case is dependent on the performance of third party service/product providers. However, since the third party is not a contractual party of an SLA, the SLA would have no governance power over the quality of service from third party.

Counter Measures:

The involvement of third party processing incidents can be reflected by setting the ticket status to “Sleep”. When reporting on such tickets, depending on requirement, the status can be eliminated from the results. For example, resolution time for such a ticket should be calculated without the time when the ticket has been put to sleep, given during that period it is not the support team’s responsibility but rather the third party's.

Scenario D: Customer/User Interaction

This scenario is similar to Scenario C, but instead of depending on third party suppliers, the resolution of incidents depends on input from or cooperation with users or customers.

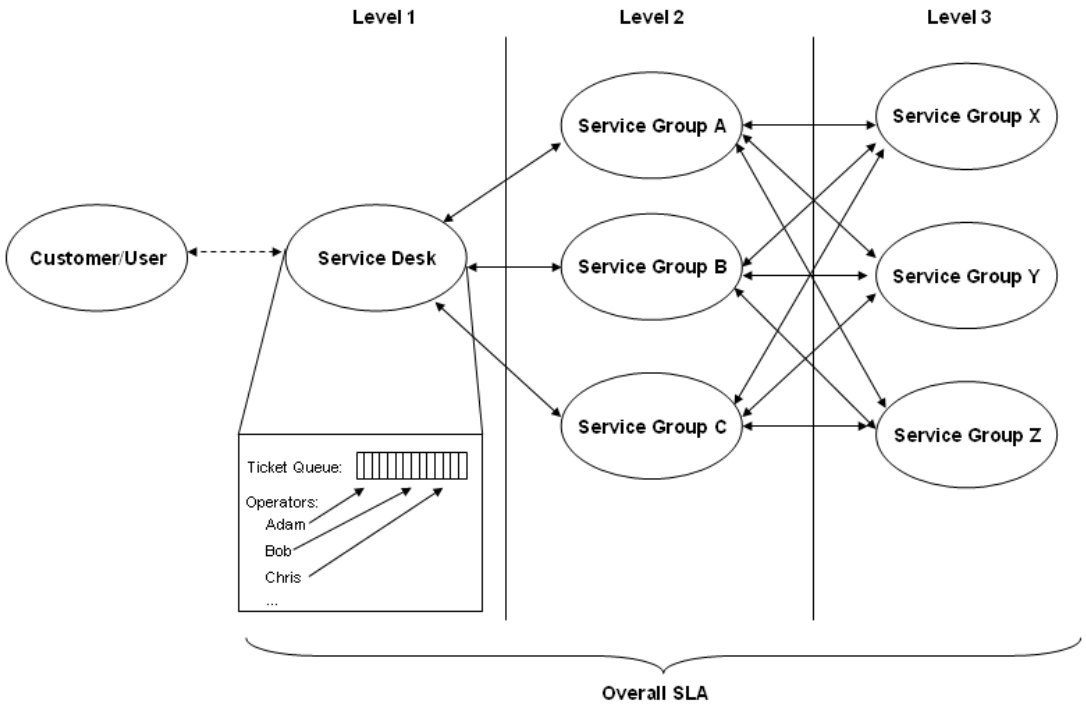


Figure 25: Sample Support Organization with Customer/User Interaction

Counter Measures:

Also, similar to Scenario C, putting ticket's status to "Sleep" can help in eliminating undesired data from reporting. However, customers and users are part of the contractual parties of SLA, so their obligation to assist and enhance the overall service performance can also be regulated in SLA.

Scenario E: Late Detection of Service Request[6]

Even with a process step of identifying that a call is an incident before creating a ticket for the incident, due to technician knowledge level of other reasons, it could still happen that only upon escalation to second or third level support is it detected that an incident should be a request.

[6] Service Request: compared to incident, requests are not disruptions of business process but a planned process or procedure ready to be executed, for example adding a new component to a software application.

Remedy® provides support to **Derive** a Request from an Incident for such a scenario, however the derived incident would not be able to be closed. When it comes to reporting, this kind of incident would become noise in the statistics. Since those tickets cannot be closed, if searches are performed to retrieve un-closed incidents, those tickets would always show up in the search results until the derived request is closed.

Counter Measures:

Remedy® could have these kinds of incidents closed upon derivation and list the incident ticket ID in the reference field of the newly derived request ticket. For SLA reporting, such tickets should be eliminated from certain data. "Total number of resolved tickets" would be an example, since the incidents are not really resolved but dealt with as request tickets.

Scenario F: Dispatching and Ticket Routing

Some companies choose to have a dispatcher to route the tickets between support levels, as shown in Figure 26, to reduce human error during escalation of tickets among different levels, for instance a technician wrongly assigns a ticket to another technician.

Remedy® does not have a specific role for dispatchers in the system; the dispatchers either have the same authorization as other technicians in the same level or are grouped as other service groups. Given no specific role to distinguish the dispatchers, when calculating data such as incidents handled per technician, the numbers for dispatchers would be higher since all incidents route through

them. If such numbers are included for calculating the average then the data will not be accurate.

