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Abstract	The Information Technology Infrastructure Library (ITIL) is readily available for establishing the best practices, reengineering and improving the IT service support process. However, the ITIL framework only provides recommendations, and a company needs to explore a methodology for improving the IT service support process and adopting the best guidelines of ITIL framework. To this end, this chapter investigates upon how to apply the ITIL framework can be used for evaluating the current IT service support process and its reengineering. A set of Key Performance Indicators (KPI) were established which are monitored by a decision support system (DSS) for triggering on-going reengineering of IT service support process. A case study methodology is used for an effective reengineering of IT service support process. This chapter focuses on implementing the ITIL guidelines at an operational level, improving the service desk, incident management, problem management, change management, release management, and configuration. It also focuses on implementing the ITIL guidelines at a tactical level, improving the service level management, capacity management, IT service continuity management, service availability, and security management. The chapter describes a methodology and an experience in implementing process reengineering techniques following ITIL framework.

Keywords (separated by '-')	ITIL - KPI - IT service support processes - DSS - Reengineering

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 1/31

Chapter 3
DSS Based IT Service Support Process Reengineering Using ITIL: A Case Study

Raul Valverde and Malleswara Tallal

AQ1

Abstract The Information Technology Infrastructure Library (ITIL) is readily available for establishing the best practices, reengineering and improving the IT service support process. However, the ITIL framework only provides recommendations, and a company needs to explore a methodology for improving the IT service support process and adopting the best guidelines of ITIL framework. To this end, this chapter investigates upon how to apply the ITIL framework can be used for evaluating the current IT service support process and its reengineering. A set of Key Performance Indicators (KPI) were established which are monitored by a decision support system (DSS) for triggering on-going reengineering of IT service support process. A case study methodology is used for an effective reengineering of IT service support process. This chapter focuses on implementing the ITIL guidelines at an operational level, improving the service desk, incident management, problem management, change management, release management, and configuration. It also focuses on implementing the ITIL guidelines at a tactical level, improving the service level management, capacity management, IT service continuity management, service availability, and security management. The chapter describes a methodology and an experience in implementing process reengineering techniques following ITIL framework.

Keywords ITIL · KPI · IT service support processes · DSS · Reengineering

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Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 2/31

1 Introduction

The complexity of Information Technology (IT) applications makes it difficult to properly tune customer requirements and service provider capabilities. Customers often cannot express their real service requirements and do not know the corresponding performance needs. Likewise, service providers often do not know how to differentiate between IT services and how to attune them to a specific customer [1]. In order to address these problems, many organizations are adopting the Information Technology Infrastructure Library [2] as a framework to support their primary business processes. In the past, many IT organizations focused only on technical issues. Nowadays this has changed to a more service oriented way of thinking in order to provide a high quality service. IT became a part and participle of daily business activities in every organization.

The IT Infrastructure Library (ITIL) is not hardware or software, but it is a technique to manage the technology and communications in an optimal way. The ITIL is not a set of rules that must be followed, but a guideline to help organize and arrange the IT organization. The primary objective of the ITIL is to establish the best practices and improving the standard of IT service quality that customers should demand and providers should supply [2]. The ITIL can be used as a quality service guideline to help an organization to achieve the following objectives [2]:

- Better quality control,
- Increase service level,
- Cost reduction,
- Increase efficiency and effectiveness of information supply,
- Unambiguously describing the service in setting up Service Level Agreements (SLAs), and
- More control over business processes.

The ITIL plays an important role in helping a business organization to meet its objectives since it helps to manage the IT resources more efficiently. One should consider the environment (social, organizational, and physical), the processes and their interdependencies among different dimensions of an organization; e.g. clinical information system (CIS) and end-user of a bio-medical application, as depicted in Fig. 1 [3].

The ITIL framework for Service Delivery and Support can be accomplished in three levels: the strategic, tactical and operational level. The strategic level key performance areas aim at long term goals. The tactical and operational levels focus on medium and short terms respectively. Figure 2 presents the KPIs at a tactical and operational levels which are the main areas addressed in this research.

The basic premise of this work presented in this chapter is to investigate how to apply the ITIL framework for the reengineering the IT service support process. A set of key performance indicators (KPIs) for IT service support areas will provide a better means of monitoring need for reengineering. A decision support system (DSS) can gather data and derive the KPIs and monitor them in a timely

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 3/31

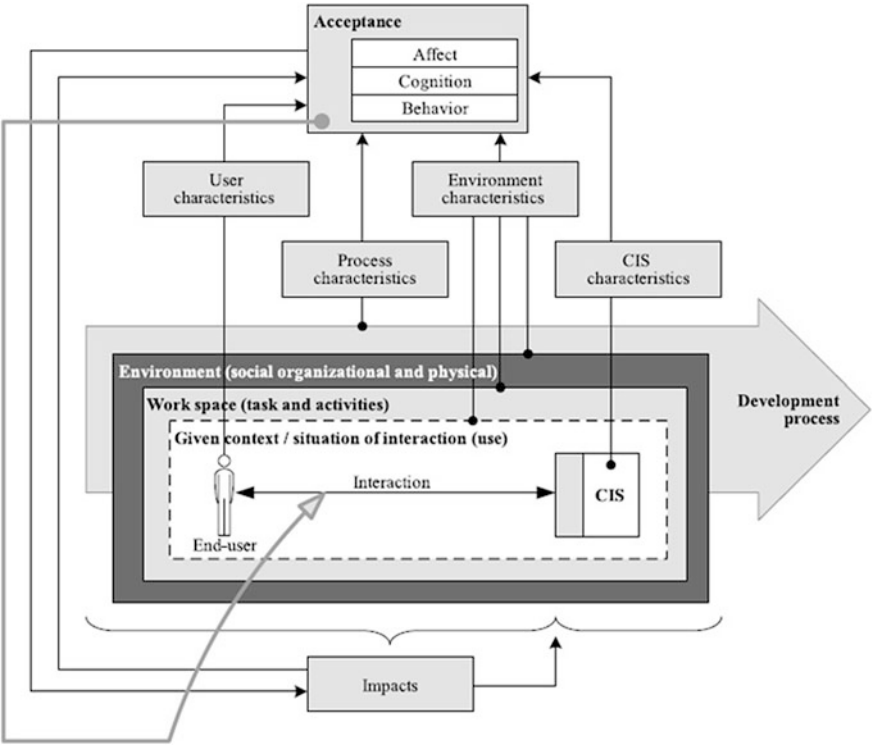

Fig. 1 The Information system interaction model (*Source* [3])

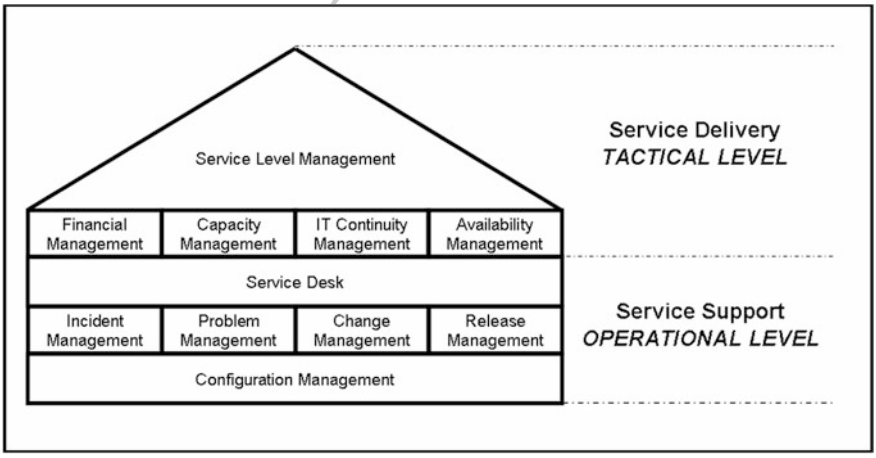

Fig. 2 ITIL core service management functions and processes (*Source* [29])

manner for triggering the need for reengineering. The chapter proposes an architecture for integrating a DSS into the corporate Intranet, which provides a pathway for an on-going reengineering of IT service support process.

2 Research Method

A case study methodology is chosen to emphasize and explore factors, which may lead to directions for the question [4]. This approach is commonly used as a qualitative method for researching the information systems [5]. The research in [4] suggested the following three reasons why the case study approach is suitable for information systems:

- The researcher can study the information system in a natural setting,
- The researcher can answer "how" and "why" questions, and
- It is suitable for studies in which little formal research has been conducted previously.

