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Best practices for Network Infrastructure Management – a case study of IT Infrastructure Library (ITIL)

Helsinki University of Technology Abstract of the Master's Thesis

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Abstract:

Managing network infrastructure is an important part of delivering IT services to the end-users. Networks play an essential part in the service delivery and while network infrastructures are becoming more complex it is vital that the processes for the Network Infrastructure exist and function effectively.

In this thesis I will construct and present processes for Network Infrastructure Management for company with thousands of users scattered globally. The solution is based on IT Infrastructure Library (ITIL) Change and Configuration Management best practice guidance. Integral part of this solution is also to introduce a structure to Configuration Management Database (CMDB), which holds the information and relationships of the network infrastructure. Focus is in the network management support processes, not in the technology to implementing it.

ITIL and specifically Change and Configuration Management are presented in the thesis for background information. Several other ITIL process areas overlap the subject but they are only discussed briefly. ITIL forms the basis for creating Network Infrastructure Management processes for the case study corporation, but it only gives some guidelines for the implementation. More specific approach had to be tailored for the company's use. When processes are in use the network staff can become an internal provider for network support and development for the end users. After processes are documented it is easier to train IT staff for network support and network specialists can focus more on the development side of network management and proactive management rather than just solely reacting on incidents.

Thesis also discusses the difficulties of implementing the new support processes. Processes define the required procedures of people executing Network Infrastructure Management. Resistance to change from local individual ways of managing the network infrastructure to global common ways of executing Network Infrastructure Management is the key problem implementing new processes.

Capability Maturity Model Integration (CMMI) process maturity set is used to define the initial level of maturity for Network Infrastructure Management and also to assess the results of final level of maturity. CMMI presents general areas to focus on when creating support processes. Further development possibilities in the area of Network Infrastructure Management are also assessed.

Keywords: Network Infrastructure Management, ITIL, Configuration Management, Change Management, CMDB

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Tiivistelmä:

Verkkoinfrastruktuurin hallinta on tärkeä osa IT-palvelujen tarjoamista loppukäyttäjille. Tietoverkot näyttelevät välttämätöntä osaa palvelujen toimittamisessa ja koska verkkoinfrastruktuureista on tullut yhä monimutkaisempia on elintärkeää, että verkkoinfrastruktuurin hallinta on olemassa selkeät prosessit, jotka toimivat tehokkaasti.

Tässä diplomityössä luon ja esittelen prosessit verkkoinfrastruktuurin hallintaan yrityksellä, jolla on tuhansia käyttäjiä levittäytyneenä ympäri maailmaa. Ratkaisu perustuu IT Infrastructure Library:n (ITIL) hyödyntämiseen, varsinkin Muutos- ja Konfiguraationhallinnan parhaiden käytäntöjen osalta. Olennainen osa ratkaisua on myös esitellä sopiva Configuration Management Database:n (CMDB) rakenne, jota käytetään verkkoinfrastruktuurin tietojen ja suhteiden varastointiin. Painopiste on verkkoinfrastruktuurin tukiprosesseissa, ei sitä toteuttavassa teknologiassa.

ITIL ja erityisesti Muutoksen- ja Konfiguraationhallinta esitellään tässä työssä taustainformaation saamiseksi ratkaisua varten. Monet muut ITIL prosessi-alueet liittyvät vahvasti aiheeseen, mutta ne esitellään vain lyhyesti. ITIL muodostaa pohjan tapaustutkimusyrityksen verkkoinfrastruktuurin hallinnan prosessien luomiselle, mutta se antaa vain suuntaviivoja siihen. Tarkempi toteutus täytyy räätälöidä kohdeyrityksen mukaan. Kun tukiprosessit ovat käytössä voi verkkotuen henkilöstöstä muodostaa sisäinen toimittaja verkkotuelle ja kehitykselle. Prosessien dokumentoinnin jälkeen on helpompaa kouluttaa uusia verkkotukihenkilöitä ja verkkospesialistit voivat keskittyä enemmän verkkoinfrastruktuurin kehittämiseen ja ennakoivaan verkonhallintaan, aiemmin tapahtuneen pelkän ongelmiin reagoinnin sijaan.

Diplomityö käsittelee myös uusien prosessien käyttöönoton vaikeuksia. Prosessit määrittelevät vaaditus työtavat ihmisille, jotka toteuttavat verkkoinfrastruktuurin hallintaa. Muutosvastarinta muutokselle paikallisesta yksilöllisestä tavasta pitää yllä verkkoinfrastruktuuria globaaleihin yhtenäisiin verkkoinfrastruktuurin hallinnan prosesseihin tulee olemaan iso. Muutosvastarinta tulee olemaan suurin ongelma prosesseja käyttöönotettaessa.

Capability Maturity Model Integration (CMMI) prosessikehitys ohjeistoa käytetään määrittelemään verkkoinfrastruktuurin hallinnan alun kypsyystaso ja myös määrittämään lopullisten tulosten kypsyystasoa. CMMI esittelee yleisiä alueita joihin tulee keskittyä tukiprosesseja luodessa. Verkkoinfrastruktuurin hallinnan jatkokehitysmahdollisuuksia pohditaan myös lopussa.

Avainsanat: Verkkoinfrastruktuurin hallinta, ITIL, Konfiguraation hallinta, Muutoksen hallinta, CMDB

Foreword

This work has been done at Konecranes Group IT department as part of the IT Service Management process implementation project. I wish to thank my professor Jörg Ott for the advice and support he has given me. I would also like to thank my instructor Harri Heinonen for the support.

I am very grateful to my uncle and godfather Atso Mattila for his extensive support and also pushing me forward with the thesis. I want to offer my deepest gratitude for my betrothed Terhi for accepting the long hours that this thesis has required and being a tower of strength for me during the long writing process.

I would also like to thank the music by The Offspring, AFI and Bullet for my Valentine and the group of people supporting disoriented canine for helping me to endure this extensive project.

Espoossa 27.2.2008
Antti Mattila

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Terms and Abbreviations

CCTA	*Central Computer and Telecommunications Agency*, was a UK government agency providing computer and telecoms support to government departments
Change Management	The process responsible for controlling the lifecycle of all changes to IT infrastructure
CI	*Configuration Item*, any component that needs to be managed in order to deliver an IT Service
CMDB	*Configuration Management Database*, a database used to store Configuration Items throughout their lifecycle
CMMI	*Capability Maturity Model Integration*, a process improvement approach developed by Software Engineering Institute (SEI)
COBIT	*Control Objectives for Information and Related Technology*, provides guidance and best practice for the management of IT processes
Configuration Management	The process responsible for maintaining information about Configuration Items throughout their lifecycle
GITMM	(British) *Government Information Technology Infrastructure Management Methology*, direct predececcor of IT Infrastructure Library
ICT	*Information and Communication Technology*, a broad subject concerned with technology, communications and other aspects of managing and processing information
ICT Infrastructure Management	The process of building and maintaining the infrastructure for ICT (Information and Communications Technology)
ISO	*International Organization for Standardization*, an international standard-setting body
IT	*Information Technology*, a broad subject concerned with aspects of managing, editing and processing information
ITIL	*IT Infrastructure Library*, a set of best practice guidance for IT Service Management
ITSM	*IT Service Management*, the implementation and management of quality IT Services that meet the needs of the business
itSMF	*IT Service Management Forum*, an independent organization dedicated to promoting a professional approach to IT Service Management
LAN	*Local Area Network*, a local computer network for communication between computers
MPLS	*Multi-protocol Label Switching*, a data-carrying mechanism in computer networking
Network	Multiple computers and other devices connected together to share information
Network Infrastructure	Architecture, in terms of equipment and connections, that makes up a network
Network Infrastructure Management	The process of building and maintaining the infrastructure of network

OGC	(British) *Office of Government Commerce*, a UK government department that supports the delivery of the government's procurement agenda
QoS	*Quality of Service*, is the ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow
RfC	*Request for Change*, a formal proposal for a change to be made
VPN	*Virtual Private Network*, is a form of communication over networks that are public in ownership, but emulate a private network in terms of security
WLAN	*Wireless Local Area Network*, is a group of computers and associated devices that communicate with each other wirelessly

1 Introduction

Networking enables employees within corporations to work with each together and with people in various locations and businesses elsewhere. It enables contact in entirely new ways and entirely new levels, across the office and right around the world. When the business is properly networked, no one is ever very far away.

The complexity of information networks has been growing very rapidly as virtually every employee is connected to corporate information networks and to the Internet. The extent of this, of course, depends on the type of business. Information networks carry a growing amount of data traffic and, as more services run through networks, the data is becoming more versatile and thus the demand for network management is growing. This has put a great amount of new requirements to enterprise IT departments, including data network administrators and managers. One popular approach has been to outsource network services, but the IT buyer still has to know the requirements and manage them to be fulfilled. These are key elements that have to be in order for outsourcing to be successful. Marcia Robinson states in her book *Offshore Outsourcing* [1] that additional management needed for offshore outsourcing can dilute initial outsourcing savings by 20-30%. Regardless of the network services being outsourced or made in-house, they have to be managed efficiently.

A study by Thomas Mendel [2] states that, on average, the information network causes 15% of all problems resulting in downtime at $1 billion-plus companies. However, only 2% are caused by actual networking hardware failures: The other 13% are due to different issues like human errors, unmanaged changes, misconfigurations, routing failures, and problems with networking software.

Few companies build their network infrastructure without a need for extension or replacement investments in the future. Although network equipment is nowadays usually fairly long-lived the network infrastructure might need replacement investment for other reasons for example, to improve functionality, data rates or response times. This also adds up the needs of effective Network Infrastructure Management, which means the process of building and maintaining the infrastructure of the network.

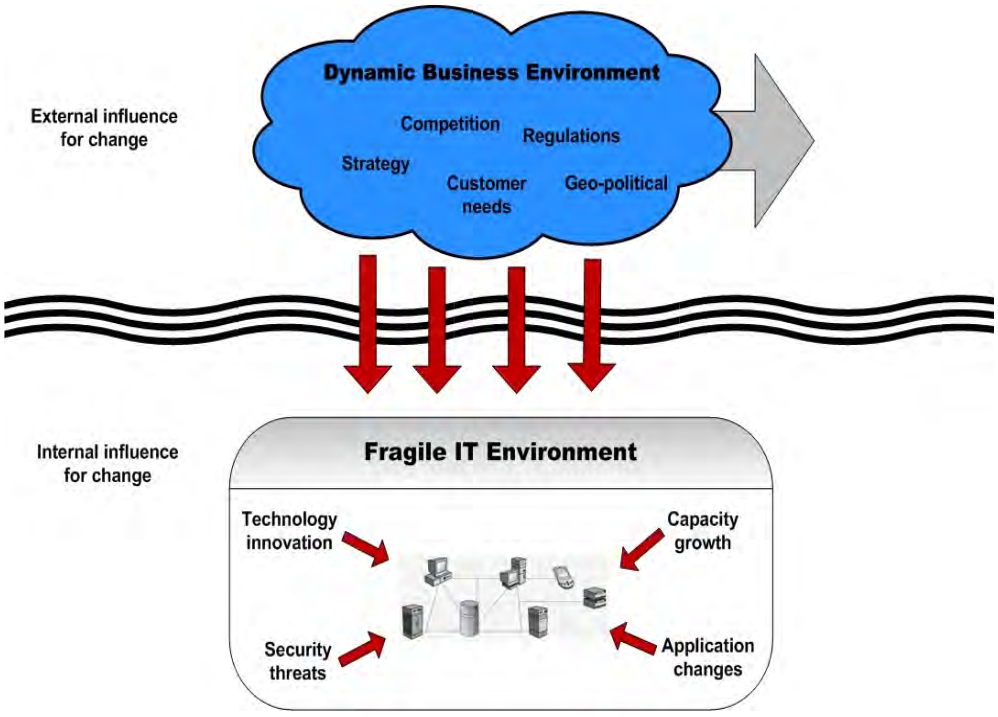

Figure 1 Influences affecting IT infrastructure changes [3]

Network management of large multinational corporations has become so complex that centralized IT infrastructure management solutions are needed. Some driving forces are listed in the *figure 1*. It is easier to buy software than change the way people behave so many IT departments have purchased ample centralized management solutions. Some projects involving the implementation of network management tools have failed because the processes have not changed with the project. This has generated a need for best practices for IT service management. One solution is IT Infrastructure Library, ITIL, which has been developed by British Office of Government Commerce, OGC. ITIL defines best practices for IT service management. One part of ITIL is Information and Communications Technology (ICT) Infrastructure Management, which describes best practices for IT departments to organize processes for managing ICT infrastructure. Data networks are a vital part of this infrastructure.