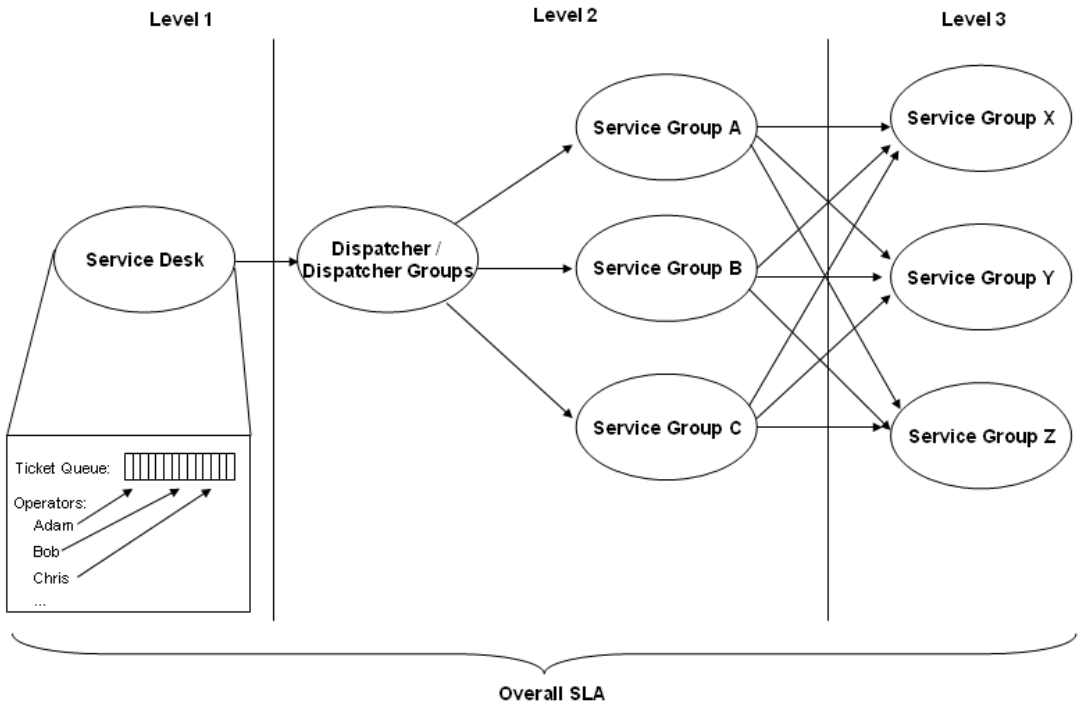


Figure 26: Sample Support Organization with Dispatcher/Dispatcher Groups

Counter Measures:

Remedy® could have a special role for dispatchers, and exclude their activities from some of the SLA measurements. Then when calculating certain data, the data from dispatchers or the dispatcher service group should be eliminated.

6. Sample SLA Reporting

6.1 ITIL SLA Reporting Metrics Calculation

Given the data available in Remedy®, the metrics suggested by ITIL for SLA performance adherence reporting as listed in Chapter 3.6 can all be calculated directly by search results or indirectly with certain workarounds. Calculation methods are given below. Remedy® is a highly customizable system so the calculation could be different depending on configuration. Some of the following calculations use sample configurations for demonstration.

Indicator 1: Total numbers of Incidents (as a control measure)

Search:

Select Tickets with Status = “Assigned”, “WIP”, “Sleep”, “Solved” or “Closed” (if needed also limit to a certain period of time), then count the number of tickets. Certain items should be excluded from the results if needed, for example incidents derived to requests.

Indicator 2: Breakdown of incidents at each stage

(e.g. ”Assigned”, “WiP”, “Closed” etc.)

Available in **Dashboard Report** (sample as shown in Figure 27)

Indicator 3: Size of current incident backlog

Search:

Select Tickets with Status = “Assigned”, “WiP”, “Sleep” or “Solved” (if needed also

limit to a certain period of time), then count the number of tickets.

Indicator 4: Number and percentage of major incidents

Search

(depends on the definition of “Major Incident”; for this example, use P1 incidents)**:**

Select Tickets with Priority = 1 (if needed also limit to a certain period of time), then count the number of tickets.

Divide the calculated number by the total number of ticket to get the percentage.

Indicator 5:

Mean elapsed time to achieve incident resolution or circumvention, broken down by impact code

Search

(depends on the definition of “resolution time” of each organization; in this case for example define resolution time as the time between a ticket’s status change to “WiP” and the ticket’s status change to “Solved”)**:**

Get the timestamp of each ticket when its status is changed to “WiP” and the timestamp when the status is changed to “Solved” (if needed also limit to a certain period of time), then calculate the difference as resolution time. Certain periods of time should be excluded from the results if needed, for example, time of the status "Sleep".

Use the calculated number to divide the total number of tickets to get the mean.

Indicator 6:

Percentage of incidents handled within agreed response time (incident

response-time targets may be specified in SLAs, for example, by impact and urgency codes)

Search

(depends on the definition of “response time” for each organization; in this case for example define response time as the time between a ticket has been created and the ticket’s status change to “WiP”)**:**

Get the timestamp of each ticket when it has been created and the timestamp when the status is changed to “WiP” (if needed also limit to a certain period of time), then calculate the difference as response time.

Count the number of tickets whose response time is within the targeted response time range as agreed in SLA, then divide it by the total number of tickets to get the percentage.

Indicator 7: Average cost per incident

Search:

Search for the total number of incidents to divide the total cost (if needed also limit to a certain period of time).

Indicator 8:

Number of incidents reopened and as a percentage of the total

Search

(depends on whether it is configured in the system to allow reopened tickets)**:**

Search for tickets the last timestamp of which is larger than the timestamp of first status change to “Closed”. Count the number of search results

Divide the calculated number by the total number of ticket to get the percentage.

Indicator 9: Number and percentage of incidents incorrectly assigned

No direct search or report available. **Workaround**:

For each wrongly assigned ticket, note in the field Log Diary or Status attribute that it is wrongly assigned. When searching for these tickets then use a full text search for the pre-defined keyword (for example: “wrong assignment”) on the field. Count the number of returned search results.