A case study based research is an exploratory research technique that investigates a contemporary phenomenon within its real-life context [6]. Soy [7] proposed a number of steps that can be used to successfully conduct the case study research. These steps include the definition of the research objective, the selection of the case study, the determination of the data gathering, and the case study analysis techniques. Thereafter, the case study data can be collected and analyzed, and the findings can be summarized in a report [7]. A repository of successful resolutions to the past problems can serve as a tool for preventing or solving the future problems, and each resolution can be visualized as a case while accomplishing an intelligent business process reengineering [8]. The business process management systems (BPMS) can actually track an organization's business processes and trigger the need for improvements [9]. The IT tools provide a means for an enterprise data extraction via process mining; where important events logged can serve as pieces of information that could trigger process improvements [10]. In nutshell, a business process performs a set of activities and the granularity of improvements at activity level can accomplish a dynamic management of an enterprise process performance (Tan 2008). A service model supports service planning, provisioning, operation and service management at customer-provider-interface [11]. The contemporary business process simulators can be used for decision support systems as well [12]. Likewise, every piece of information is useful for a successful reengineering of business processes.

The contemporary research focused on exploiting the ITIL framework for improving the IT services that eventually improve the business processes in any organization. The IT Service Support companies are focusing on ensuring that their customers have appropriate services to support for business functions [13]. The ITIL guidelines are widely used for improving IT service support processes [14]. Jantti [15] presents how the ITIL framework was used for improving the incident

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management processes in two companies. Just like all other business processes, implementing ITIL processes efficiently depends on building or procuring IT tools that can support them. The basic issue of supporting ITIL with process-oriented tools such as workflow management systems is presented in [16]. Implementing ITIL can be cumbersome and time consuming if one doesn't follow a roadmap for improvement based on priorities, dependencies, and guidelines [17]. The experience of IT staff and the amount of time devoted for understanding IT needs, and creating an appropriate service management office (SMO) could help improve the success rate of IT services [18]. A case study of managing IT services in finance industry by implementing suggestions that arise from ITIL methodology is presented in [19]. AQ3

The objective of this research chapter is to investigate upon how to apply the ITIL framework for the reengineering of IT processes in an organization. The case study selected is of an IT services company located in Liverpool, UK. The selected company is currently providing several types of support services to many organizations in the UK. This research will concentrate in one of their customers, a company that is specializing in dental care. The material provided in this chapter with respect to the case study has the consent of the involved parties.

The research will start with a description of the case study, its organizational structure, main business services and client base. The data gathering is an important part in the case study research. In this regard, [20] and [6] identified seven sources of empirical evidence in case studies, as follows:

- Documents: Written material sources that include published and unpublished documents, company reports, memos, letters, agendas, administrative documents, departmental info, reports, e-mail messages, newspaper articles, or any document that presents some evidence of some information,
- Archival records: Archival documents can be service records, organizational records, and lists of names, survey data, and other such records,
- Interviews: An interview can be used for three purposes: as an exploratory device to help identify variables and relations; as the main instrument of the research; and as a supplement to other methods (Kerlinger 86). Interviews were conducted for the present study for the first and third purposes. As a method it is one of the most important sources of information for a case study: open-ended, focussed, and structured or survey. In this study various forms were combined for collecting the data.
- Questionnaires: These are structured questions written and supplied to a large number of respondents, commonly spread over a large geographical area for consideration in advance. Respondents fill in the blank spaces and return the questionnaires to the researcher either by post or in person. Sometimes inducements, such as a small gift, are used to encourage recipients to complete the questionnaires.
- Direct observation: This occurs when a field visit is conducted during the case study. This technique is useful for providing additional information about a topic being studied. Reliability is enhanced when more than one observer is involved in the task.

- Participant-observation: Participant-observation turns the researcher into an active participant in the events being studied.
- Physical artefacts: Physical artefacts can be tools, instruments, or some other physical evidence that may be collected during the study as part of the field visit. Use of a number of these instruments to obtain data from the same source provides for triangulation as defined in [21].

AQ4

In this chapter, the case study uses the questionnaire, review of documents, archival records and observation techniques for collecting the data. The use of observation as a method of data collection is presented in [4, 20, 22] and it works well in a case research [6]. In this study, the researcher visited the site of information system to observe its functionality, collected several documents that identify the business processes and describe their current operations. This will help the researcher to learn about the details of the information systems included in the study.

Archival records are an integral part of the data that needs to be collected. The main records that will be used are the problems logs that are kept for future enhancements by the case study. These records will help the researcher to identify the areas of the IT services that will require modification for quality improvement. Based on the data collected, the researcher will perform a full analysis and benchmark the ITIL framework into the IT services operations. Further, a study on the effectiveness of ITIL framework will be conducted during the study case, in order to measure the improvement on the IT services after the ITIL framework implementation. To do this, a small portion of the ITIL framework will be implemented and one group pretest-posttest experiment will be conducted as suggested by [23].

AQ5

The one group pretest-posttest experiment is a quasi-experiment in which the subjects in the experimental group are measured before and after the experiment is administered [23].The participants of the experiment will be selected via convenience sampling. This sampling technique refers to obtaining sample units or people who are available [23]. This method is justified since the participation in the study will be voluntary and it is difficult to anticipate the number of participants in the sample. The key participants of the case study will be mailed an invitation letter.

AQ6

Further on, a questionnaire will be used as a data-gathering device administered before and after the implementation of the ITIL framework in the case study. The questionnaire will be concise and effective in addressing the requirements of data, while considering the time and moneytary constraints. As a result, the questionnaire is defined as “a pre-formulated written set of questions to which respondents record their answers, usually within rather closely defined alternatives” [24]. Questionnaires have a number of inherent advantages in regard to conducting research. The most of significant of these are that they can be sent to a sample population that is dispersed over a wide geographical and they can be answered by respondents at their own convenience [25]. Furthermore, as the participants are assured complete anonymity, self-administered questionnaires overcome the problems of interviewer bias while reducing the respondent’s likely reluctance to convey an incorrect or controversial information. Reliability is another advantage

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 7/31

since the questionnaires are easily repeated [26]. That is, as respondents simply nominate a particular box to answer questions, no value judgments are required.

A simple-dichotonomy IT services evaluation questionnaire will be developed and administered to the participants: the pre-ITIL test (pretest) and post-ITIL test (posttest). A simple-dichotonomy question requires the respodent to choose two alternatives (Yes and No) [23]. Both tests will contain the same questions related to the IT services that need to be evaluated.

In order to analyze the data from the questions, and ascertain the general trends, descriptive statistics methods are used. The hypothesis that the ITIL framework helps to improve processes of the IT services is tested by using the *t* Test for comparing the mean values of the pre-ITIL test and post ITIL test [23] to find the evidence of a possible effect of the ITIL framework in improving the quality of services.

3 Process Analysis

The case study has ten dental clinics in different locations of Liverpool. All these clinics are connected via a high-speed Wide Area Network (WAN). The data is centralized into the IBM RS 6000 server located in the main dental center. Workstations are located in the user office and they are connected through the same network as well (Table 1).

After analyzing the documents that describe the current operation of IT service for the case study and the problem logs reported by the users, the researcher was able to model the current mode of operation and recommend changes to them based on the ITIL guidelines.

3.1 Service Desk

3.1.1 Current Practice

A support hotline was established that uses a Single Point of Contact (SPOC) for all incidents, as follows:

3.1.2 Problems

- In Fig. 3, the general users follow the reporting path whereas the senior users by-pass it. The incident will not be logged and the communication among the supporting team members may also break down.
- The general users are not well aware of the scope of hotline support. Often, some out-of-scope incidents are not served by the support hotline, and some incidents are not requested that need of customers are not delivered to the

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 8/31

Table 1 Scopes of the IT services provided to the case study

Services	Description
Application support	Provision of application support services on all matters related to the application systems, e.g. answering phone, fax, e-mail, written request and so on.
System maintenance	Bug fixing
	Minor system modification and minor data conversion
	Problem diagnosis
	Documentation update
System monitoring and optimization	Periodic system performance monitoring and tuning on the application system
Production support and ad-hoc processing requests	Liaise with relevant parties to collect and analyze user requirements
	Perform data extraction
	Answer the enquiries on the system data
Environment and operation support	Perform backup and recovery if needed
	Assist system software upgrade and patches
Procurement support	Provide support and advice
	For capacity planning
	On potential technology substitution and cost estimations
	On hardware/software installation and relocation
Planning, drill test and support for disaster recovery and business resumption	Conduct annual disaster recovery and business resumption drill
	Assist in resumption of business and application in case of disaster
Project management and reports	Prepare relevant papers and minutes to management for advice, approval and endorsement
	Prepare periodic progress reports for system performance and achievement
	Coordinate and attend project related meetings
	Prepare agenda, minute and other related document

support team. IT infrastructure and scope of services should enable its users to customize their expectations. Any suggestions for enhancement should be encouraged for improving and maintaining a right balance among people, processes and technology.