ITIL Service and ICT Infrastructure Management are also closely linked to the ITIL Change and Configuration Management. Configuration Management Database, CMDB, is an essential part of Infrastructure Management. It is a repository of information related to all components of enterprise information system and is fundamental part of ITIL Configuration Management process. CMDB can be used widely for IT and Network Infrastructure Management.

1.1 Problem Description

The purpose of this thesis is to describe a solution for Network Infrastructure Management using ITIL best practices; essentially Change and Configuration Management processes. Constructing Configuration Management Database (CMDB) in an efficient way regarding Network Infrastructure Management perspective is an important portion of the solution.

This thesis aims at answering the following questions:

- How to construct Network Infrastructure Management processes for a global corporation using ITIL best practice guidance as a background?
- How to construct and describe Change Management process ·to enable common and consistent way of managing changes in the network infrastructure?
- How to construct and describe the Configuration Management process and CMDB so that information about network infrastructure is globally accessible, relationships between infrastructure items are known and the information about the infrastructure is kept up-to-date?

1.2 Content of the Thesis

In this thesis ITIL and ITIL ICT Infrastructure Management are presented first. Also, the related topics ITIL Change and Configuration Management and Configuration Management Database (CMDB) are introduced. A multinational corporation, Konecranes, and its initial state of Network Infrastructure Management before adapting ITIL are presented. Solution for using ITIL best practices for specifically on Network Infrastructure Management using Change and Configuration Management processes is illustrated for Konecranes. Essential part of this solution is Configuration Management Database (CMDB) and processes for successful Network Infrastructure Management.

Network Infrastructure Management is also closely related to network monitoring. According to Haojin Wang [4] network monitoring has two fundamental tasks: monitoring the state of network equipment and reacting to error conditions in the network. Carl Wahlberg discusses network monitoring in his master's thesis [5]. Network monitoring could be used for reporting the functioning of Network Infrastructure Management. Network monitoring is not however included in this thesis.

2 General Concepts

Purpose of this chapter is to introduce general concepts related to this thesis. Network Infrastructure Management is presented first as a concept. ITIL and its most important components related to this thesis, ICT Infrastructure Management, Change Management, Configuration Management and the CMDB are introduced. Survey about ITIL adoption level in the Nordic countries is reported to give a better picture of the current ITIL situation. Also, some basic related concepts, Capability Maturity Model Integration (CMMI), Control Objectives for Information and related Technology (COBIT) and IT Costs and Cost-Benefit analysis are presented. COBIT is introduced to give an example of alternative for ITIL and Cost-Benefit analysis is presented to illustrate the benefits of implementing ITIL processes.

2.1 Network Infrastructure Management

Network Infrastructure Management is part of network service management (see *figure 2*). Managing network infrastructure means managing the network devices and the network connections. For efficient Network Infrastructure Management devices and connections have to be documented to ensure information availability. If problems arise in the information network, network administrators should be able to find respective network devices rapidly to take needed action. Configuration of common network devices should be standardized and information of configuration should be saved in a common database. Changes should be made to the database when configuration of network infrastructure changes. Those changes should also be documented.

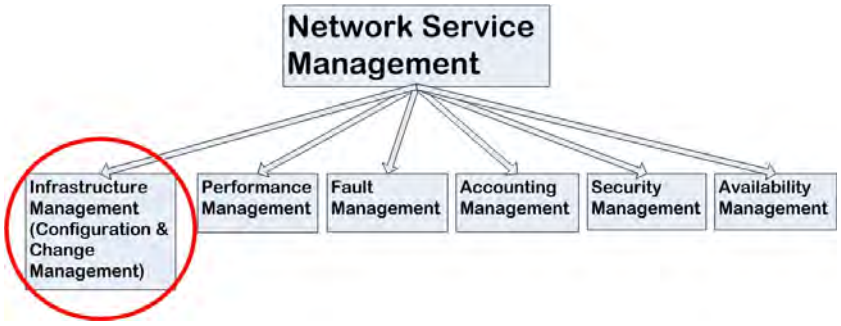

Figure 2 Network Service Management areas and Network Infrastructure Management [6]

This brings us to ITIL best practices. ITIL best practices for ICT Infrastructure Management, Change and Configuration management provide general means of reaching Network Infrastructure Management targets. Those general processes have to be modified to a more specific approach for individual enterprises using them. This thesis discusses only processes related to Network Infrastructure Management, not the hardware management done by specific tools and protocols.

2.2 Information Technology Information Library (ITIL)

The IT Information Library, ITIL, was initially developed during 1980's by the British Central Computer and Telecommunications Agency, CCTA [7, p.1]. CCTA became part of British Office of Government Commerce in 2001. What is now called ITIL version 1 was entitled "Government Information Technology Infrastructure Management Methodology" (GITMM) and over several years eventually expanded to 31 volumes in a project initially directed by Peter Skinner and John Stewart at the CCTA. Although developed during the 1980s, ITIL was not widely adopted until the mid 1990s. This wider adoption and awareness has led to a number of standards, including ISO/IEC 20000[8 - 9] which is an international standard covering the IT Service Management elements of ITIL.

In order to make ITIL more accessible (and affordable) to those wishing to explore it, one of the aims of ITIL v2 was to consolidate the publications into logical "sets" that grouped related process guidelines into the different aspects of IT management, applications and services.

Seven ITIL version 2 books are:
The IT Service Management:

1. Service Delivery
2. Service Support

Operational guidance:

3. ICT Infrastructure Management
4. Security Management
5. The Business Perspective
6. Application Management
7. Software Asset Management

In December 2005, the OGC issued notice of an ITIL refresh, commonly known as ITIL v3, which became available in May 2007. ITIL version 3 initially includes five core texts:

1. Service Strategy
2. Service Design
3. Service Transition
4. Service Operation
5. Continual Service Improvement

These publications update much of the current ITIL version 2 (ITILv2) and extend the scope of ITIL in the domain of service management. ITIL version 3 (ITILv3) to this date is not yet widely deployed though. This thesis focuses on ITILv2. When ITILv2 best practices are in use there is a direct transitional path to deploy ITILv3

ISO 20000 consists of two documents. ISO20000-1:2005 [8] is a specification for providing recommendations for those responsible for IT Service Management. It promotes the adoption of an integrated process approach to effectively deliver managed services to meet the business and customer requirements. ISO20000-2:2005 [9] is a code of practice, describing specific best practices for the processes within ISO 20000-1:2005. ISO20000 standard is based on ITILv2.

According to IT Service Management book [10, p.359] businesses are starting to insist that the IT sector should also adopt Service Quality Management. ISO/IEC 20000 is an international standard specifically aiming to establish such service quality management systems in IT organizations. For this reason this standard is expected to become a major factor in IT Service Management. Gartner predicts that by the end of 2008 compliance to ITIL (meaning 'ISO/IEC 20000) will be a buying criterion in 75% of relevant IT sourcing decisions [11].

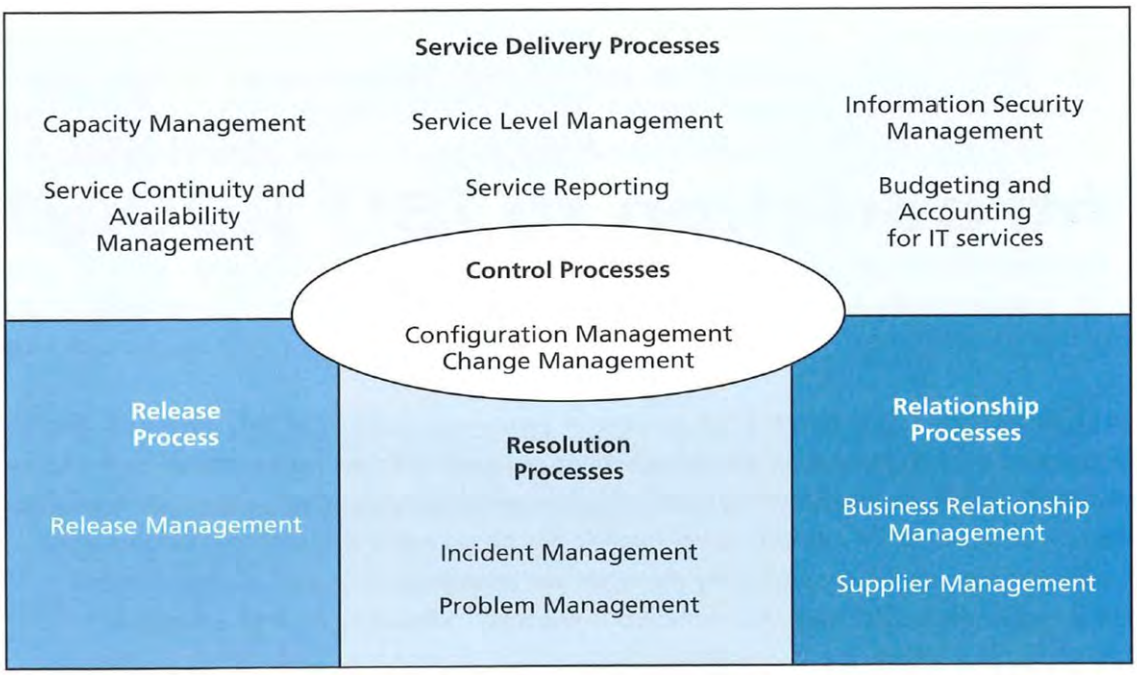

Figure 3 IT Service Management according to ISO/IEC 20000 [10, p.360]

The ISO/IEC 20000 standard promotes the adaptation of an integrated process approach for the management of IT services. Processes have been positioned within a process scheme, covering the ITIL version Service Support and Service Delivery processes and functions together with some additional management processes (see *figure 3*). It sets out to address everything that is mandatory for good service management – things that are common to and required by every IT service provider – whether external or internal.