Divide the calculated number by the total number of ticket to get the percentage.

Indicator 10:

Number and percentage of incidents incorrectly categorized

Search:

Search for tickets which have the record of activity of modifying Category, Component or Component Type more than once, meaning the tickets have been categorized multiple times. Count the number of returned search results.

Divide the calculated number by the total number of ticket to get the percentage.

Indicator 11:

Percentage of Incidents closed by the Service Desk without reference to other levels of support (often referred to as ‘first point of contact’).

Search:

Search for tickets which have only been assigned to Groups that are defined for Service Desk. Count the number of search results.

Divide the calculated number by the total number of ticket to get the percentage.

Indicator 12:

Number and percentage of the incidents processed per Service Desk agent

Search:

Search and group the tickets by Owner. Count the number of tickets for each owner. Certain items should be excluded from the results if needed, for example dispatchers.

Divide the calculated numbers by the total number of ticket to get the percentage.

Indicator 13:

Number and percentage of incidents resolved remotely, without the need for a visit

No direct search or report available. **Workaround**:

For each ticket resolved remotely (or conversely, for each ticket resolved on-site), note in the field Log Diary or Way of Resolution that it is resolved remotely (or on-site). When searching for such kind of tickets then use a full text search for the pre-defined keyword (for example: “Off-site” or “On-site”) on the field. Count the number of returned search results.

Divide the calculated number by the total number of ticket to get the percentage.

Indicator 14:

Number of incidents handled by each Incident Model

Search:

(depends on how many levels an organization categorizes incidents; in this case assume one level, by the field of Classification)**:**

Search and group the tickets by Classification. Count the number of tickets for each kind of Classification value.

Indicator 15:

Breakdown of incidents by time of day, to help pinpoint peaks and ensure matching of resources.

Search:

Search and group the tickets by timestamp of creation. Count the number of tickets for each timeslot; an interval of 2 hours is used as an example in this paper. In real world business practice the interval can be determined depending on the business hours, management reporting demand or as defined in SLAs.

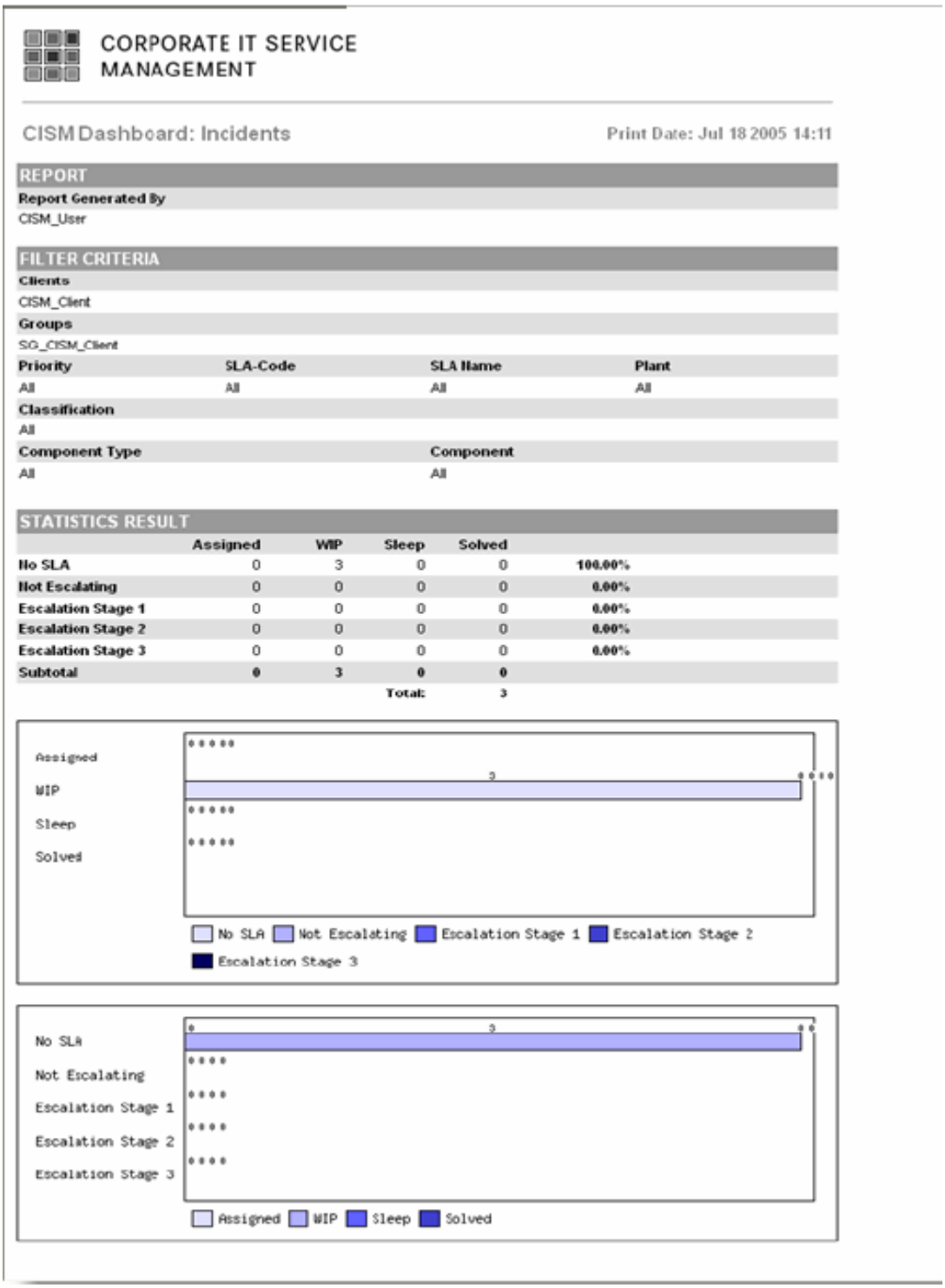


Figure 27: Sample Remedy® Dashboard Report

6.2 Sample Report

With the calculated indicator data to measure SLA performance and adherence, a sample report can be build for both the service provider and the customer to review. Since the scope of this paper is restricted to Incident

Management related SLA reporting, other aspects of SLA reports figures such as system availability, database growth are not included in the sample report.