3.1.3 Recommendations to Benchmark the Case Study Practice with ITIL

Based on the ITIL framework, recommendations to the existing system following guidelines of ITIL framework have been provided. Guidelines (GL) of ITIL framework for service desk are provided in Fig. 4.

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 9/31

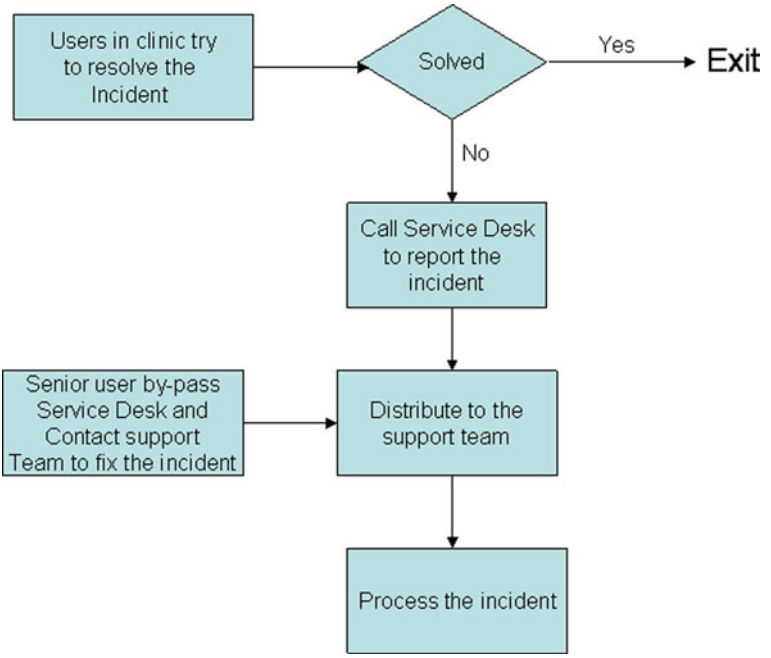

Fig. 3 Current practice of service desk

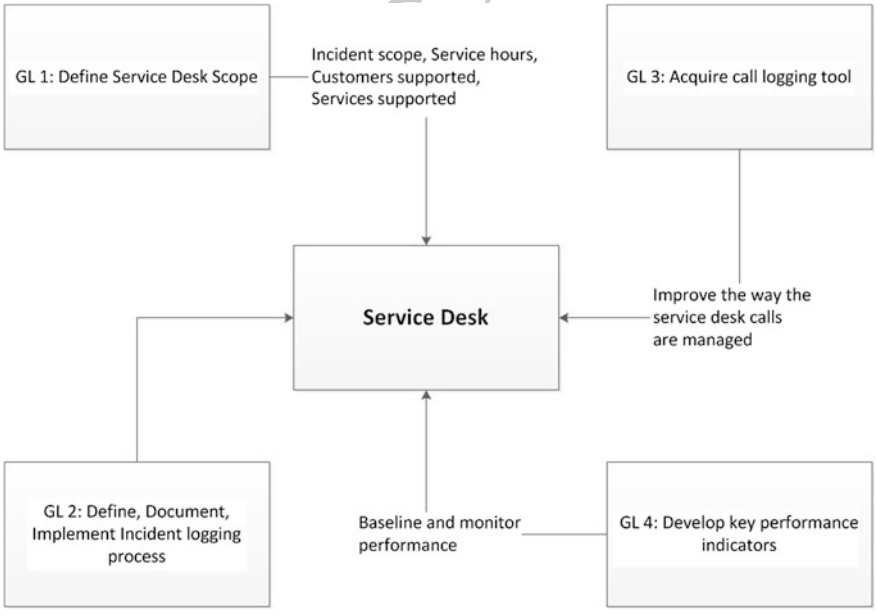

Fig. 4 Service desk guidelines

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 10/31

According to GL 1 in Fig. 4, SMISS system should define:

- Service hours
- Contact point after service hours including mobile phone, email and paper
- Scope of services
- Problem incidents including hardware, software, application and office automation,
- Change request,
- Ad-hoc query, and
- Coordinate with the supplier (of h/w and s/w) for procurement and maintenance issues
- Nature of incidents
- Application Help Desk—dedicated support staff in normal office hour with mobile phone support after office hour.
- "Fire" Fighting—solve emergency problem.
- Problem management—solves any application problem and coordinates with other suppliers to solve any product problem that affects SMISS operation.
- System Administration—provide server, LAN and database administration.
- Ad-hoc processing request—Data Analysis and Extraction.
- Minor enhancement—impact analysis and implementation of enhancement with effort not more than 10 man days.
- Management Activities—proved change, capacity, availability and service continuity management.

According to GL 2 in Fig. 4, the recommendations to the call logging procedure are:

- Contact points of business user, IT representative, clinic contact, hardware and software supplier and network provider are maintained in the list of contacts for Service Desk. For strategic and direction issue, the members in the maintenance board are the key users. There is already a need to improve the message system in the application for broadcasting and point-to-point communication. For support service, it can be helpful for announcing of event and activity that can improve the call efficiency.
- Incident reported through any channel should be logged by the service desk to enforce the "single point of contact". The dissemination of the incident is performed by the service desk accordingly.
- For incidents classified medium and severe, the service desk supervisor should call the users to check the satisfaction of the solution.

According to GL 3 in Fig. 4, Microsoft Excel is used to keep the call logs. Excel macro can be used to facilitate the log entry and to generate the statistics.

According to GL 4 in Fig. 4, the key performance indicators (KPI) to measure Service Desk are:

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 11/31

- Time to log the incident to the incident log database for calls via email, phone, or voice mail,
- Time to acknowledge the user,
- Time to categorize and prioritize the incident,
- Time to start the resolving action,
- Time to complete the action, and
- Percentage of number of satisfaction over the number of medium and high priority incidents.

3.2 Incident Management

3.2.1 Current Practice

Incident handling procedure was established to handle incidents. (Refer to Fig. 5)

3.2.2 Problems

- The logging information was not enough to measure the performance against the server level requirement. There was no escalation procedure defined and support team performance was not measured by any key performance indicator.
- Each service desk staff actually maintained a separate log. The incidents were discussed and prioritized by the Change Advisory Board, but other users were not able to learn the status of the incident being reported.

3.2.3 Recommendations to Benchmark Case Study Practice with ITIL

Based on the ITIL framework, recommendations to the existing system following guidelines of ITIL framework have been provided.

According to GL 1 in Fig. 6, SMISS system should define:

- Maintain centralized database for incident log using the Excel
- Content of the incident log should include
- Unique identity number
- Report date and time
- Log date and time
- Type of call (written, phone, voice message or verbal)
- Nature of incident (enhancement, ad-hoc request, hardware, software, network, application)
- Acknowledgement date and time
- Priority
- Time to return to office in case of non office hour

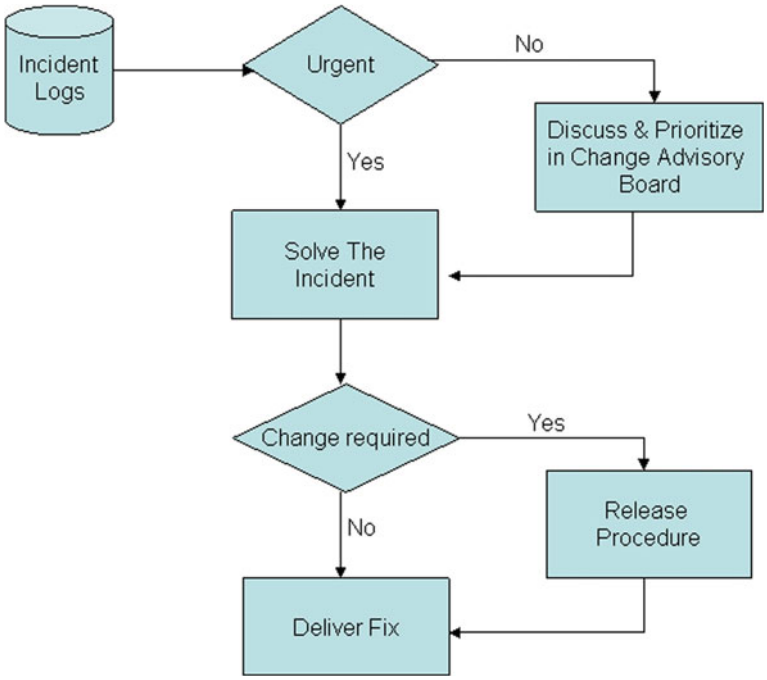

Fig. 5 Current practice of incident management

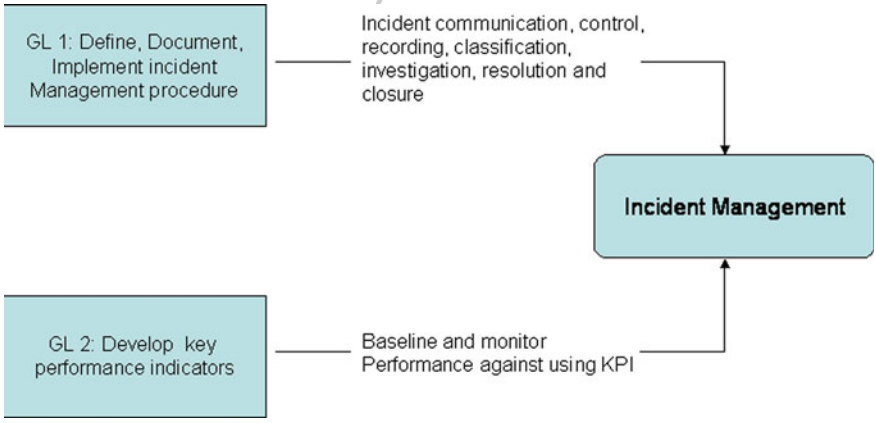

Fig. 6 Incident management guidelines

- Date and time to determine priority of the incident
- Date and time of written reply
- Date and time of analysis result completed
- Date and time of resolution