IT Service Management – An Introduction book [10] states that although ISO/IEC 20000 is not formally related to ITIL, it was clear that it was strongly aligned to the ITIL version 2 books. This means that the changes in content, scope and terminology in ITIL version 3 are not reflected in ISO/IEC 20000. ISO/IEC 20000 was launched in December 2005 and normally ISO standards are frozen for a four to five year period after initial publication. Meaning that ITIL version 3 implementations will not be ISO certified for years.

This thesis mainly covers areas related to "Service Support" [7] and "ICT Infrastructure Management" [12] publications of ITIL version 2 framework. Most importantly the ITIL version 2 Service Support book includes Change and Configuration Management together with CMDB. *Figure 4* shows the ITIL publication framework related to this thesis. Areas that are covered in the thesis are encircled.

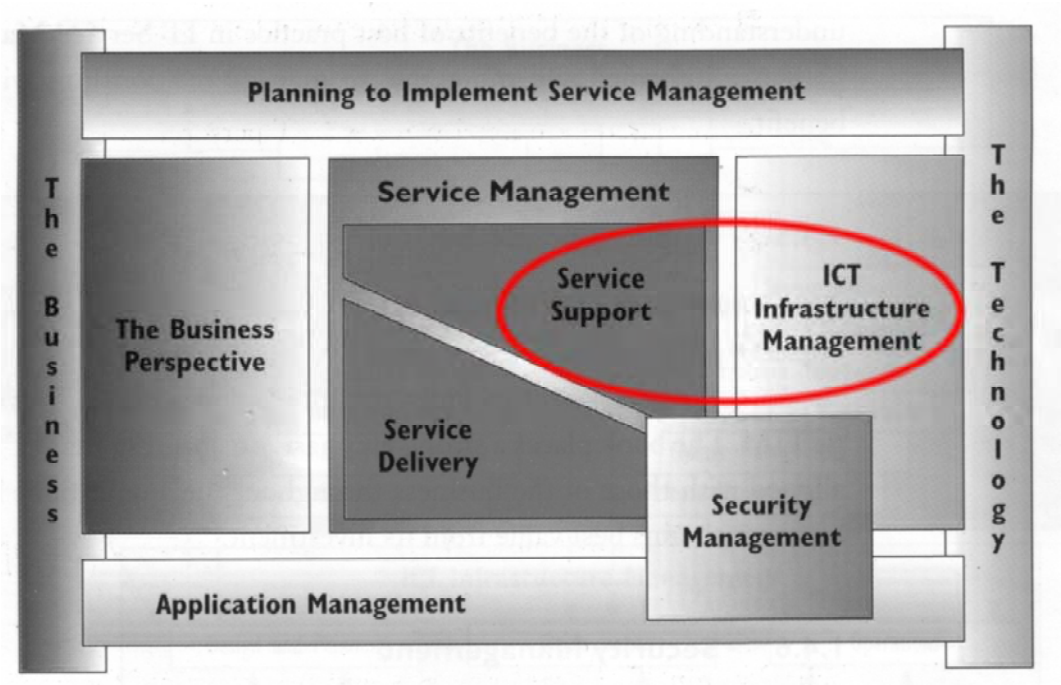

Figure 4 The ITIL version 2 publication framework and this thesis [12, p.7]

ITIL is essentially a series of documents that are used to aid the implementation of a framework for IT Service Management. This customizable framework defines how Service Management is applied within an organization. Although ITIL was originally created by the CCTA, a UK Government agency, it is now being adopted and used across the world as the defacto standard for best practice in the provision of IT Service Management [7, p.1]

According to the IT Service Management Forum (itSMF) [10, p.49] ITIL offers a systematic approach to the delivery of quality of IT services. It gives a detailed description of most of the important processes in an IT organization, and includes checklists for tasks, procedures and responsibilities which can be used as a basis for tailoring to the needs of individual organizations. At the same time, the broad coverage of ITIL also provides a helpful reference guide for many areas, which can be used to develop new improvement goals for an IT organization, enabling it to grow and mature.

Carl Walhberg discusses ITIL related to network monitoring in his thesis [5]. According to Wahlberg the most important ITIL disciplines related to Network management are:

- Service desk
- Incident Management
- Problem Management
- Service Level Management
- Change Management
- Configuration Management

Change and Configuration Management are part of ICT Infrastructure Management and more specifically part of Network Infrastructure Management. Other areas are closely related to infrastructure management but because they are not part of Network Infrastructure Management, they are not included in this thesis. *Figure 5* shows an example of the relationship between Problem and Change Management. Problem is first detected, a known cause for error is found and request for change is made.

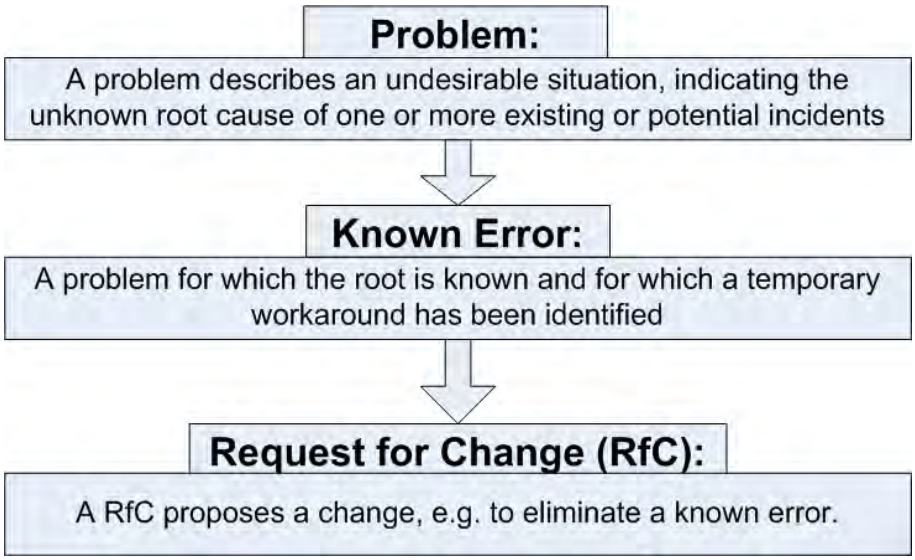

Figure 5 Example of relations between Problem and Change Management [13, p.55]

2.2.1 ITIL ICT Infrastructure Management

According to ITIL ICT Infrastructure Management book [12, p.1] ICT Infrastructure Management is concerned with processes, organizations and tools to provide a stable IT and communication infrastructure, and is the foundation for ITIL Service Management processes, promoting a quality approach to achieving business effectiveness and efficiency in the use of information systems. *Figure 6* shows the historical development of ICT Infrastructure Management.

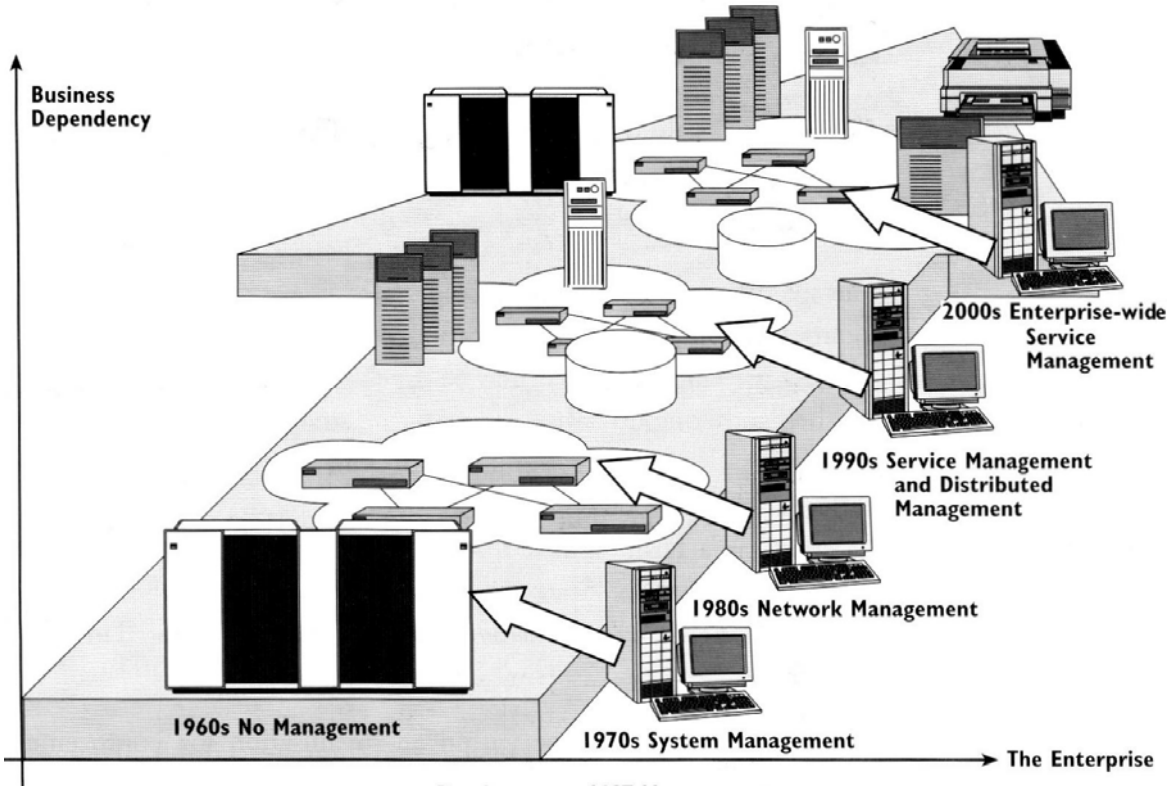

Figure 6 Development of ICT Infrastructure Management [12, p.3]

There are several underlying reasons why effective, proactive management of ICT is becoming more important [12, p.2]:

- Dependency – organizations are increasingly dependent on ICT (*see figure 6*).
- Pervasiveness – ICT is now a significant channel for delivery of the organization's products and services.
- Complexity – ICT infrastructures are becoming larger, more distributed and complex (*see figure 6*).
- Flexibility – changing business requirements mean that users are demanding new services; often these have to be provided using the existing infrastructure.
- Customer satisfaction – customers have become less tolerant of poor services owing to the severe impact that failures have on mainstream business functions.

- Investment – for many organizations ICT forms a substantial portion of the budget, and there is a growing demand for ICT to demonstrate and deliver the long-term value from an investment perspective. Gartner states [14] that at least two-thirds of all IT spending is on IT infrastructure maintenance to sustain the business, not to change or transform it. “The investments allocated to do new things, to change the business, are usually low, no more than 20%, and the investment in innovations which could transform the business is even less”.
- Time to market – movement towards global competition, and shorter lifecycles for technologies that afford competitive advantage, increase the necessity to deliver products and services to market in shorter time-frames.

ICT Infrastructure Management [12, p.2] states that challenges facing Business and ICT Managers are both diverse and extensive. It is acknowledged widely by the business community that their organizations have a significant dependency on ICT for business operations. ICT components are often an integral part of business services and products. This dependency necessitates alignment of strategic planning between the business and ICT.