SAMPLE REPORT FOR SLA ADHERENCT EVALUATION

Reporting Period: XXXX-XX-XX to XXXX-XX-XX (YYYY-MM-DD)

SLA Reference: XXXXXXXX

Service Summary:

……

Service Status:

Numbers of Incidents: Indicator 1 data

Current Incident Backlog: Indicator 3 data

Number and percentage of major incidents: Indicator 4 data

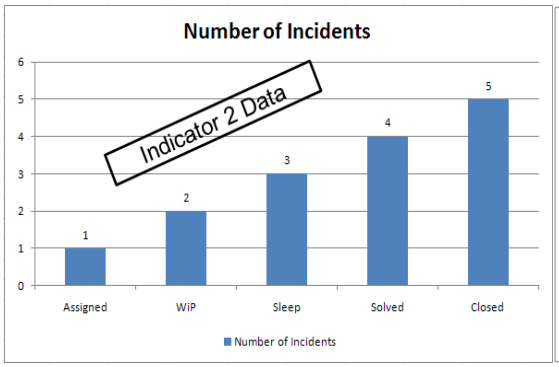
Operation Performance:

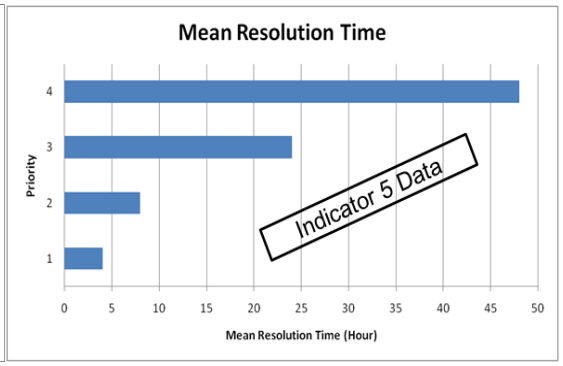
Percentage of incidents handled within agreed response time: Indicator 6 data

Number of incidents reopened and as a percentage of the total: Indicator 8 data

Number and percentage of incidents incorrectly assigned: Indicator 9 data

Number and percentage of incidents incorrectly categorized: Indicator 10 data





Capacity Analysis:

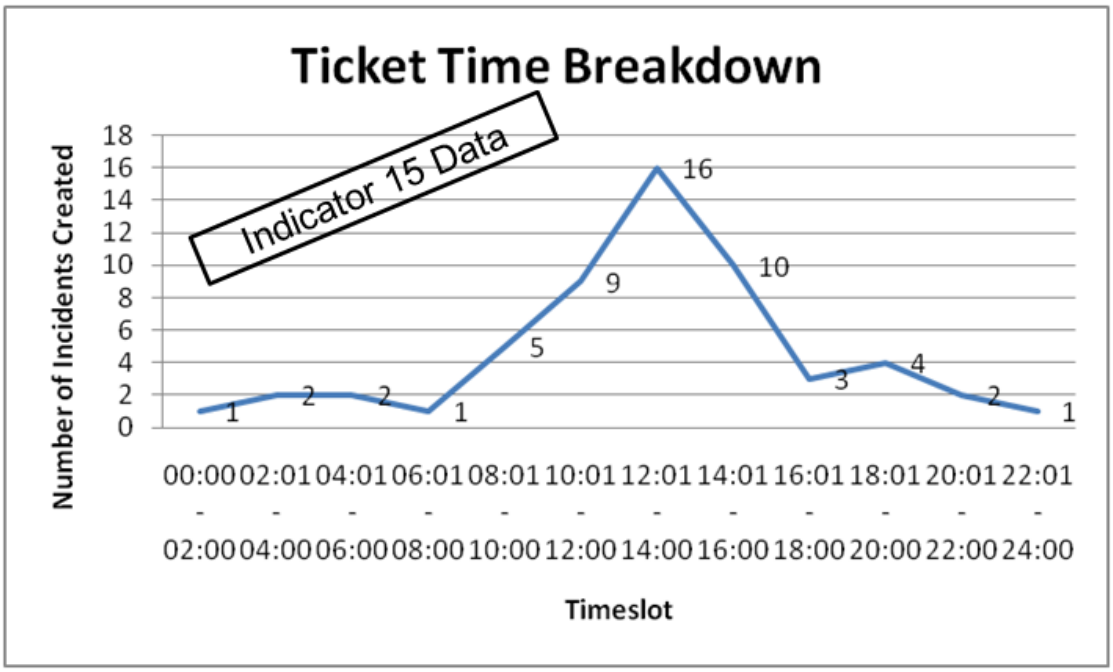
Percentage of Incidents closed by the Service Desk without reference to other levels of support: Indicator 11 data

Number and percentage of the incidents processed per Service Desk agent: Indicator 12 data

Number and percentage of incidents resolved remotely, without the need for a visit: Indicator 13 data

Category	Number of Incidents
Software	1
Hardware	2
Network	3
Password	4
Administration	5
Misc	6

Indicator 14 Data



Cost Management

Average cost per incident: Indicator 7 data

Overall SLA Adherence:

Contact:

Incident Manager: … Phone: …

Service Manager: … Phone: …

7. Discussion and Conclusion

Based on the ITIL best-practice Incident Management Process and Service Level Management, this paper examines in detail the Incident Management process in Remedy® and how the data extracted from Remedy® can be used to evaluate and report on SLA adherence performance.