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 13/31

- Resolution
- Date and time of third party complete the case (resolution is calling the third party)
- Down time and number of workstations affected
- Staff codes perform the receiving, logging, acknowledgement and resolving the incident
- Unique identity number of the configuration item
- Effort estimation
- Effort spent
- Type of the incident
- Application (custom developed programs)
- Hardware
- Software (for example, operating system or system software)
- Network
- Ad-hoc query
- Enhancement
- Query about office automation tool
- Query about application usage
- Other
- Priority of the incident
- Urgent (complete as soon as possible)
- High (complete in 3 days)
- Medium (complete in 2 weeks)
- Low (complete in 2 months)
- Escalation procedure by reporting to support team manager if the incident cannot be solved within the period defined.
- Incidents log is posted to the Intranet site so that users are able to inquire the status of the incident in the log.

According to GL 2 in Fig. 6, the followings are the KPIs for Incident Management:

- number of incidents in open state,
- number of incidents reported within the month,
- number of incidents solved within the month, and
- number of incidents in closing state.

3.3 Change Management

3.3.1 Current Practice

The change management procedure which was established, addresses any change requests required as a result of incident logs, as follows. (Refer to Fig. 7)

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 14/31

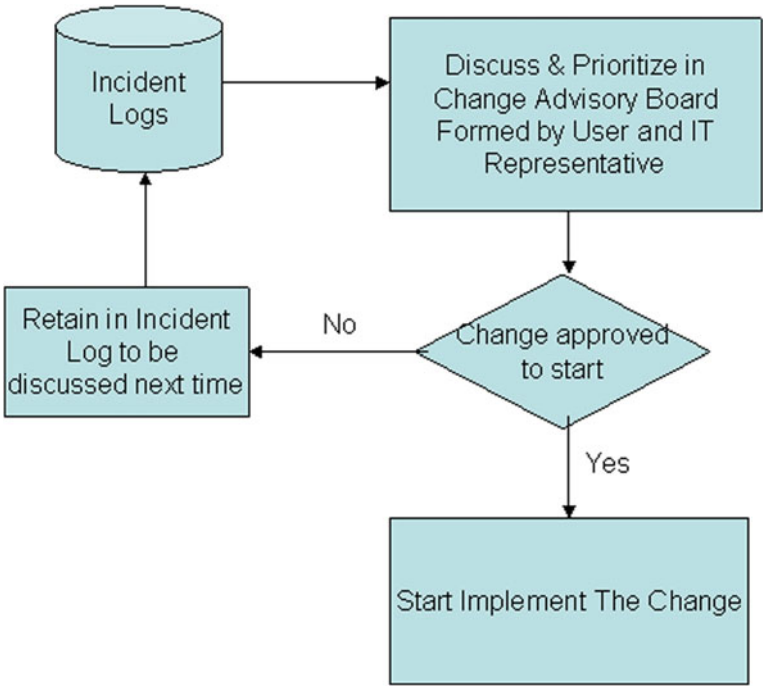

Fig. 7 Current practice of change management

3.3.2 Problems

- The maintenance board doesn't have representative from all functional groups which means, some decisions cannot be made effectively and efficiently.
- The procedure for issuing Request For Change (RFC) is specified; however the duplicated and unpractical requests were not filtered before passing to the Change Advisory Board (CAB). The impact analysis could estimate the effort and the scheduled delay for implementation; however such impact analysis was not conducted.
- There were no key performance indicators for measuring the changes in the system performance.

3.3.3 Recommendations to Benchmark Case Study Practice with ITIL

Based on the ITIL framework, recommendations to the existing system, following the guidelines of ITIL framework have been provided.

According to GL1 in Fig. 8, SMISS system should define scope of CAB:

- CAB should be composed of representative from IT department and staff from each clinic. The agenda and incidents to be discussed will be distributed before

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 15/31

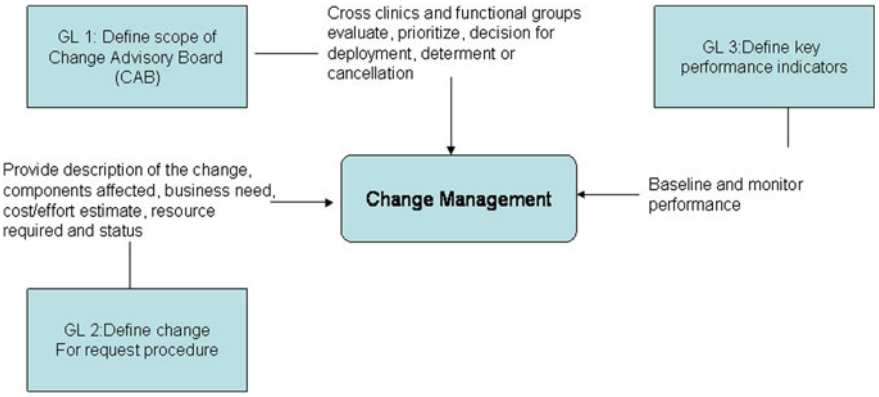

Fig. 8 Change management guidelines

CAB meeting and each functional group should arrange a representative to attend the meeting. The CAB will make decisions for deployment, further analysis, approval or cancellation of changes.

According to GL2 in Fig. 6, the procedure of Request for Change (RFC) should be:

- Incidents that need change should be reviewed before the CAB meeting. Any duplication and unnecessary incidents should be filtered. The status of the filtered incidents will be distributed to the CAB members and the requestor.
- The board should analyze the technical and business impact of the request. The analysis result should be assessed by the CAB.
- If the man-days required exceed the scheduled limit (5 man-days) for the service that will affect the normal support service, then the CAB should determine whether to acquire extra budget for the request or to do it with support team resource but it has lower priority than the service request.
- Change for request should be issued after CAB approves the request. The priority of change request should be high, medium or low. The rollout schedule should also be determined by the CAB. The rollout schedule should be documented and distributed.

According to GL3 in Fig. 6, the followings are the KPIs for Change Management:

- number of failed changes implemented,
- number of emergency changes implemented,
- number of occurrences of the process being circumvented,
- percentages of these numbers, and
- critical level of percentage to be defined and it should be escalated once the level is reached (Fig. 9).

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Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 16/31

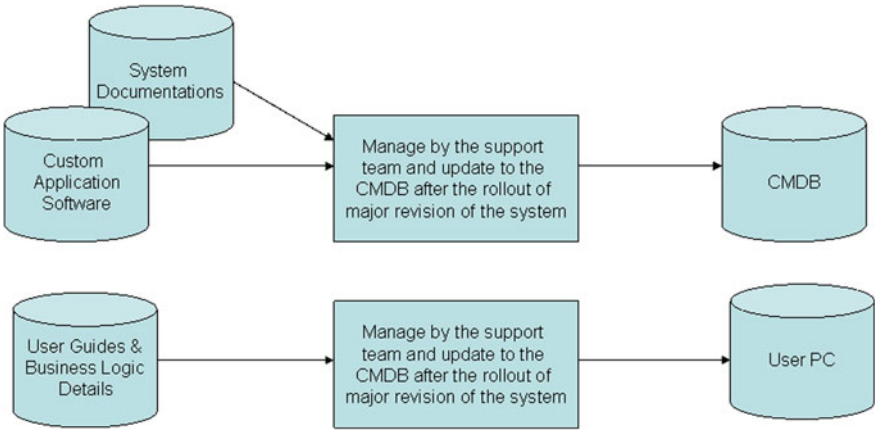

Fig. 9 Current practice of configuration management

3.4 Configuration Management

3.4.1 Current Practice

Problems

- Hardware item was not included in the database since the configuration information of hardware was not available.
- Change Management Database (CMDB) and user prepared materials were not stored centrally and not shared by related parties, and the materials prepared between the parties were not related.
- There were no change records to the configuration items (CIs). The accuracy of the CMDB was not ensured.