ICT Infrastructure Management has many interfaces in corporate IT world (see *figure 7*). Most important ones are the Business, Service Management, Application Management, the ICT technology and Partners. Note from the figure that ICT Infrastructure Management has a great multitude of interfaces.

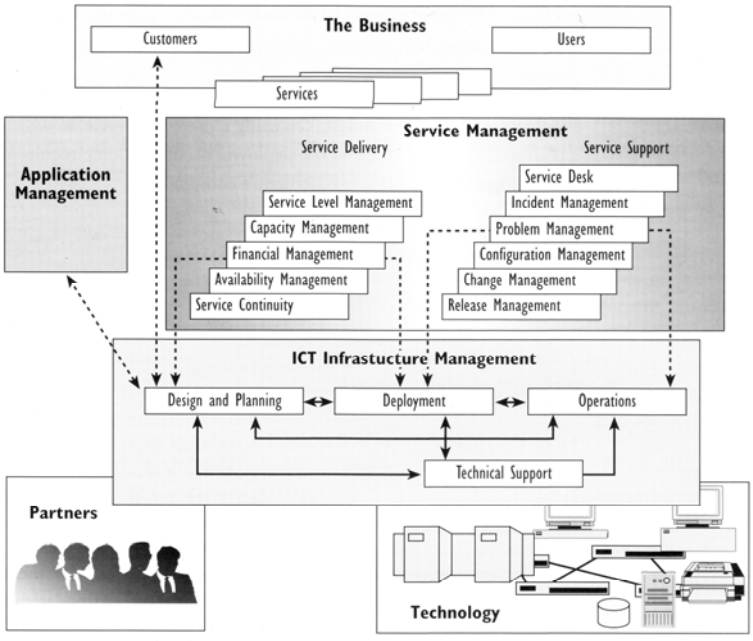

Figure 7 Interfaces of ICTIM [12, p.9]

2.2.2 ITIL Change Management

Gartner research [15] shows that an average of 80 percent of mission-critical application service downtime is directly caused by people or process failures (“unmanaged changes”). The other 20 percent is caused by technology failure, environmental failure or a disaster. The complexity of today's IT infrastructure and applications makes high-availability systems management enormously difficult

ITIL Support Service book states [7, p.165] that Change Management ensures that standardized methods and procedures are used for efficient and prompt handling of all changes, in order to minimize the impact of change-related incidents upon service quality, and consequently to improve the day-to-day operations of the organization. *Figure 8* shows the interfaces of Change Management process to other ITIL processes.

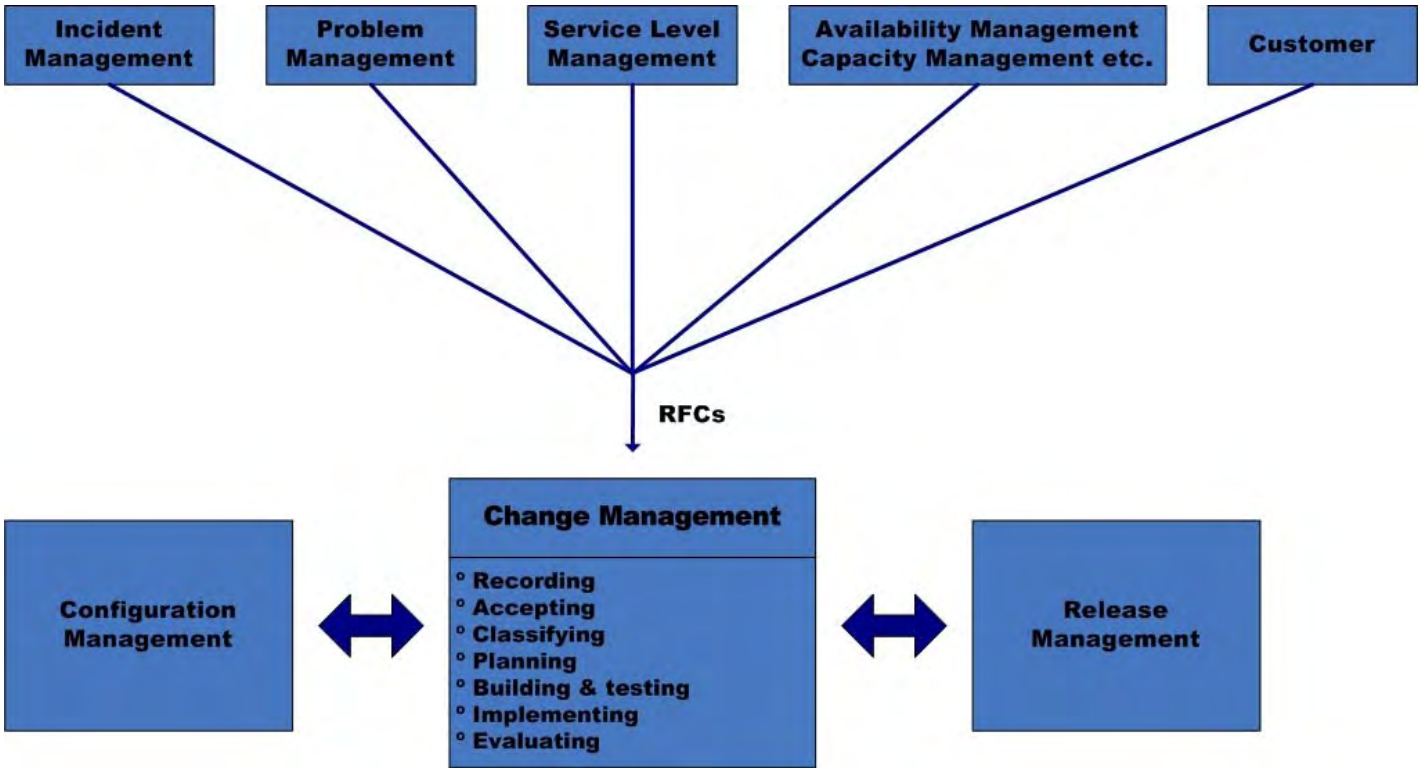

Figure 8 Change Management and other ITIL functional areas [13, p.88]

ITIL Change Management refers to British Standards Institute “A Code of Practice for IT Service Management” book [16], which defines that Change Management consists of:

- raising and recording Changes
- assessing the impact, cost, benefits and risks of Changes
- developing the business justification and obtaining approval
- management and co-ordination of Change implementation
- monitoring and reporting on the implementation
- closing and reviewing Change requests

According to ITIL [7, p. 166] Change Management is responsible for managing Change processes involving:

- hardware
- communications equipment and software
- system software
- ‘live’ application software
- all documentation and procedures associated with the running, support and maintenance of live systems

Changes to any components that are under the control of projects are subject to *project* Change Management procedures, not under general Change Management procedures. The Change Management team will, however, be expected to liaise closely with project managers to ensure smooth implementation and consistency within the changing management environments.

Figure 11 shows the activities involved in the ITIL Change Management process. The activities form a process flow for IT infrastructure changes.

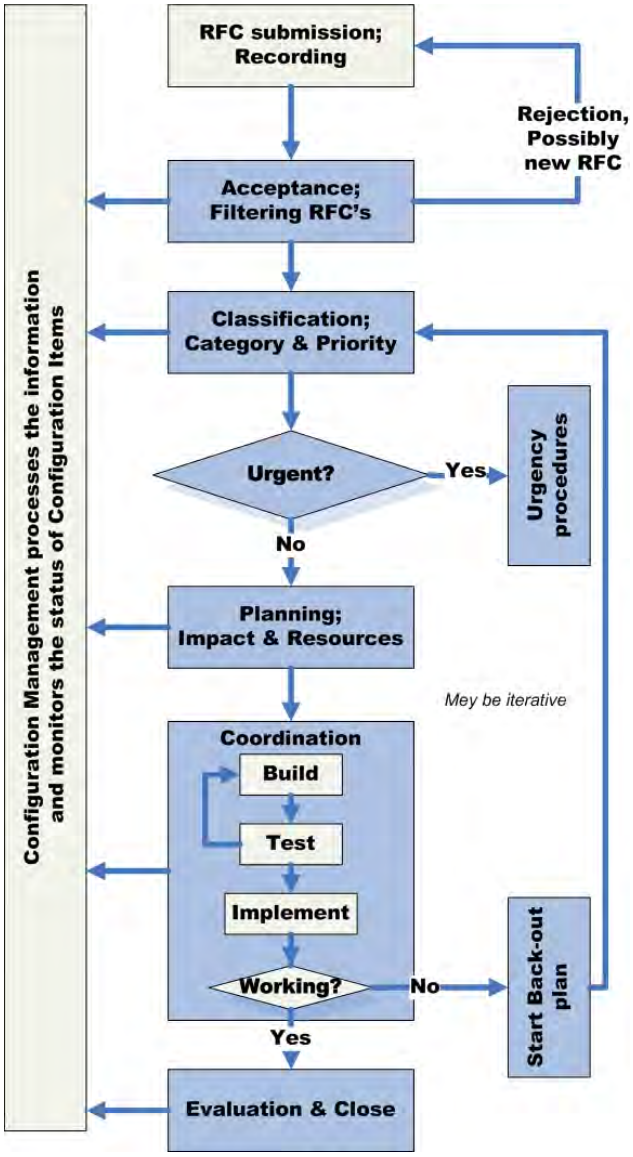

Figure 9 Change Management activities [13, p.90]

2.2.3 ITIL Configuration Management

According to ITIL [7, p.121] Configuration Management covers the identification, recording, and reporting of IT components including their versions, constituent components and relationships. Items that should be under Configuration Management include hardware, software and associated documents.

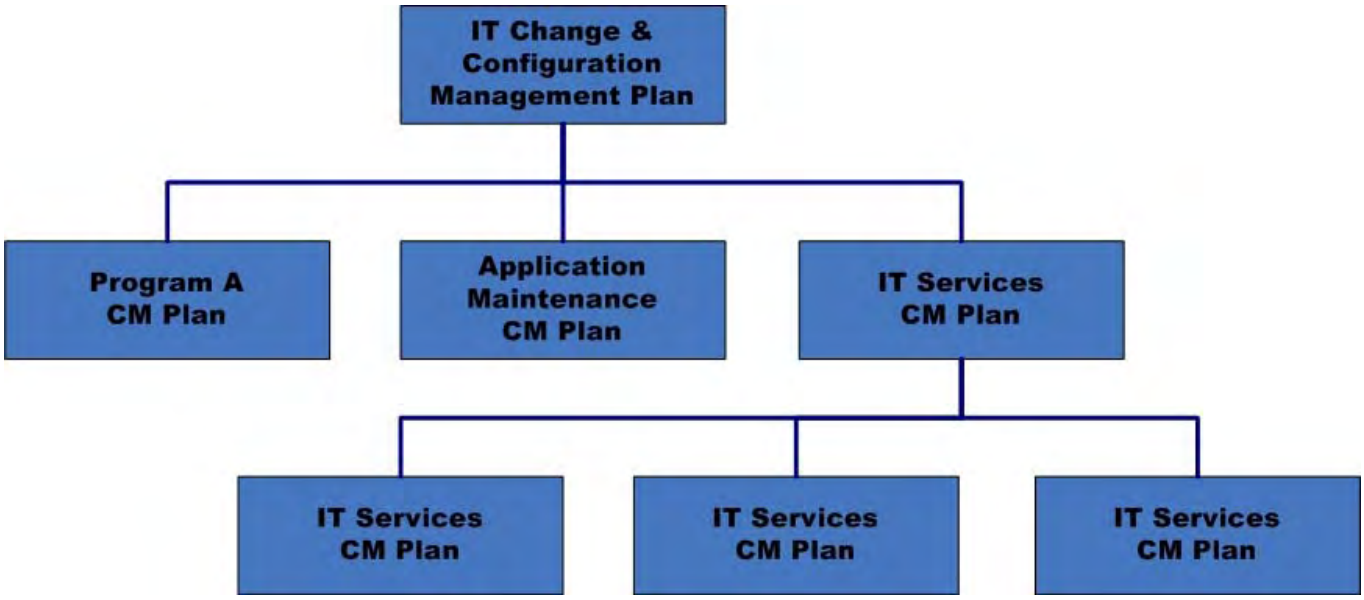

Figure 10 Examples of possible Change and Configuration Management plans for an organization [7, p.131]

Figure 10 shows some examples of possible Change and Configuration Management process documents for different areas. Process documents for different IT areas should be based on the general IT Change and Configuration process plan for the organization, which give guidelines how Change and Configuration Management is handled by IT department in the organization in question. Configuration Management is responsible of maintaining Configuration Items (CI) in Configuration Management Database (CMDB).