Some scenarios which might result in errors in Remedy® SLA reporting are also demonstrated in this paper, together with counter measures, which could be used as a reference for actual business practice.

7.1 Problems and Limitations

More and newer frameworks and standards for technical support service are gaining recognition in the market; yet this paper bases its research and evaluation purely on the ITIL framework.

Although Remedy® is recognized as the market lead for the support service tool, there are a lot of similar tools in the market as well. Web-based incident tracking tools are gaining popularity but are not analyzed in this paper.

Technical support service can include many processes besides Incident Management, for example Change Management, Event Management, Problem Management, and Capacity Management., Each of them can be defined and measured by Service Level Management. The scope of this paper is restricted to

Incident Management.

7.2 Recommendations for Future Studies

Overall, the objectives of this paper have been achieved. For future studies the scope can be expended to other technical support service frameworks and systems. Within the focus on ITIL and Remedy® the topic can also be broaden to other processes than Incident Management.

Appendix 1: ITIL Sample Service Level Agreement

SERVICE LEVEL AGREEMENT (SLA – Sample) [32]

This agreement is made between

.....

And

.....

The agreement covers the provision and support of the ABC services which.....(brief service description).

This agreement remains valid for 12 months from the (date) until (date). The agreement will be reviewed annually. Minor changes may be recorded on the form at the end of the agreement, providing they are mutually endorsed by the two parties and managed through the Change Management process.

Signatories:

Name.....Position.....Date.....
Name.....Position.....Date.....

Service description:

The ABC Service consists of.... (a fuller description to include key business functions, deliverables and all relevant information to describe the service and its scale, impact and priority for the business).

Scope of the agreement:

What is covered within the agreement and what is excluded?

Service hours:

A description of the hours that the customers can expect the service to be available (e.g. 7 × 24 × 365, 08:00 to 18:00 – Monday to Friday). Special conditions for exceptions (e.g. weekends, public holidays) and procedures for

requesting service extensions (who to contact – normally the Service Desk – and what notice periods are required).
This could include a service calendar or reference to a service calendar. Details of any pre-agreed maintenance or housekeeping slots, if these impact on service hours, together with details of how any other potential outages must be negotiated and agreed – by whom and notice periods etc.
Procedures for requesting permanent changes to service hours.

Service availability:
The target availability levels that the IT service provider will seek to deliver within the agreed service hours. Availability targets within agreed service hours, normally expressed as percentages (e.g. 99.5%), measurement periods, method and calculations must be stipulated. This figure may be expressed for the overall service, underpinning services and critical components or all three. However, it is difficult to relate such simplistic percentage availability figures to service quality, or to customer business activities. It is therefore often better to try to measure service unavailability in terms of the customer's inability to conduct its business activities. For example, 'sales are immediately affected by a failure of IT to provide an adequate POS support service'. This strong link between the IT service and the customer's business processes is a sign of maturity in both the SLM and the Availability Management processes.
Agreed details of how and at what point this will be measured and reported, and over what agreed period should also be documented.

Reliability:
The maximum number of service breaks that can be tolerated within an agreed period (may be defined either as number of breaks e.g. four per annum, or as a Mean Time Between Failures (MTBF) or Mean Time Between Systems Incidents (MTBSI)).
Definition of what constitutes a 'break' and how these will be monitored and recorded.

Customer support:
Details of how to contact the Service Desk, the hours it will be available, the hours

support is available and what to do outside these hours to obtain assistance (e.g. on-call support, third-party assistance etc.) must be documented. The SLA may also include reference to internet/Intranet Self Help and/or Incident logging. Metrics and measurements should be included such as telephone call answer targets (number of rings, missed calls etc.)

Targets for Incident response times (how long will it be before someone starts to assist the customer – may include travelling time etc.)

A definition is needed of 'response' – Is it a telephone call back to the customer or a site visit? – as appropriate.

Arrangements for requesting support extensions, including required notice periods (e.g. request must be made to the Service Desk by 12 noon for an evening extension, by 12 noon on Thursday for a week-end extension) Note. Both Incident response and resolution times will be based on whatever incident impact/priority codes are used – details of the classification of Incidents should also be included here.

Note. In some cases, it may be appropriate to reference out to third-party contacts and contracts and OLAs – but not as a way of diverting responsibility.

Contact points and escalation:

Details of the contacts within each of the parties involved in the agreement and the escalation processes and contact points. This should also include the definition of a complaint and procedure for managing complaints.

Service performance:

Details of the expected responsiveness of the IT service (e.g. target workstation response times for average, or maximum workstation response times, sometimes expressed as a percentile – e.g. 95% within two seconds), details of expected service throughput on which targets are based, and any thresholds that would invalidate the targets).

This should include indication of likely traffic volumes, throughput activity, constraints and dependencies (e.g. the number of transactions to be processed, number of concurrent users, and amount of data to be transmitted over the network). This is important so that performance issues that have been caused by excessive throughput outside the terms of the agreement may be identified.

Batch turnaround times:

If appropriate, details of any batch turnaround times, completion times and key deliverables, including times for delivery of input and the time and place for delivery of output where appropriate.