3.4.2 Recommendations to Benchmark Case Study Practice with ITIL

Based on the ITIL framework, recommendations to the existing system, following guidelines of ITIL framework have been provided.

According to GL 1 in Fig. 10, SMISS system should prepare configuration management planning:

- Identify the configuration items
  - Hardware—workstation, monitor, printers, external disk, tape, uninterrupted power supply, server, printer, bar code scanner, Chinese input device and rack.

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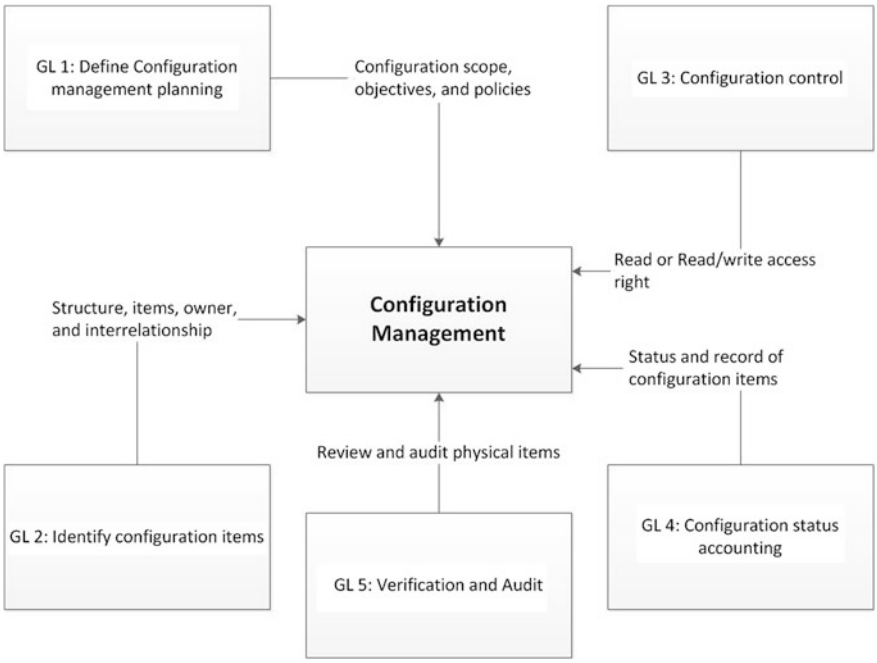


Fig. 10 Configuration management guidelines

  - Software—operating system, database server, development tool, version control software. These are the software developed by other vendors for general use.
  - Program source—all UNIX and Windows programs custom developed for the customer that the support service is being provided.
  - Job script—job scripts to apply change to the production environment.
  - System documentation—meeting minute and agenda, incident log, feasibility study, proposal, project plan, analysis & design, system specification, program specification, operation manual, test plan and result, acceptance, approval forms of change implementation, and impact analysis.
- Deployed version control tool to manage the softcopy configuration items. The Software, Program Source, Job Script and System Documentations are stored and protected in a Definitive Software Library (DSL). Standardized configurations of Hardware are stored in the Definitive Hardware Store (DHS).
- CMDB is made ready in the Intranet site to enable user inquiry.

According to GL 2 in Fig. 10, SMISS system should establish the followings configuration structure:

- Identity the owner of the CIs.
- Grant different access right to Read or Read/Write of the CIs.
- Group the materials according to the item types defined; they are Hardware, Software, Program Source, Job Script and System Documentation. For example,

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 18/31

the user guide and business logic description prepared by user should be grouped under system documentation.

According to GL 3 in Fig. 10, the following controls should be applied:

- A unique identity code is assigned to each CI.
- The identity code is kept in the incident, problem logs and release document as records to the change of the CIs

According to GL 4 in Fig. 10, status accounting should be performed:

- A quarterly configuration status accounting will be performed to report the status of the CIs. The report should include the version number, check in/check out officer, check in date, check out date, baseline date and version for all the CIs.

According to GL 5 in Fig. 10, verification and audit should be performed:

- A yearly configuration audit will be performed for proper execution of the configuration management. The physical CIs will be verified with the CMDB to check if it matches with the change request and rollout log, and whether the items in the version are all included. Then the configuration activities will be verified to see if all planned activities are conducted accordingly.
- For hardware and software, a yearly audit will be performed to check the labeling and the information regarding the inventory is correct and matches with the information in the CMDB (Fig. 11).

3.5 Release Management

3.5.1 Current Practice

Problems

- There was no release policy; and the support team performed as many changes as possible for each release. Usually the low priority RFCs were left outstanding.
- There was no policy for Hardware and System software upgrades.
- There was no communication to the users about the changes in each release.
- There was no fallback plan in case of unsuccessful releases. There was no plan to merge the emergency fixes and into normal releases.
- Distribution and installation of new releases were error prone since every workstation has to be installed separately.

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 19/31

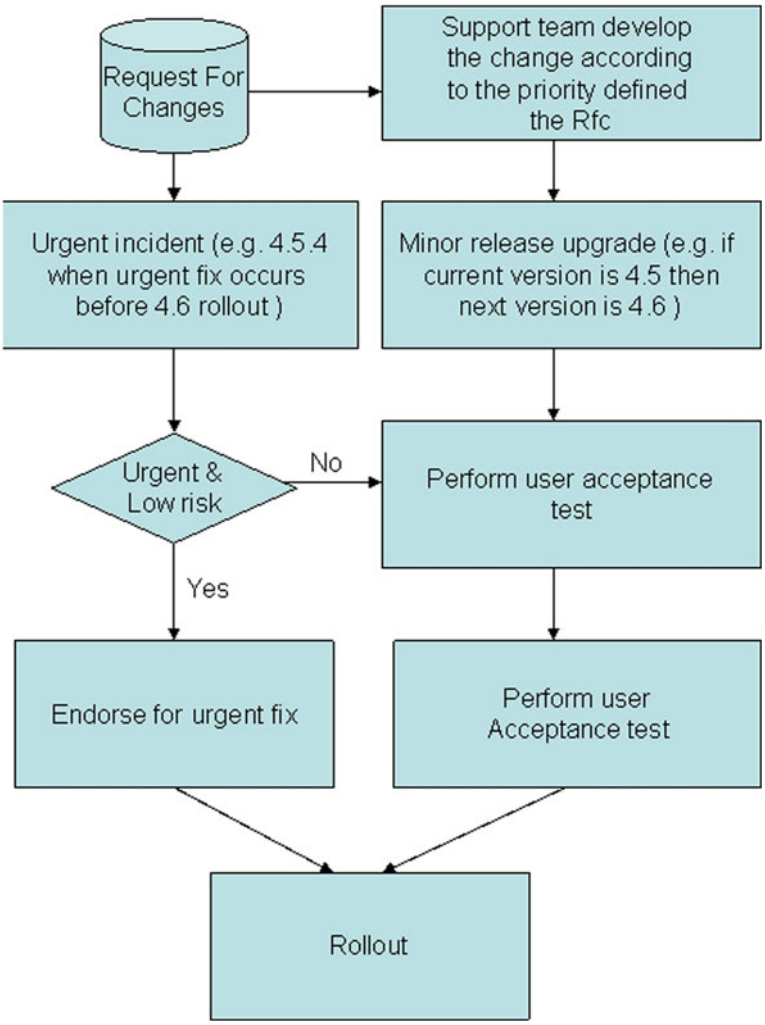


Fig. 11 Current Practice of Release Management

3.5.2 Recommendations to Benchmark the Case Study Practice with ITIL

Based on the ITIL framework, recommendations to the existing system following guidelines of ITIL framework have been provided.

According to GL 1 in Fig. 12, SMISS system should have the following release policy:

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 20/31

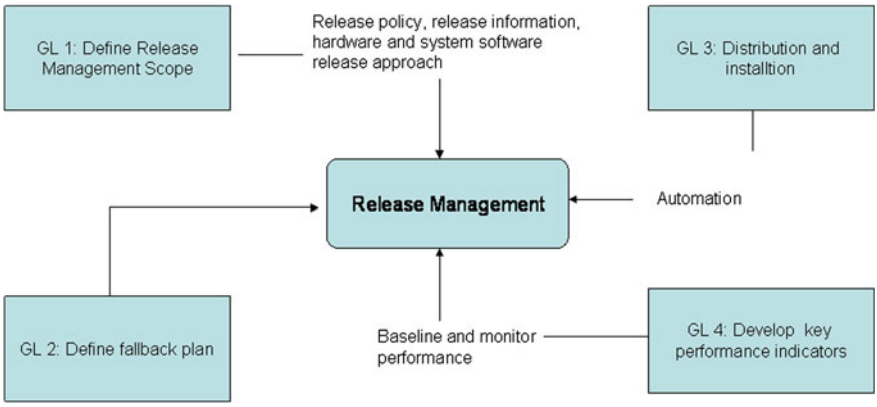


Fig. 12 Release management guidelines

- Adopt Package Releases, each consisting a series of changes of high and low priority requests. The high priority requests should be completed before any of low priority requests.
- Prepare rollout schedule and put it in the Intranet and make available to all users.
- Hardware and system software upgrades (e.g. a Windows patch) must be tested on pilot workstation before a full rollout. The pilot test should be conducted on a frequently used workstation for a period of at least 2 weeks to prove that the upgrade is working and stable.