ITIL terminology [7, p.266] states that a Configuration Item (CI) is a component of an infrastructure or an item that is (or is to be) under the control of Configuration Management. Configuration Items may vary widely in complexity, size and type, from an entire system (including all hardware, software and documentation) to a single module or a minor hardware component. ITIL Configuration Management suggests example attributes that could be used in the CMDB. This list is presented as *Appendix 1*. *Figure 11* shows some examples of possible Configuration Items.

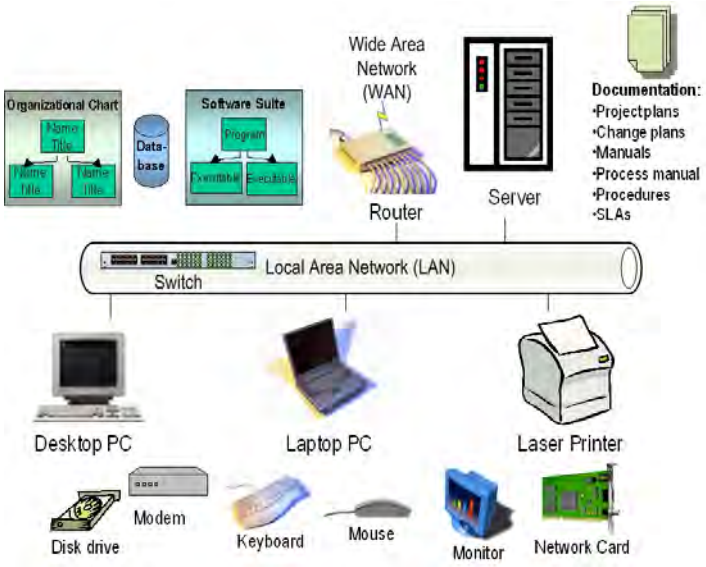

Figure 11 Example of Configuration Items

Configuration management database (CMDB) is a repository of information related to all the components of an information system. Although repositories similar to CMDBs have been used by IT departments for many years, the term CMDB stems from ITIL. In the ITIL context, a CMDB represents the authorized configuration of the significant components of the IT environment. It is a database that contains all relevant details of each CI and details of the important relationships between CIs [7, p. 267] A CMDB helps an organization understand the relationships between these components and track their configuration.

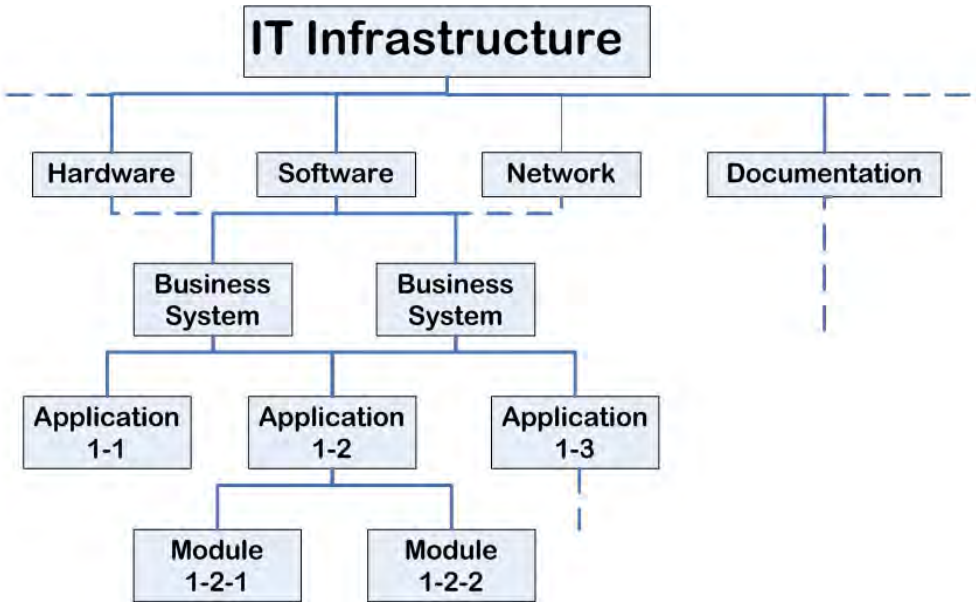

Figure 12 Example breakdown structure of CMDB [7, p.139]

CMDB forms a structured way of representing Configuration Items saved in the CMDB. ITIL offers an example for this structure in ITIL Service Management book (see *figure 12*).

CMDB is a fundamental component of the ITIL framework's Configuration Management process. A key success factor for implementing CMDB in a large organization is the ability to automatically discover information about the CIs and track changes as they happen. Idea behind CMDB is that Configuration Items, CIs, are hyperlinked to each other like World Wide Web-pages. Those CIs that have relations with other CIs are directly linked in CMDB and therefore it is easy to see, from infrastructure management viewpoint, with a glance, relations between components and services. Considering Konecranes Network Infrastructure Management it is easy to make network architectural visual images that show how network devices are actually linked.

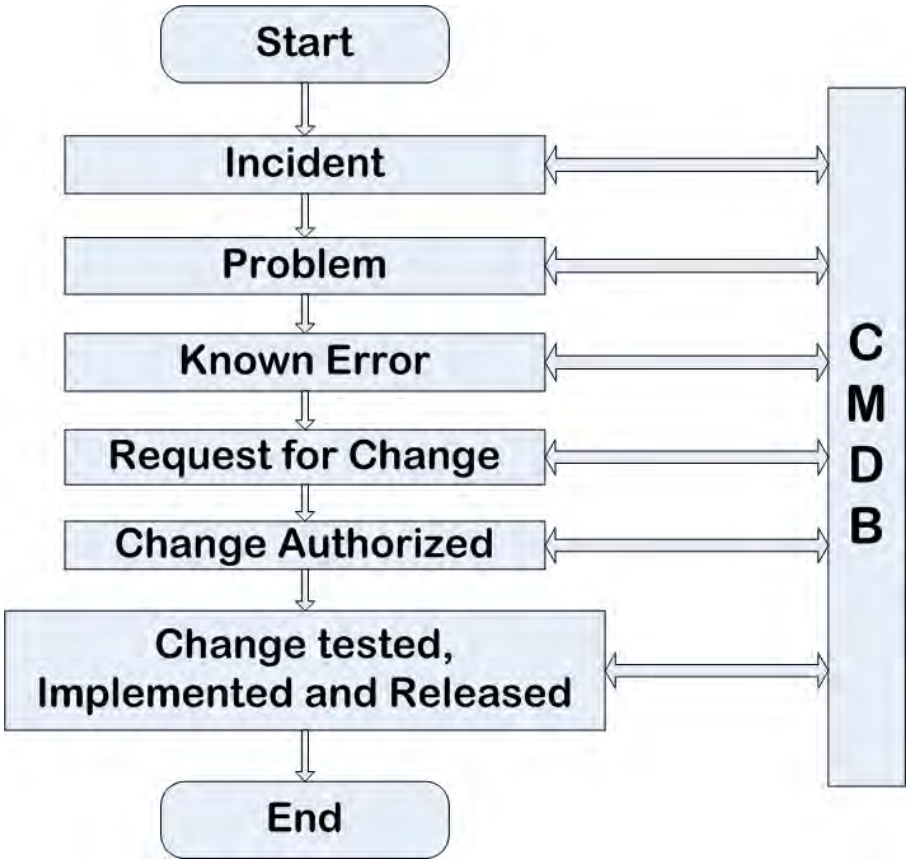

Figure 13 [7, p.151] CMDB interfacing to Incident, Problem, Change and Release Management

Figure 13 shows how CMDB interfaces to ITIL Incident, Problem, Change and Release Management process areas and also shows the process how a disruption of standard operation of a service for the end user leads to a change in IT infrastructure.

ITIL Configuration Management lists examples of potential use for CMDB [7, p.124]:

- Release contents, including component CIs and their version numbers
- component CIs and their version numbers in the test and live environments
- CIs affected by a scheduled (authorized) Change
- all Requests for Change (RFC)

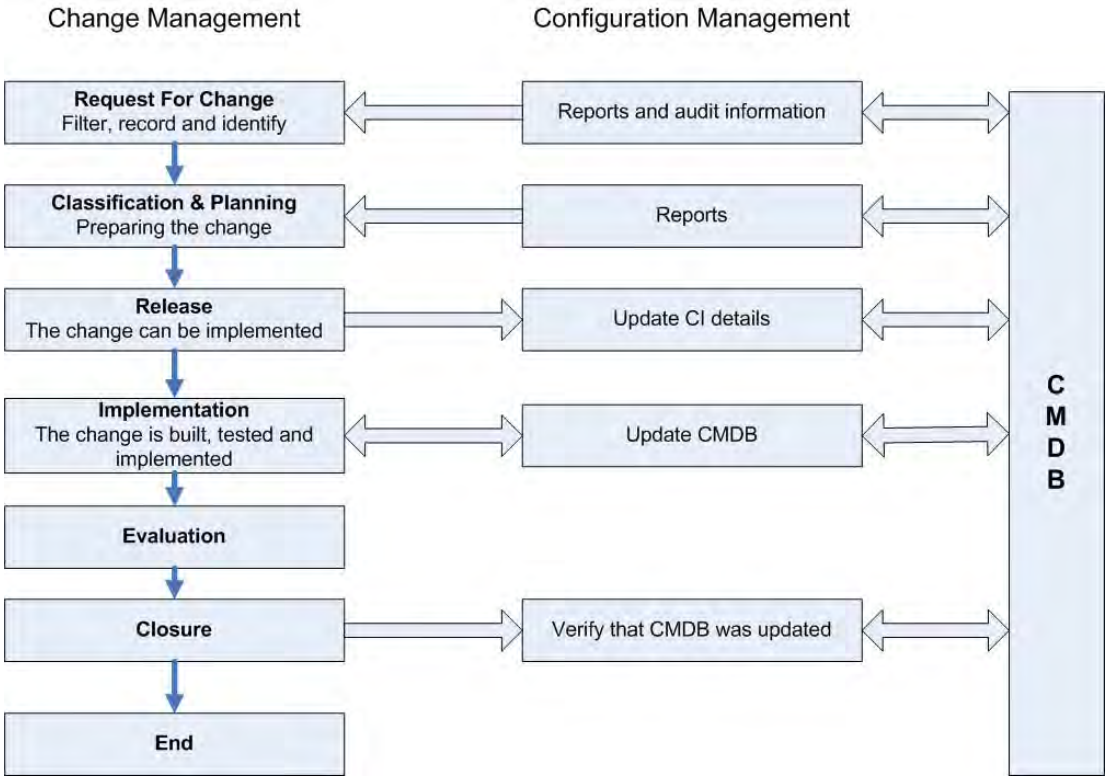

Figure 14 Relationships between Change and Configuration Management and CMDB [based on 13, p.70]

Change, Configuration Management and CMDB are closely related. *Figure 14* shows the process of Change Management introducing changes to CMDB through Configuration Management. If every change in the IT infrastructure is handled according to Change Management and Configuration Management processes the information in the CMDB stays up to date. Up to date information in the CMDB can be used for other IT Service Management purposes for example troubleshooting problems and IT financial planning.