Functionality (if appropriate):

Details of the minimal functionality to be provided and the number of errors of particular types that can be tolerated before the SLA is breached. Should include severity levels and the reporting period.

Change Management:

Brief mention of and/or reference out to the organization's Change Management procedures that must be followed – just to reinforce compliance. Also targets for approving, handling and implementing RFCs, usually based on the category or urgency/priority of the change, should also be included and details of any known changes that will impact on the agreement, if any.

Service Continuity:

Brief mention of and/or reference out to the organization's Service Continuity Plans, together with details of how the SLA might be affected or reference to a separate Continuity SLA, containing details of any diminished or amended service targets should a disaster situation occur. Details of any specific responsibilities on both sides (e.g. data backup, off-site storage). Also details of the invocation of plans and coverage of any security issues, particularly any customer responsibilities (e.g. coordination of business activities, business documentation, backup of freestanding PCs, password changes).

Security:

Brief mention of and/or reference out to the organization's Security Policy (covering issues such as password controls, security violations, unauthorized software, viruses etc.). Details of any specific responsibilities on both sides (e.g. Virus Protection, Firewalls).

Printing:

Details of any special conditions relating to printing or printers (e.g. print

distribution details, notification of large centralized print runs, or handling of any special high-value stationery).

Responsibilities:

Details of the responsibilities of the various parties involved within the service and their agreed responsibilities, including the service provider, the customer and the users.

Charging (if applicable):

Details of any charging formulas used, charging periods, or reference out to charging policy documents, together with invoicing procedures and payment conditions etc. must be included. This should also include details of any financial penalties or bonuses that will be paid if service targets do not meet expectations. What will the penalties/bonuses be and how will they be calculated, agreed and collected/paid (more appropriate for third-party situations). If the SLA covers an outsourcing relationship, charges should be detailed in an Appendix as they are often covered by commercial in-confidence provisions.

It should be noted that penalty clauses can create their own difficulties. They can prove a barrier to partnerships if unfairly invoked on a technicality and can also make service provider staff unwilling to admit to mistakes for fear of penalties being imposed. This can, unless used properly, be a barrier to developing effective relationships and problem solving.

Service reporting and reviewing:

The content, frequency, content, timing and distribution of service reports, and the frequency of associated service review meetings. Also details of how and when SLAs and the associated service targets will be reviewed and possibly revised, including who will be involved and in what capacity.

Glossary:

Explanation of any unavoidable abbreviations or terminology used, to assist customer understanding.

Amendment sheet:

To include a record of any agreed amendments, with details of amendments, dates and signatories. It should also contain details of a complete change history of the document and its revisions.

It should be noted that the SLA contents given above are examples only. They should not be regarded as exhaustive or mandatory, but they provide a good starting point.

Appendix 2: Sample Fields Searchable in Remedy®

Field	Searchable Value
Caller:	
Department	Full text
Email	Full text
Feedback	Full text
First Name	Full text
Last Name	Full text
Notification	Value List
Notification Via	Value List
Phone	Full text
Owner:	
Building	Full text
Changed	Boolean
CostCenter	Full text
Department	Full text
Email	Full text
First Name	Full text
Floor	Full text
Language	Full text
LastName	Full text
Location	Full text
Phone	Full text
Plant	Full text
Room/Cube	Full text
UserID	Indexed Number
Organization:	
City	Full text
Code	Value List
Country	Full text
Country Code	Full text
Email	Full text
Fax	Full text

Language	Full text
Name	Full text
Phone	Full text
Status	Value List
Street	Full text
Type	Full text
ZIP Code	Full text
Ticket Data:	
Assigned to Group	Full text
Assigned to Individual	Full text
Classification	Full text
Client	Full text
Component	Full text
Component Type	Full text
External	Full text
Priority	Value List
Ref No	Full text
SLA Time	Full text
Schedule	Full text
Short Description	Full text
Source	Value List
Status	Value List
Status Attribute	Full text
Submitter Group	Full text
Ticket ID	Indexed Number
Process:	
Name	Full text
Phase	Value List
Status	Value List
Step	Full text
Equipment:	
Asset ID	Full text
Changed	Boolean

Class	Full text
Comment	Full text
Computername	Full text
Costcenter	Full text
HW Building	Full text
HW Plant	Full text
IP Address	Full text
LU No	Full text
Local ID	Full text
MAC Address	Full text
Operation System	Full text
SLA Code	Full text
Serial No	Full text
Service No	Full text
Type	Full text
Virtual Equipment No	Full text
Custormer:	
Cellphone	Full text
Fax	Full text
Internal Code	Full text
Remark	Full text
Reporting:	
Changed By Another User	Boolean
Escalation Stage	Value List
External SystemID	Full text
External SystemName	Full text
Incoming Message	Boolean
Last Modified By	Full text
SLA Name	Full text
Submitter	Full text
Task Activity	Full text
Task Activity Status	Full text

References

[1]. Agle, A. & Alberghini, M. (2006). *An Introduction to the Action Request System*. Office of Information Technology, Georgia Institute of Technology. Retrieved on April 10th from http://remedy.gatech.edu/documentation/remedyguide512.pdf

[2]. Aman, Fadhilah. (2005). *A Web Based Help Desk System Using Open Source Software*. Universiti Utara Malaysia. Retrieved on May 2nd from http://eprints.uum.edu.my/1066/

[3]. Barash, G., Bartolini, C. & Wu, L. (2007). *Measuring and Improving the Performance of an IT Support Organization in Managing Service Incidents.* Proc. 2nd IEEE Workshop on Business-driven IT Management, Munich, Germany.