According to GL 2 in Fig. 12, a fallback plan should be established:

- Use version control tool to keep the previous release for fallback use.
- Compare the urgent fix version with the next release; apply the delta to the next release.
- Retrieve correct previous release in case of fallback.

According to GL 3 in Fig. 12, distribution and installation should be enhanced:

- Inform user of the release and the content in 2 days in advance.
- Automate the distribution and installation by developing an auto-installation module to the system. The module upgrades the workstation module once a new version is found.

According to GL 4 in Fig. 12, the followings are the KPIs for Incident Management:

- number of problem incidents caused, and
- number of occurrences of the process being circumvented.

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 21/31

3.6 Problem Management

3.6.1 Current Practice

The current practice of Service Management Information Support System (SMISS) was mainly reactive, i.e. the support team solved the reported incidents. There was no procedure defined for proactive problem management (PM).

3.6.2 Problems

- The number of incidents was not reduced and the system could not be stabilized.
- Users stopped reporting the repeated incidents and restarted the system to solve the incidents. User satisfaction dropped and blamed the system informally.
- Support team prepared the data extraction manually for each clinic and repeated periodically. User data services effort was not reduced.

3.6.3 Recommendations to Benchmark Case Study Practice with ITIL

Based on the ITIL framework, recommendations to the existing system following guidelines of ITIL framework have been provided.

According to GL 1 in Fig. 13, SMISS system should define a reactive problem management, as follows:

- Conduct monthly review incidents should identify chronic problems by verifying the number of occurrences of the same or similar incidents.
- Build a problem log database using a unique reference number for each problem. This number is updated to the incidents log and incident number should be updated to the problem log for cross reference. It is possible to have multiple incidents pointing to the same problem. The problem log should have the following attributes:
  - Problem reference number
  - Date and time of creation
  - Date and time of solution
  - Created by
  - Solved by
  - Major type (hardware, software or network)
  - Minor type (for example servers, workstation, MS word or router)
  - Supplier (for example, Microsoft or CISCO)
  - Description of problem
  - Incident numbers

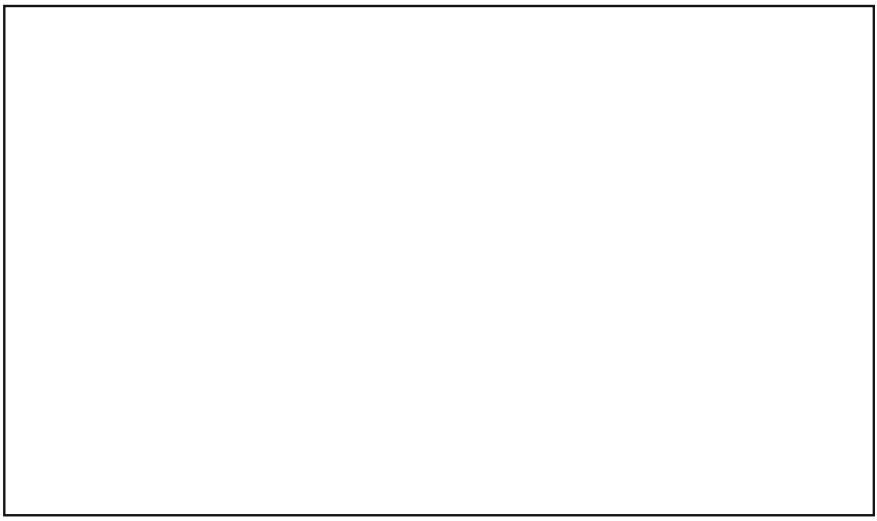


Fig. 13

According to GL 2 in Fig. 13, SMISS system should define a proactive problem management. In general, the problems that are related to the network and CPU, could gradually downgrade the system performance. Users report incidents related to system performance when it becomes unacceptable. The resource utilization trend should be monitored to determine if the system (network or CPU) performance has fallen below an acceptable threshold.

- Build in-house technical focus groups. A focus group for SMISS could monitor:
  - Windows,
  - Unix,
  - Web,
  - Development tool, or a
  - Database.
- A focus group will be able to solve any technical incidents more efficiently in a proactive manner. The focus group should keep the support team informed of any possible problems that could occur in a timely manner.

According to GL 3 in Fig. 13, the KPIs are:

- Number of incidents,
- Average number of incidents related to a problem, and
- Number of problems.

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 23/31

4 ITIL Framework Implementation, Testing and Results

SMISS is a nursing information system developed with the Microsoft Visual Studio development tools. It runs under the Windows operating system; and the workstations are distributed in a local area network. In July 2010, a group of SMISS users and IT representatives were invited to discuss the implementation of ITIL practice as a case study for improving the service. At least one user from each clinic was invited to participate in this discussion (Fig. 14).

Microsoft provides package guidance called Microsoft Operation Framework (MOF) that enables organizations to achieve mission-critical system reliability, availability, supportability, and manageability of IT solutions that are built with Microsoft technologies. To achieve the operations excellence, Microsoft combines the ITIL best practices into MOF, and extends MOF to follow the ITIL code of practice. The MOF provides assessment templates with a set of questions with yes/no answers. Operation guidelines are provided to help users to answer these questions. The questionnaire concerning various performance criteria was prepared using the MOF assessment template. Because the questionnaire has been used before as a successful tool to measure the level of effectiveness of the IT services in an organization according to the MOF guidelines, the answers that were collected from the selected group of users can represent as an important test tool for the system.

All ITIL functions and processes are tested in this chapter except the Financial Management because the simplified data communication and Sharing (SDCS) adopts the financial processes according to the Government practice. At the same period of this research, there was a security audit process conducted by a third party vendor, as well. Most of the users in the test group were also participated in the security audit process to measure the level of effectiveness of Security Management.

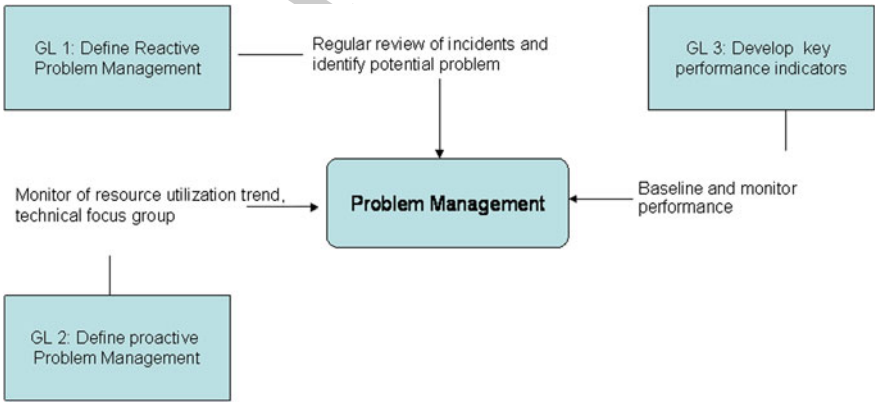


Fig. 14 Problem management guidelines

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 24/31

Table 2 Frequency distribution of service desk result

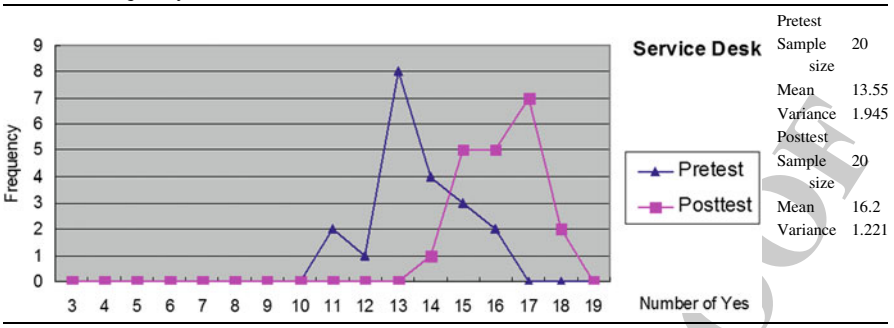
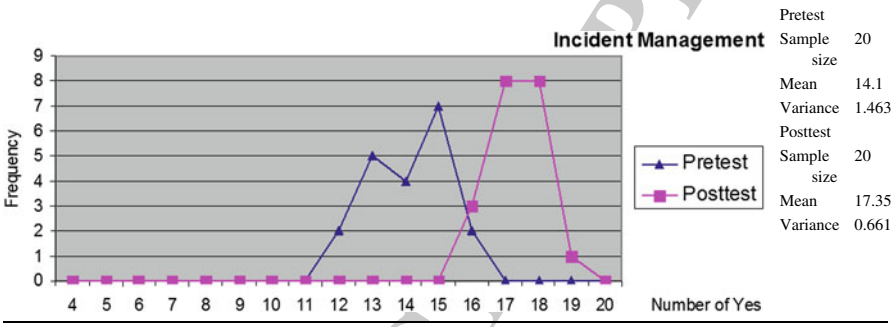


Table 3 Frequency distribution of incident management



In November 2010, the same group of SMISS users and IT representatives were invited to participate in the research to collect the posttest data. The answers to pretest and posttest data using the same questionnaire are presented in Tables 2 and 3, respectively. The questionnaire was formatted in such a way that the ITIL functions and processes. The count of positive feedback is presented in the following frequency distribution table, with statistics such as mean and variance.