2.2.4 Current ITIL Adaption

A survey made by Materna in September 2007 [17], which included 109 respondents from different companies in Finland, Sweden and Denmark across different industries, gives some information of ITSM and ITIL adaptation in the Nordic region. Majority of responses came from large companies (over 1000 employees).

Key findings were that Service Desk, Incident Management and Problem Management are the most frequently implemented ITSM processes. Also about three quarters of the surveyed companies use ITIL. 96% of the companies that had implemented parts of ITIL would also recommend it to other companies. *Figure 15* shows that around 80% of the respondents plan to implement further ITSM processes during the next two years. According to *Figure 16* the Service Level Management, **Change Management** and **Configuration Management / CMDB** are the top planning areas.

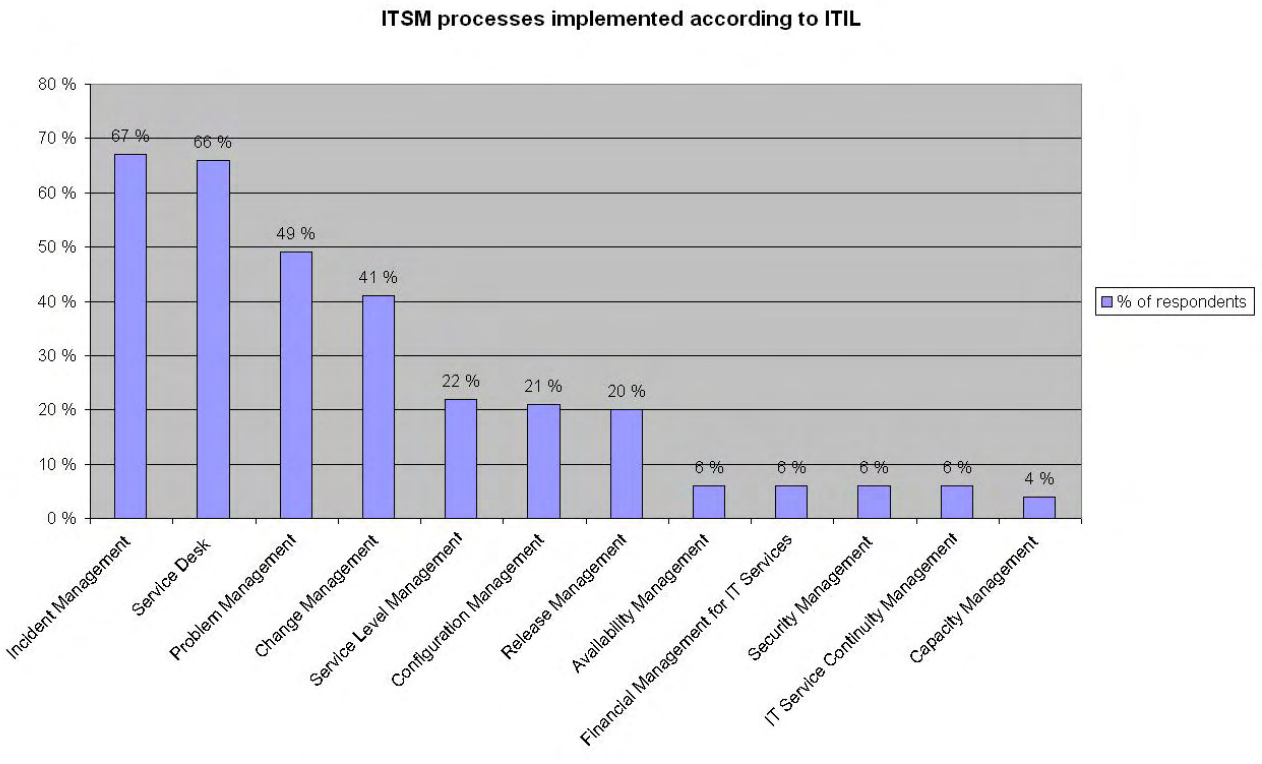

Figure 15 ITSM processes implemented according to ITIL principles [17, p. 17]

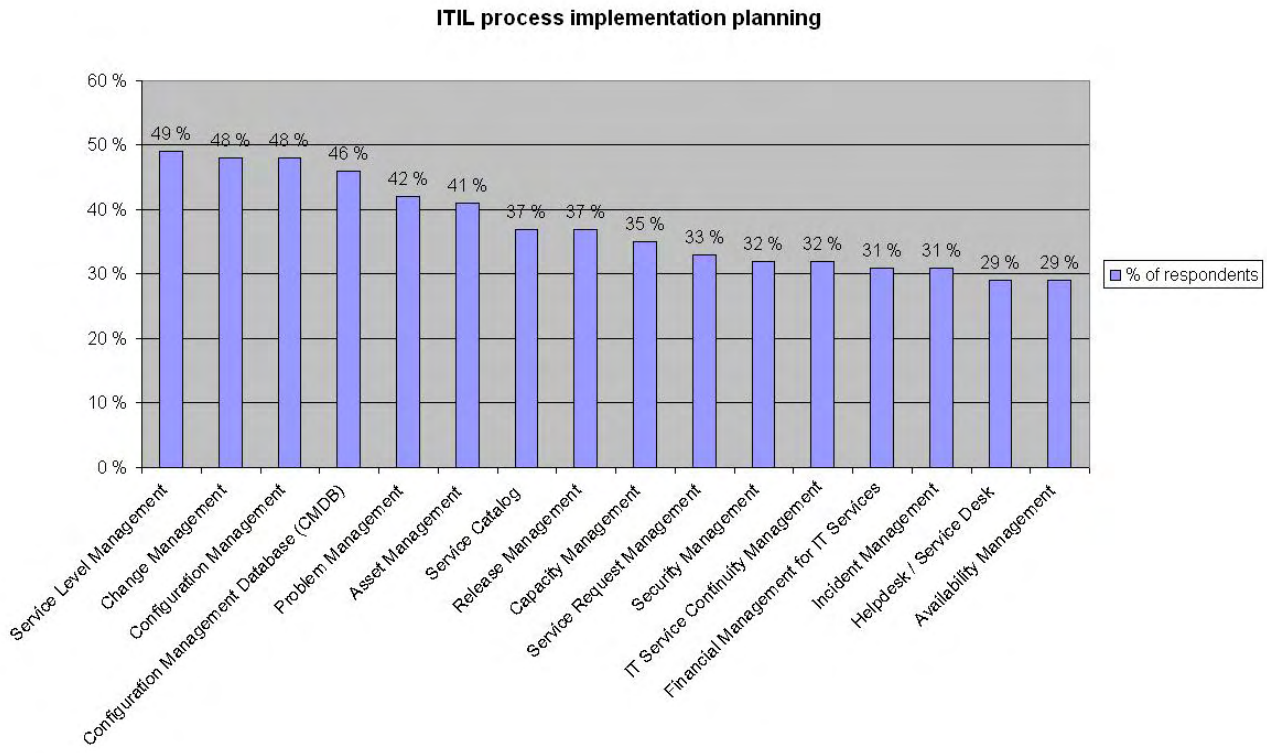

Figure 16 ITSM process implementation planning [17, p.28]

2.2.5 Capability Maturity Model Integration (CMMI) and ITIL

When discussing process development, Capability Maturity Model Integration (CMMI®) needs to be mentioned alongside with ITIL. CMMI models are collections of best practices that help organizations to improve their processes [18, p. I]. CMMI model was developed by a product team with members from the industry, the US government, and the Software Engineering Institute (SEI) for the application of process improvement in the development of products and services covering the entire product lifecycle from conceptualization to maintenance and disposal. CMMI models have 6 capability levels that can be used to assess ITIL process adaptation.

These levels are:

0. Incomplete
1. Performed
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

Figure 6 shows specific requirements for reaching different CMMI levels.

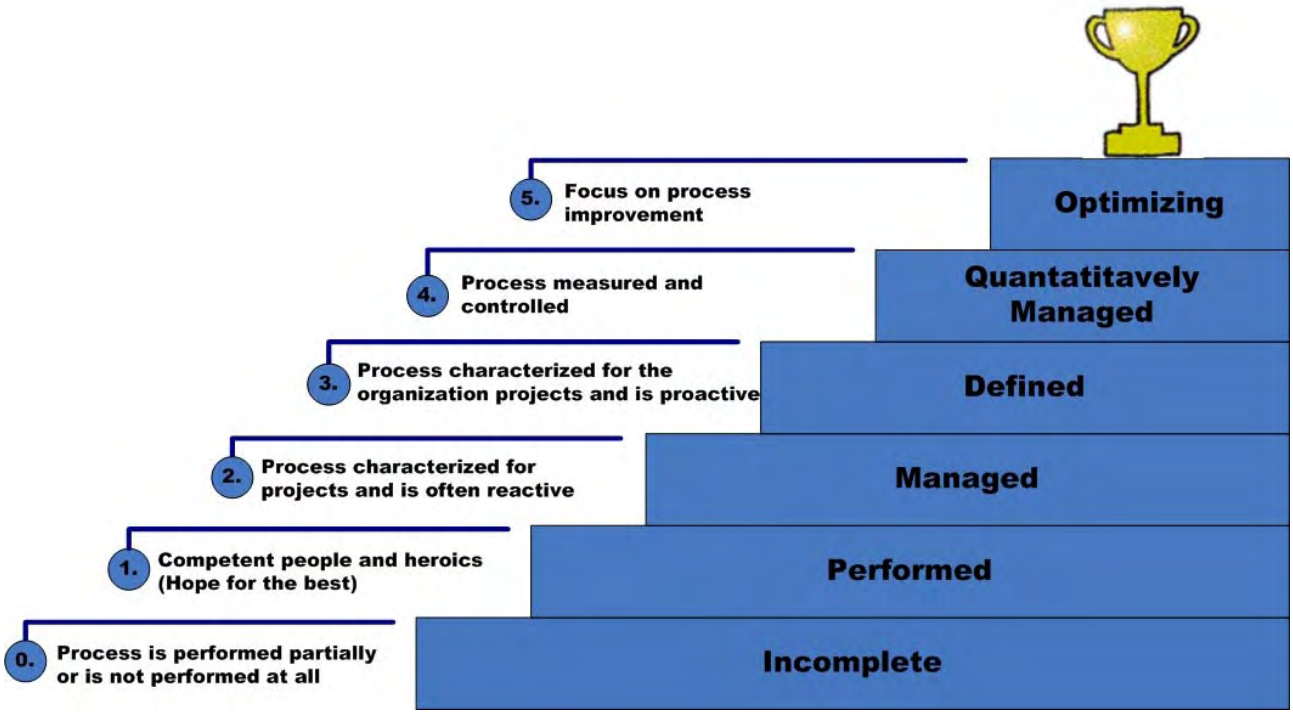

Figure 17 CMMI Capability levels [based on 17, p.24]

CMMI for Acquisitions [18, p. 23] states following about the capability levels:

- Level 0, Incomplete: An *incomplete process* is a process that either is not performed or partially performed. One or more of the specific goals of the process area are not satisfied, and no generic goals exist for this level since there is no reason to institutionalize a partially performed process.