[4]. Bartolini , C., Stefanelli, C. & Tortonesi, M. (2008).*SYMIAN: A Simulation Tool for the Optimization of the IT Incident Management Process*. Lecture Notes in Computer Science, Volume 5273, Page 83-94.

[5]. Bartsch, C., Mevius, M., & Oberweis, A. (2010). *Simulation Environment for IT Service Support Processes: Supporting Service Providers in Estimating Service Levels for Incident Management*. In Proceedings of the 2010 Second international Conference on information, Process, and Knowledge Management (February 10 - 15, 2010). EKNOW. IEEE Computer Society, Washington, DC, Page 23-31.

[6]. BMC Software, Inc. (2006). *BMC Remedy Service Desk: Incident Management 7.0 User's Guide.* Retrieved on May 2nd from http://its.uncg.edu/Service_Management/Incident/Remedy/Guides/Incident-User-Guide-700.pdf

[7]. BMC Software, Inc. (2003). *Remedy's Comprehensive ITIL Solution*. Retrieved on June 14th from http://www.mountainview.ca/Mountainview/downloads/remedy_itil.pdf

[8]. Cannon D. & Wheeldon, D (2007). *ITIL Service Operation.* Office of Governmental Commerce (OGC). The Stationery Office. ISBN 9780113310463.

[9]. CyberTrain Inc. *BMC Remedy Products.* Retrieved on May 17th from http://www.cybertraininc.com/cyber/remedy.html

[10]. Das, A. (2003). *Knowledge and Productivity in Technical Support Work.* Manage. Sci. Volume 49, Issue 4, page 416-431.

[11]. Dugmore, J. & Taylor, S. (2008). *ITIL V3 and ISO/IEC 20000*. Retrieved on June 14th from http://www.best-management-practice.com/gempdf/ITIL_and_ISO_20000_March08.pdf

[12]. Enterprise Management Associates. (2006). *BMC Strengthens its Market Position with the Introduction of BMC Atrium CMDB 2.0*. Retrieved on May 10th from http://i.i.com.com/cnwk.1d/html/itp/BMC_EMA_Atrium_IB.pdf

[13]. Green, L. (2006). *Service Level Agreements: An Ontological Approach.* Proceedings of the 8th international Conference on Electronic Commerce: the New E-Commerce: innovations For Conquering Current Barriers, Obstacles and Limitations To Conducting Successful Business on the internet (Fredericton, New Brunswick, Canada, August 13 - 16, 2006). ICEC '06, vol. 156. ACM, New York, NY, 185-194.

[14]. Greiner, L. (2007). *ITIL: the International Repository of IT Wisdom*. netWorker 11, 4, Page 9-11.

[15]. Gonzalez, L. M., Giachetti, R. E. & Ramirez, Guillermo. (2005). *Knowledge Management-centric Help Desk: Specification and Performance Evaluation.* Decision Support Systems, Volume 40, Issue 2, Pages 389-405.

[16]. Hardie, S. (2008). *XCEND Customizing Altiris Helpdesk for Global Time Zone and SLA Management to Fulfill ITIL Requirements*. Retrieved on June 14th from http://www.symantec.com/connect/articles/xcend-customizing-altiris-helpdesk-global-time-zone-and-sla-management-fulfill-itil-require

[17]. Hewlett-Packard Development Company. (2005). *ITIL Foundation for IT Service Management.*

[18]. Hughes, E. C. (1971). *The Sociological Eye*. Aldine-Atherton, Chicago, IL.

[19]. Information Systems Audit and Control Association. *COBIT Framework for IT Governance and Control*. Retrieved on May 10th from http://www.isaca.org/Knowledge-Center/COBIT/Pages/Overview.aspx

[20]. Information Systems Audit and Control Association. (2009). *COBIT Overview.* Retrieved on May 10th from http://www.isaca.org/Knowledge-Center/cobit/Documents/COBIT-Overview.ppt

[21]. Information Technology Services, The University of North Carolina at Greensboro. (2009). *Reporting: How to Obtain Data from Remedy.* Retrieved on June 14th from http://its.uncg.edu/Service_Management/Incident/Remedy/Reporting/

[22]. Iqbal, M. & Nieves, M. (2007). *ITIL Service Strategy.* Office of Governmental Commerce (OGC). The Stationery Office. ISBN 9780113310456.

[23]. IT Governance Institute & Office of Government Commerce. (2005). *Aligning COBIT, ITIL and ISO 17799 for Business Benefit.* Retrieved on May 10th from http://www.itgovernance.co.uk/files/ITIL-COBiT-ISO17799JointFramework.pdf

[24]. IT Governance Institute. (2008). *Mapping of ITIL V3 with COBIT® 4.1*. ISBN 9781604200355.

[25]. *IT Infrastructure Library.* (2010). Retrieved on April 16th from http://www.kevinburkholder.com/IT_ITIL.php

[26]. IT Service Management Forum. *What is ISO/IEC 20000?* Retrieved on May 10th from http://www.isoiec20000certification.com/about/whatis.asp

[27]. Johnson, D. (1992). *NOC Internal Integrated Trouble Ticket System Functional Specification Wishlist ("NOC TT Requirements").* RFC. RFC Editor.

[28]. Julia H. A. (2008). *Integrating Security and IT.* Software Engineering Institute, Carnegie Mellon University. Retrieved on April 16th from https://buildsecurityin.us-cert.gov/bsi/articles/best-practices/deployment/576-BSI.html

[29]. Kajko-Mattsson, Mira. (2004). *Problems within Front-end Support.* Journal of Software Maintenance and Evolution: Research and Practice 16 (4/5): Page 309–329.