The mean values of pretest and posttest results are compared to check if there is an improvement in the positive feedback to the concerned support service. The mean values were tested using the t-Student test, and the *t*-values were calculated by using the formula below [23]

$$\text{t - value} = (\text{Mean of posttest} - \text{Mean of pretest})/ \text{square root}(\text{Variance of posttest} / \text{Sample size of posttest} + \text{Variance of pretest} / \text{Sample size of pretest})$$

Alpha level = 0.05 of one tail test

Degree of freedom = sample size of pretest + sample size of posttest—2 = 38

According t-distribution significance table, the critical value is 1.684 for one tail test.

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 25/31

Null Hypothesis—there is no difference between the pretest and posttest sample means for each of ITIL function and processes.

The table presented the percentage of Yes, before and after implementing ITIL framework which indicates the effect of ITIL and the improvement achieved. From the above table, the null hypothesis of no difference between pretest and posttest mean values for PM, SLM and SM are accepted, which implies that means there is no change in the positive feedback from the test group after the ITIL practices are implemented. The null hypothesis of the other ITIL processes is rejected since the mean values of posttest are larger than the mean values of pretest. It can be concluded that the test group shows more positive feedback after the ITIL practices are implemented (Tables 4–13).

The *t*-value analysis further concludes whether the improvement is significant or not. Then, the processes can be grouped as follows:

Significantly improved—D, IM, CnM, ChM, RM, CAP, AVM and Sec Not improved—PM, SLM and SM

The t-test demonstrates whether the effect of the implementation of the ITIL practice guidelines into the service process improved the satisfaction of the test group, or not. To determine which process has to be further improved, the percentage of positive feedback is used. By setting targets of 80 %, the PM, SLM and

Table 4 frequency distribution of problem management

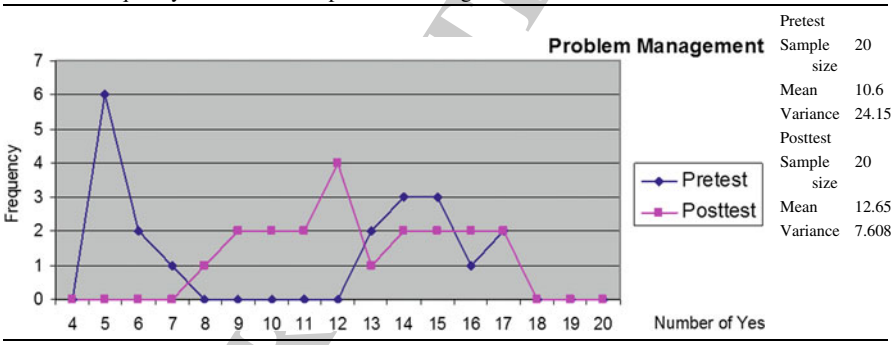


Table 5 Frequency distribution of configuration management

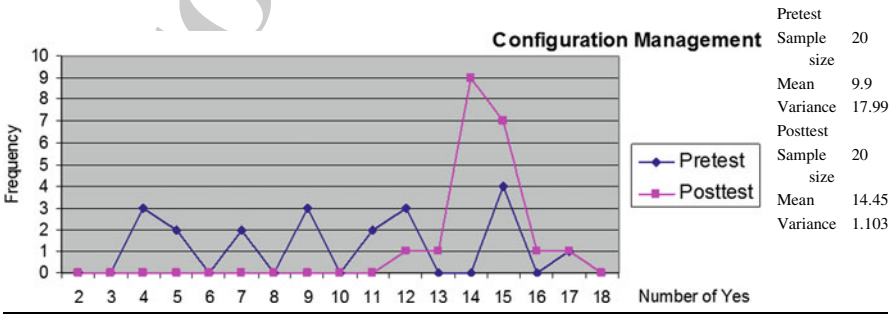


Table 6 Frequency distribution of change management

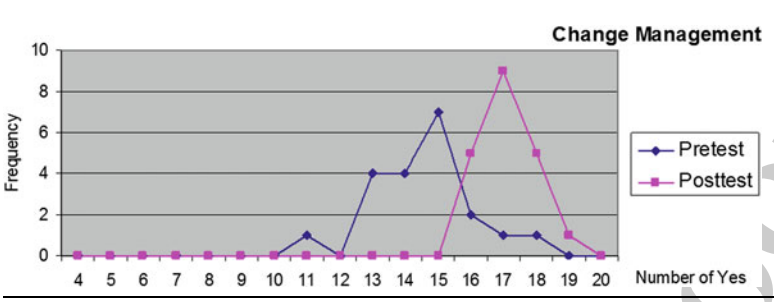


Table 7 Frequency distribution of release management

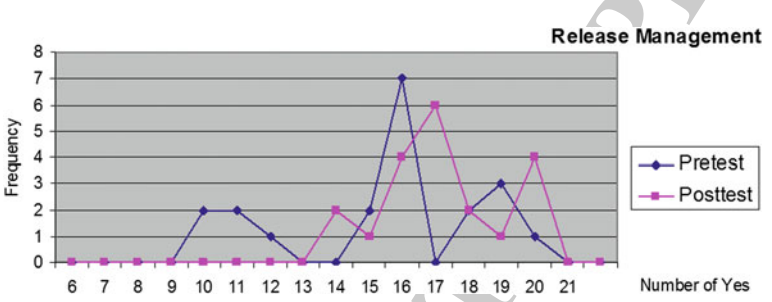
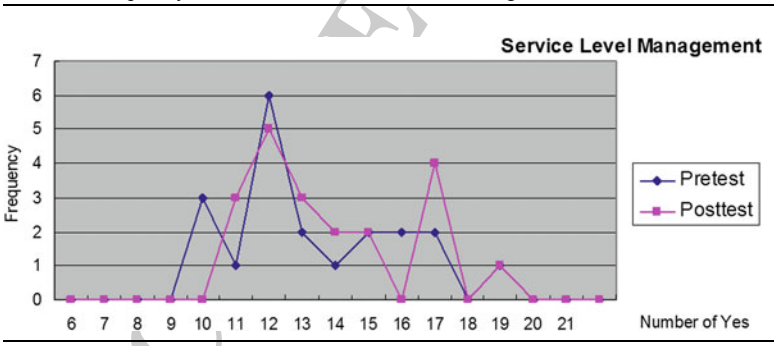
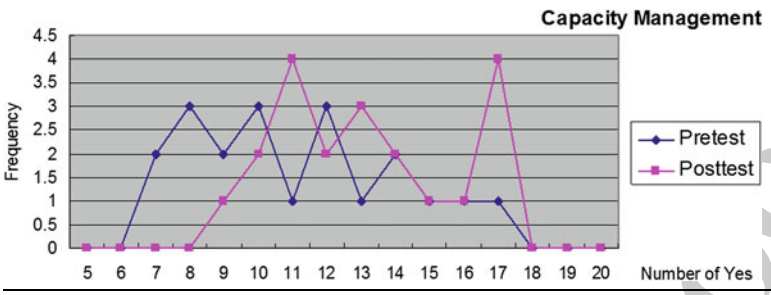


Table 8 Frequency distribution of service level management



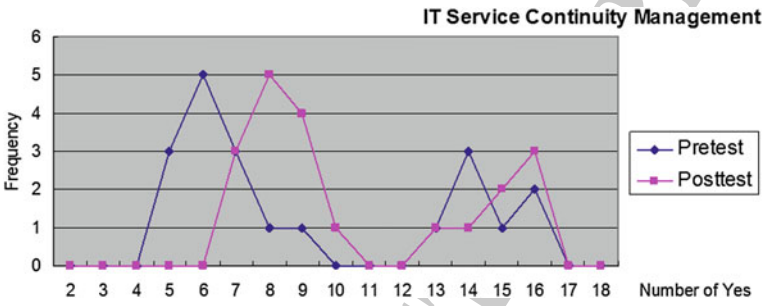
SM have to be further improved. The SM is the only process that has a pretest percentage over 80 %; the third party security audit could be the reason for the scenario and the test of SM cannot be concluded.