- Level 1, Performed: A capability level 1 process is characterized as a *performed process*. A performed process is a process that satisfies the specific goals of the process area. It supports and enables the work needed to acquire capabilities.

- Level 2, Managed: A capability level 2 process is characterized as a *managed process*. A managed process is a performed (capability level 1) process that has the basic infrastructure in place to support the process. It is planned and executed in accordance with policy. The process discipline reflected by capability level 2 helps to ensure that existing practices are retained during time of stress.

- Level 3, Defined: A capability level 3 process is characterized as a *defined process*. A defined process is a managed (capability level 2) process that is tailored from the organization's set of standard processes according to the organization's guidelines and contributes work products, measures, and other process improvement information to the organizational process assets.

- Level 4, Quantitatively Managed: A capability level 4 process is characterized as a *quantitatively managed process.* A quantitatively managed process is a defined (capability level 3) process that is controlled using statistical and other quantitative techniques. Quantitative objectives for quality and process performance are established and used as criteria in managing the process.

- Level 5, Optimizing: A capability level 5 process is characterized as an *optimizing process*. An optimizing process is a quantitatively managed (capability level 4) process that is improved based on an understanding of the common causes of variation inherent in the process. The focus of an optimizing process is on continually improving the range of process performance through both incremental and innovative improvements.

2.3 Control Objectives for Information and Related Technology (COBIT)

Control Objectives for Information and related Technology (COBIT®) created by the Information Systems Audit and Control Association (ISACA), and the IT Governance Institute (ITGI) in 1992. Version 4.1 of COBIT [19] was released on 2007. COBIT provides IT managers and users with a set of generally accepted measures, indicators, processes and best practices to assist them in maximizing the benefits derived through the use of information technology and developing appropriate IT governance and control in a company.

COBIT 4.1 defines the best practice framework [19, p. 5] for the need for assurance about IT value, the management of IT-related risks and increased requirements for control over information are now understood as key elements of enterprise governance. Value, risk and control constitute the core of IT governance. *Figure 18* shows the core context of IT Governance: Strategic Alignment, Value Delivery, Risk Management, Resource Management and Performance Measurement.

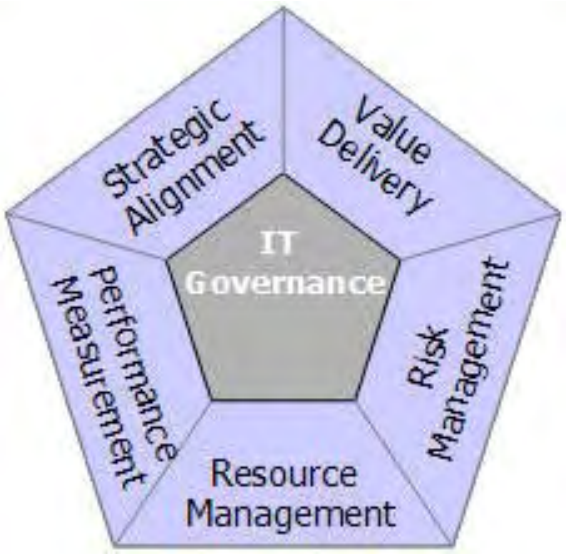

Figure 18 IT Governance Focus Areas [19, p.6]

COBIT 4.1 states following about IT Governance:
"IT governance is the responsibility of executives and the board of directors, and consists of the leadership, organizational structures and processes that ensure that the enterprise's IT sustains and extends the organization's strategies and objectives."

In response to the growing significance of best practices to the IT industry and the need for senior business and IT managers to better understand the value of IT best practices the UK government Office of Government Commerce (OGC) and the IT Governance Institute (ITGI) made a study of aligning COBIT and ITIL best practices in 2005 [20], which also includes information of mapping ITIL to COBIT control objectives [20, p.21] and also information of mapping COBIT control objectives to ITIL [20, p.59]. ITIL Configuration Management maps to COBIT Configuration Management defined in COBIT Deliver and Support process (DS9). ITIL Change Management maps to COBIT Change Management defined in COBIT Acquire and Implement process (AI6).

Table 1 Aligning ITIL with COBIT [20, p.23]

ITIL	**COBIT**		
Process	**Process**	**Detailed control objective**	
Configuration Management			
1. Undertake configuration management planning	DS9	All	Manage the configuration
2. Identify configuration items	DS9	DS9.1	Configuration recording
3. Establish CMDB and DSL	DS9	DS9.1	Configuration recording
4. Control configuration	DS9	DS9.2	Configuration baseline
5. Maintain and track CI status	DS9	DS9.3	Status accounting
6. Verify and audit CIs against CMDB records	DS9	DS9.4	Configuration control
7. Manage libraries and licenses	DS9	DS9.6	Software storage
Change Management			
1. Establish change approach, advisory board and procedures	AI6	All	Manage changes
2. Assess and prioritize change	AI6	AI6.1	Change request initiation and control
3. Approve change	AI6	AI6.2	Impact assessment
4. Plan change	AI6	AI6.3	Control of changes
5. Maintain forward schedule of change	AI6	AI6.1	Change request initiation and control
6.Co-ordinate change implementation	AI6	AI6.3	Control of changes
7. Review change	AI5	AI5.14	Management's post-implementation review
8. Report on change metrics	AI6	AI6.3	Control of changes

Table 1 shows Configuration and Change Management objectives and their counterparts in COBIT documentation. This information can be used to align ITIL Configuration and Change Management processes to COBIT processes.

2.4 IT Costs and Cost-Benefit Analysis

IT management is becoming more cost-aware because of the directions from the upper management. When the goal is to improve the cost-efficiency of the whole organization to maximize the profits IT expenses can no longer be over-looked. Cost-benefit analysis is demonstrated to give an example of IT cost reductions of Configuration and Change Management.

ITIL Service Support book [7, Appendix E] gives a general example of the cost-benefits related to implementing Change and Configuration Management. In this example the following assumptions are made:

- all employees cost 50$ an hour
- a working day has 8 hours
- a working year has 200 days
- customers have an average purchasing power of 500$

Process	**Purpose**	**Cost/benefit examples**
Configuration Management	Controlling the IT infrastructure Ensuring that only authorized hardware and software is in use	Following the implementation of Configuration Management, the Service Desk has a much greater insight into the relationship between Users, CIs and Incidents. The 3 people assigned to Incident matching can be reduced to 2, resulting in a benefit of 200x8x50$ =$83,300 per year.
Change Management	Efficient handling of Changes	Two Changes are implemented simultaneously, resulting in a major problem. The Customer support system fails, resulting in the loss of 50 Customers with an average purchasing power of 500$. This has just cost your company 25,000.

Although the previous example is very generalized it illustrates the way cost-benefit analysis is done and also shows the potential of IT department becoming more cost-efficient after introducing new management processes.

2.5 Summary

In this chapter general concept Network Infrastructure Management was introduced. ITIL and its most important components related to this thesis, ICT Infrastructure Management, Change Management, Configuration Management and CMDB were presented. Survey about ITIL adaptation level in the Nordic countries was reported. Also basic related concepts Capability Maturity Model Integration (CMMI), Control Objectives for Information and related Technology (COBIT) and IT Costs and Cost-Benefit Analysis were presented. This information is needed to understand the background for the solution. ITIL processes Change and Configuration Management are used extensively to construct corresponding processes for the case study company. CMMI is used to determine a starting maturity level for the case study company Network Infrastructure Management processes and to assess the situation after implementing the new processes. COBIT and Cost-Benefit analysis was introduced to give a framework for the thesis.

3 Case Study Environment

In this chapter a case study corporation for this thesis, Konecranes is introduced. Current IT situation and network infrastructure are portrayed on a general level. Also current problems with network management are presented. Konecranes IT Service Management project related to ITIL is introduced and Konecranes ITIL practices Change Management and Configuration Management current situation is presented.

3.1 Konecranes – Lifting businesses – Global Crane Manufacturer and Service Corporation

Purpose of this thesis is to describe a solution for Konecranes Network Infrastructure Management using ITIL Change and Configuration Management best practices. Here Konecranes is shortly introduced as an enterprise.

Figure 19 Konecranes corporate logo

Konecranes is a global crane manufacturer and crane service corporation. It is world's leading corporation servicing cranes and hoists and one of the world's leading crane and hoist manufacturers. Konecranes corporate logo (*figure 19*) shows the brand promise "Lifting Businesses™" meaning that Konecranes is not about lifting things but entire businesses. This means that Konecranes always offers the highest lifecycle value by focusing not only on minimizing downtime of Konecranes lifting equipment, but also on maximizing the productivity of the uptime [21]

At the end of 2007 Konecranes employed 8404 employees in more than 370 locations in 41 countries. Group sales totalled 1749 million euros for the year 2007 (18% increase from 2005) [22].

Konecranes has three business areas: Service operations, Standard and Heavy lifting. Market share for crane service is about 20% of the world market (18% in Q3/2007 [23, p.4]) and market share for new standard lifting cranes is about 15% overall (15% in Q3/2007 [23, p.4]), which makes Konecranes number one in crane service and standard lifting business globally. Market shares for heavy lifting areas are slightly smaller, but in heavy lifting business Konecranes is still one of the largest companies worldwide. *Figure 20* shows an example of Konecranes crane offering.

Goliath Gantry Cranes	
Lifting capacity up to	1200 ton
- upper trolley	2 x 400 ton
- lower trolley	600 ton
Lifting height up to	80 m
Rail span up to	210 m

Figure 20 Example of Konecranes Heavy Lifting crane offering

Konecranes has crane-manufacturing plants in three continents: in Europe, in North America and in Asia. Main factories are in Hyvinkää and Hämeenlinna, (Finland), in Houston, Texas (USA) and in Shanghai and Dalian (China). Service base for Konecranes was about 287 000 cranes or hoists in Q3/2007 [23, p.48]. Konecranes has not manufactured around 80% of the cranes and hoists in its service base. *Figure 21* shows the Konecranes global locations.