[30]. Lacy, S. & Macfarlane, I. (2007). *ITIL Service Transition.* Office of Governmental Commerce (OGC). The Stationery Office. ISBN 9780113310487.

[31]. Livetime. (2010). *ISO 20000.* Retrieved on May 10th from

http://www.livetime.com/solutions/iso-20000-compliance/

[32]. Lloyd, V. & Rudd C. (2007). *ITIL Service Design.* Office of Governmental Commerce (OGC). The Stationery Office. ISBN 9780113310470.

[33]. Marcella, R. & Middleton, I. (1996). *The Role of The Help Desk in the Strategic Management of Information Systems.* OCLC Systems and Services 12 (4), Page 4 – 19.

[34]. Microsoft (2009). Microsoft® Operations Framework: Using MOF for ISO/IEC 20000: A MOF Companion Guide. Retrieved on July 10th from http://www.itsmacademy.com/files/MOF_ISO.pdf

[35]. Middleton, I. (1996). *Key Factors in HelpDesk Success*. British Library R&D Report 6247, The British Library

[36]. McLaughlin, K. & Damiano, F. (2007). *American ITIL.* In Proceedings of the 35th Annual ACM SIGUCCS Conference on User Services (Orlando, Florida, USA, October 07 - 10, 2007). SIGUCCS '07. ACM, New York, NY, Page 251-254.

[37]. Niedzwiecki, R.& Peterson, M. (2002). *Help desk support: to be or not to be eligible.* In Proceedings of the 30th Annual ACM SIGUCCS Conference on User Services (Providence, Rhode Island, USA, November 20 - 23, 2002). SIGUCCS '02. ACM, New York, NY, Page 89-94.

[38]. Nissen, M., Kamel, M. & Sengupta, K. (2000) I*ntegrated analysis and design of knowledge systems and processes*, Information Resources Management Journal, 2000, page 24– 43.

[39]. Nurmela, T. & Kutvonen, L. (2007). *Service level agreement management in federated virtual organizations*. Proceedings of the 7th

IFIP WG 6.1 international Conference on Distributed Applications and interoperable Systems (Paphos, Cyprus, June 06 - 08, 2007). J. Indulska and K. Raymond, Eds. Lecture Notes In Computer Science. Springer-Verlag, Berlin, Heidelberg, Page 62-75.

[40]. Office of Government Commerce. (2007). *The Official Introduction to the ITIL Service Lifecycle*. The Stationery Office. ISBN 9780113310616.

[41]. Pair, V. & Boyle, D. (2005). *Internal and external communication and collaboration: building a strong help desk environment*. Proceedings of the 33rd Annual ACM SIGUCCS Conference on User Services (Monterey, CA, USA, November 06 - 09, 2005). SIGUCCS '05. ACM, New York, NY, Page 305-309.

[42]. Porter, M. & Newport, B. *Output-based Contracts in the IT Industry — Whose Responsibility Is It?* Retrieved on May 2nd from http://www.iaccm.com/contractingexcellence.php?storyid=517

[43]. SENECA. *Service Level Management, Guaranteeing Customer Satisfaction*. Retrieved on May 10th from http://www.itsmportal.com/system/files/white-paper-SLM-with-SLA-template.pdf

[44]. *Service Desk Objectives in ITIL Foundation*. (2008). Retrieved on April 18th from http://www.itilfoundation.org/Service-Desk-Objectives-in-ITIL-Foundation_43.html

[45]. Spalding. G. & Case, G. (2007). *ITIL Continual Service Improvement.* Office of Governmental Commerce (OGC). The Stationery Office. ISBN 9780113310494.

[46]. Takano, A., Yurugi, Y., & Kanaegami, A. (2000). *Procedure based help desk system*. Proceedings of the 5th international Conference on

intelligent User interfaces (New Orleans, Louisiana, United States, January 09 - 12, 2000). IUI '00. ACM, New York, NY, 264-271.

[47]. *Trouble Ticket – Definition*. Retrieved on April 18th from http://www.zazachat.com/kb/trouble_ticket/articles/trouble_ticket.aspx

[48]. *VMware Service Manager IT Service Management Model*. Retrieved on May 10th from http://www.infra-corp.com/solutions/

[49]. Wallhoff, J. (2004). *Combining ITIL with COBIT and ISO/IEC 17799:2000*. Scillani Information AB. Retrieved on May 10th from http://www.scillani.se/assets/pdf/Scillani%20Article%20Combining%20ITIL%20with%20Cobit%20and%2017799.pdf

[50]. Weiss, C., Premraj, R., Zimmermann, T. & Zeller, A. (2007). *How Long Will It Take to Fix This Bug?*. Proceedings of the Fourth international Workshop on Mining Software Repositories (May 20 - 26, 2007). International Conference on Software Engineering. IEEE Computer Society, Washington, DC, Page 1.

[51]. Wetzel, I. & Klischewski, R. (2004). *Serviceflow beyond workflow? IT support for managing inter-organizational service processes*. Information System 29, 2, Page127-145.

[52]. Xie, M., Tomlinson, M. & Bodenheimer, B. (2004). *Interface design for a modern software ticketing system*. Proceedings of the 42nd Annual Southeast Regional Conference (Huntsville, Alabama, April 02 - 03, 2004). ACM-SE 42. ACM, New York, NY, Page 122-127.

[53]. Yan, J., Kowalczyk, R., Lin, J., Chhetri, M. B., Goh, S. K., & Zhang, J. (2007). *Autonomous service level agreement negotiation for service composition provision.* Future General Computer System Volume 23, Issue 6, Page 748-759.