Table 9 Frequency distribution of capacity management



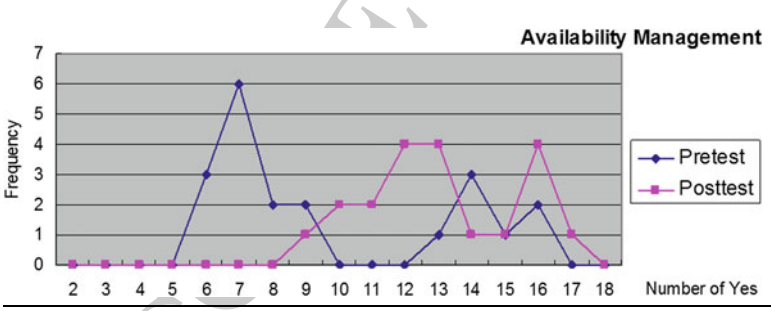
Pretest	
Sample size	20
Mean	11.1
Variance	9.042
Posttest	
Sample size	20
Mean	13.15
Variance	6.871

Table 10 frequency distribution of IT service continuity management



Pretest	
Sample size	20
Mean	9.25
Variance	17.36
Posttest	
Sample size	20
Mean	10.6
Variance	11.94

Table 11 Frequency distribution of availability management



Pretest	
Sample size	20
Mean	9.8
Variance	13.96
Posttest	
Sample size	20
Mean	13.05
Variance	5.418

5 DSS Interface to IT Service Support

The ITIL provides a framework for operations and infrastructure while the CMMI (capability maturity model integration) provides a set of improvement goals and a point of reference for appraising current processes. Both CMMI and ITIL improve

Table 12 Frequency distribution of security management

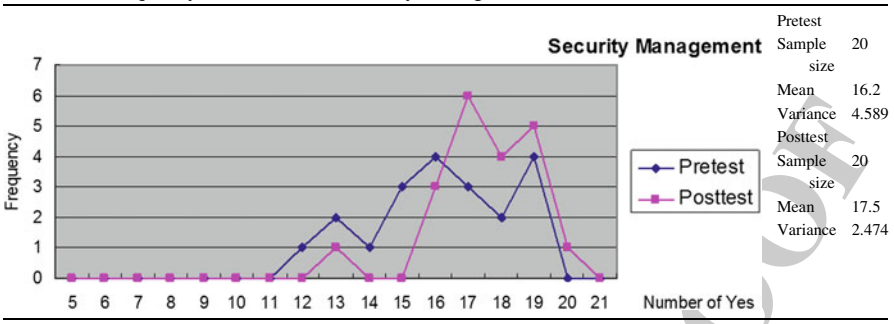


Table 13 Null hypothesis of the services

	Pretest			Posttest				
	% of Yes (%)	Mean	Variance	% of Yes (%)	Mean	Variance	*t*-value	Null hypothesis
SD	75	13.55	1.9447	90	16.2	1.2211	6.661	Reject
IM	74	14.1	1.4632	91	17.35	0.6605	9.974	Reject
PM	56	10.6	24.147	67	12.65	7.6079	1.627	Accept
CnM	58	9.9	17.989	85	14.45	1.1026	4.657	Reject
ChM	77	14.55	2.4711	90	17.1	0.7263	6.378	Reject
RM	74	15.45	9.7342	82	17.2	3.5368	2.148	Reject
SLM	64	13.4	6.7789	66	13.85	5.9237	0.565	Accept
CAP	58	11.1	9.0421	69	13.15	6.8711	2.298	Reject
SM	54	9.25	17.355	62	10.6	11.937	1.116	Accept
AVM	58	9.8	13.958	77	13.05	5.4184	3.302	Reject
Sec	81	16.2	4.5895	88	17.5	2.4737	2.188	Reject

SD Service Desk, *IM* Incident Management, *PM* Problem Management, *CnM* Configuration Management, *ChM* Change Management, *RM* Release Management, *SLM* Service Level Management, *CAP* Capacity Management, *SM* IT Service Continuity Management, *AVM* Availability Management, *Sec* Security Management, *% of Yes* percentage of positive answer for the group

the IT service support process as they improve software quality and decrease the cost of quality software system. The decision making process requires both knowledge and information. The knowledge management process involves gathering, analyzing, storing, and sharing knowledge and information within the organization [27]. Information provides clues to resolve an uncertainty and complexity of an issue, while the knowledge helps in understanding the ambiguity around the issues. A decision support system aids in decision making under the conditions of uncertainty and complexity [28].

The IT support process reengineering is an ongoing process, which requires a continuous monitoring of the KPIs at an operational level and tactical level. The various targets such as green light, yellow light, and red light signals can be established for each KPI. Recent advancements in the telecommunications and

Layout: T1 Standard SC | Book ID: 305166_1_En | Book ISBN: 978-3-642-39927-5
Chapter No.: 3 | Date: 22-7-2013 | Page: 29/31

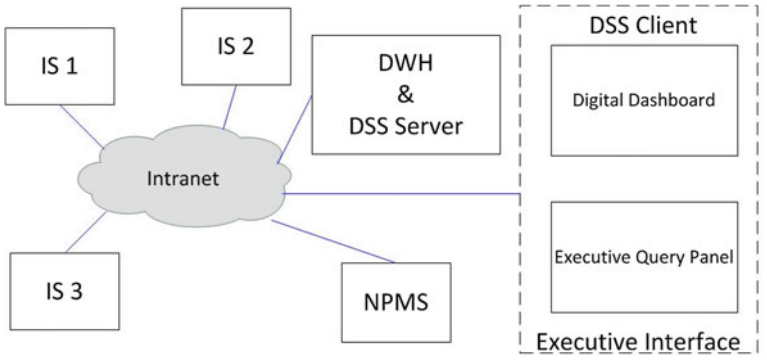


Fig. 15 Decision support system

computer networking technologies are able to connect any distant and disparate systems together, making it possible to control a remote system from anywhere, based on decisions made in effective management of IT service support process. A decision support system continuously monitors the KPIs and signals appropriate actions that can be performed on any remote system as depicted in Fig. 15.

The software components of Intranet and the information systems (IS) connected to it, are managed by the network performance management system (NPMS). A data warehouse (DWH) system is also connected to the network that extracts, transforms and loads (ETL) all needed data related to the KPIs of IT service support process. The Decision Support Server (DSS) again interfaces with the DWH builds the KPIs of IT service support process and displays them on a digital dashboard of an IT executive responsible for supporting all IT services. Both DWH and DSS server can be housed on the same hardware platform for simplicity or on different systems that are connected together. An IT executive who manages IT service support process runs a DSS client that provides a realtime digital dashboard with all KPIs and alarms suggesting IT service actions. Furthermore, the executive can also perform queries for addional information if needed. The proposed DSS application futher improves the IT service support process and serves as tool for an effective on-going reengineering of IT service support process.

6 Conclusions

Although the results of all KPIs examined in this case study have demonstrated some improvement, it did not fully meet our initial expectations, as some of the processes did not have significant improvement. There are two major possible explanations for this outcome pattern. Firstly, the duration of the test is not long enough for the test group to experience ample improvement. For example, there

were no major in SM upgrades performed during the test period. Secondly, some of the intended process reengineering efforts couldn't be fully implemented during the period of this case study, as it required more time, effort, and budget. For example, the Problem Management required a focus group and a pool of technical expertise that was not possible during the pilot project. However, a case study like this one serves as a trigger for major reengineering of business processes. It could motivate the senior management to allocate appropriate budget, and plan a gradual implementation of process reengineering. The ITIL framework consists of a well evaluated, explored and maintained set of guidelines. It certainly serves a tool for exploring process reengineering and improvements while meeting the budget constraints. The case study required a lot of coordination and consensus while identifying process improvements, establishing a process reengineering methodology, and constructing questionnaires for process evaluation.

The experience gained in a case study like this one can alleviate the possibility of expensive mistakes if a major process reengineering is initiated at once. Actually, the customer company appreciated the efforts in this case study, well received, and motivated for further reengineering of companywide processes. The chapter also proposed a comprehensive DSS client/server system which further improves the IT service support process in reading real time KPIs and IT service actions. Further work to this research can focus on automatic implementation of IT service support actions based on DSS signals.

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