Figure 21 Konecranes Worldwide Sales, Service and Manufacturing locations

3.2 Konecranes IT Current Situation

3.2.1 Overall IT Situation

Konecranes has been growing very rapidly during the past few years and the growth is expected to continue in the future, even though it is very challenging to sustain such a rate. Although organic growth has been swift, business acquisitions have been a large part of the overall growth. Business acquisitions are expected to continue in the future too. Group target is that organic growth and acquisitions with communicated target double the business in few years. Effectively this would mean from IT perspective that number of managed devices and sites will increase greatly. Konecranes IT must be an enabler and support growth and acquisitions. Goals are also set for operational margin improvement. Not only business processes, but also IT operational efficiency has to improve.

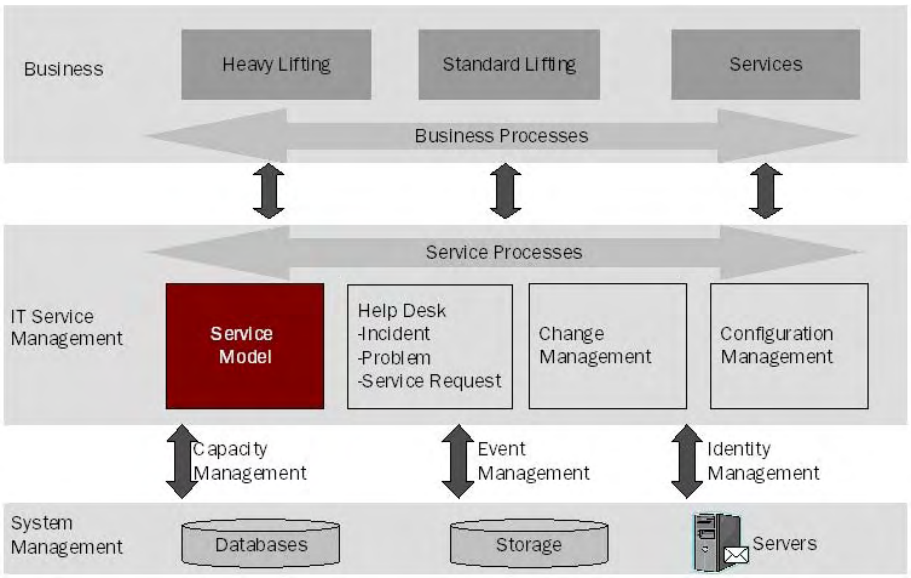

Figure 22 Konecranes IT Services Model

Figure 22 shows the planned model for Konecranes IT to deliver IT services to the customers. Change and Configuration Management are considered to be an essential part of Konecranes IT Service Management.

General development has set a challenge for Konecranes IT. To be able to sustain such a growth a need for some global common IT practices has become imminent. The need to efficiently integrate acquired businesses to Konecranes IT infrastructure has also contributed to the need for global processes. IT Service Delivery strategy has been to centralize IT services as much as possible. It gives business a freedom to move, grow and acquire companies rapidly when the most important services are provided centrally. Historically IT has concentrated on the IT technologies. Business today however needs IT to offer services. Users are not interested in the technology behind the solutions. Managing the change from "technology to users" to "IT services to Customers" is therefore a top priority.

3.2.2 IT Service Productization

IT sector has traditionally lacked common practices or standards to handle IT infrastructure. (see section 2.2.1 Capability Maturity Model Integration and ITIL). There is also a trend to start categorizing the functionality of IT as services that are offered to business internally. One of the drivers has been outsourcing the different aspects of IT.

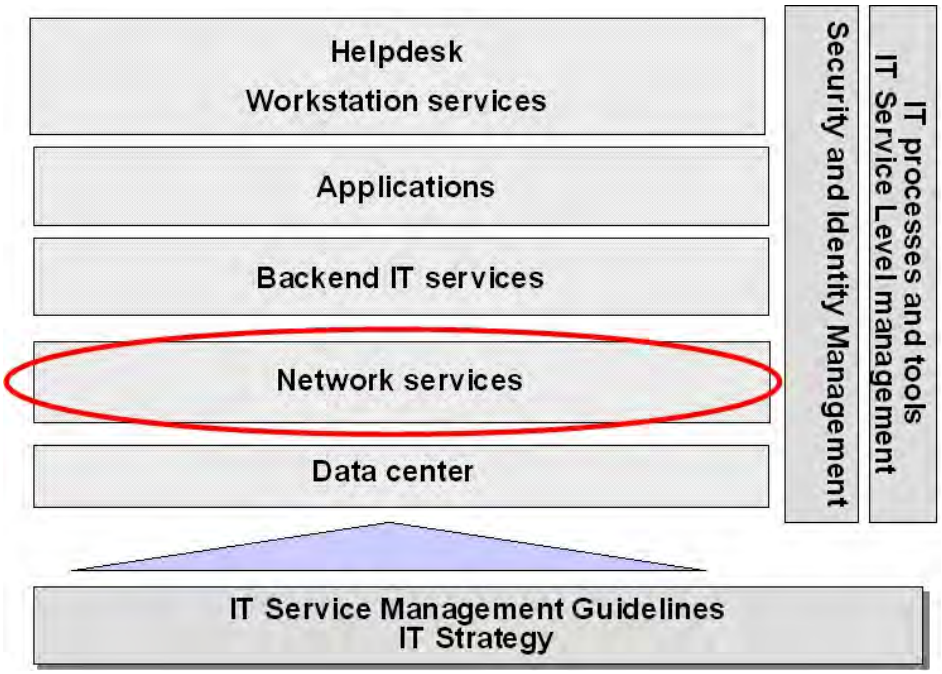

Figure 23 Konecranes IT service layers and Network services

Figure 23 shows how Network services are integrated to the Konecranes IT service offering. Network services are considered supporting function for other services offered by Konecranes IT.

The continued growth has meant an immense increase in the number of managed network devices and remote offices for Network services. Also the complexity of network under Network Infrastructure Management has grown along with the increase of supported applications and growing need for infrastructure changes. Business applications demand even lower downtime tolerances and lower latencies from the network. Still person resources available for network management have remained approximately the same. Konecranes Network Infrastructure Management has succeeded very differently in various parts of the world. All this has created a vastly growing need for standardizing Konecranes Network Infrastructure Management globally.

Goal of the IT Service Management project is to rise from the CMMI maturity level 0 "Processes undefined" to level 3 "Defined processes" so that there would be defined processes for different aspects of IT Service Management and the operations would be more proactive. Continual improvement for the processes is needed to rise to higher CMMI maturity levels in the future.

3.3 IT Service Management Project

ITIL has been seen as a one possible answer for these challenges in Konecranes IT organization and bringing service orientation to Konecranes IT. IT Service Management (ITSM) project according to ITIL best practices was started in 2006. The goal was to introduce and test new IT Service Management ITIL processes in Hyvinkää and then to mobilize these processes globally. Most critical places for this have been three main data centers in Hyvinkää (Finland), Shanghai (China) and Springfield (Ohio, USA), which are called tier 1 data centers (see *figure 24*). Also implementing IT Service Management to tier 2 data centers shall be important. Konecranes currently has 18 smaller data centers that are considered to be tier 2. Data centers are located near the main manufacturing and service locations (compare *figures 21* and *24*).

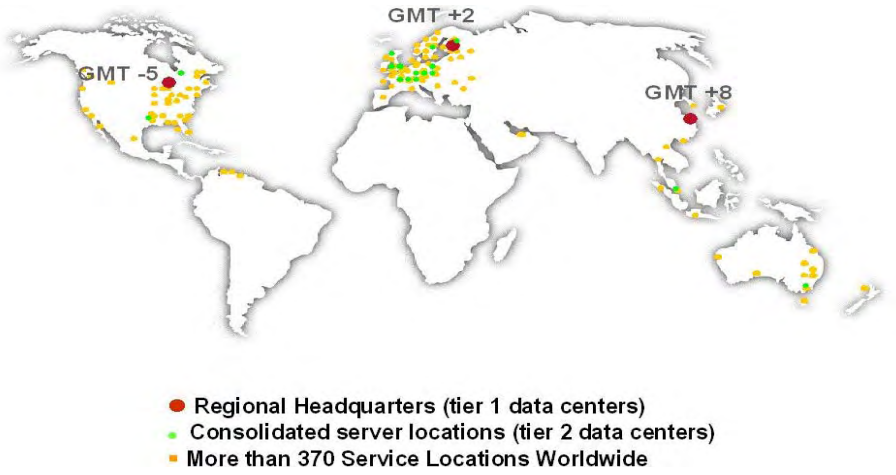

Figure 24 Konecranes data centers

Decision was made to implement ITIL version 2 instead of freshly published ITIL version 3. ITIL version 3 offers a clear transition from ITIL version 2 and it has been said that ITIL version 2 best practices are easier to implement at first than ITIL version 3 which includes for example Service lifecycle concepts.

Big part of Konecranes IT Service Management project has been and will be in the future to adapt general ITIL best practices to Konecranes environment in more detail. ITIL gives some tools and means to get to the ITSM project goals – it is not the goal itself

3.4 Background for the Solution

Implementing processes introduces formality, which many IT employees might envision as a problem. It is easier to do infrastructure management without recording what you do. Some might argue though that this should not be called infrastructure management at all. Therefore IT management must make clear that introducing processes for infrastructure management actually brings benefits in the long run. Many times there will be people that are reluctant to embrace the change; they are used to their own ways and are unwilling to change.

It is not enough to take these processes in use initially, it is also IT management's task to make sure that these processes are followed and if they seem too restrictive and are considered to hinder productivity then these processes should be reviewed and altered. Some sort of follow-up and monitoring for ITIL processes is therefore also essential. IT management must also be ready to deal with the employees reluctant to change their work procedures. Benefits must be made clear and management must also show that they are willing to commit for the whole new IT Service Management framework. It might mean that for example work descriptions for employees have to be changed in order to emphasize what is required from them. Following global IT Service Management should be included to work descriptions.

If Network Infrastructure Management processes are made uniform it is possible to escalate or delegate incidents to other network specialists globally. Network service support can also be introduced as a global service. If problems arise outside local service hours a specialist in other region could help with the problem. If the problems are not solved within service hours in that region, problems can be transferred to another specialist in another region easily when the followed procedures are the same globally.

Konecranes network team should also see benefits of doing things in a standardized way after a while when incidents are solved easier and thus faster. Change management practices should also increase quality of Network Infrastructure Management and the number of network related issues should decrease. Increase in productivity should be evident in the long run. Of course benefits are made clearer when the new processes are in use globally. Employee's bonus plan could include adaptation of Network Infrastructure Management and change management as a one area and the career development could be considered.

When processes are documented it is possible to outsource simple routine tasks or pass them on to internal IT staff. Skilled specialist resources have more time to plan and implement more demanding tasks. These tasks would seem more reasonable to perform to specialists and it would increase the job satisfaction and motivation. Susanne Rinn discusses further aspects of cooperation and collaboration in service process development in her thesis *Collaborative Service Development* [24]

There was an apparent need for clear processes for infrastructure management. The need to hold configuration information in one centralized location and develop processes to keep the information up-to-date. A way to control changes in a managed way was also an explicit need. Global IT service support and development requires that people involved with Konecranes network management are able to help with issues globally. This requires global common processes for infrastructure management along with standardized infrastructure equipment and infrastructure management tools (see *figure 25*)

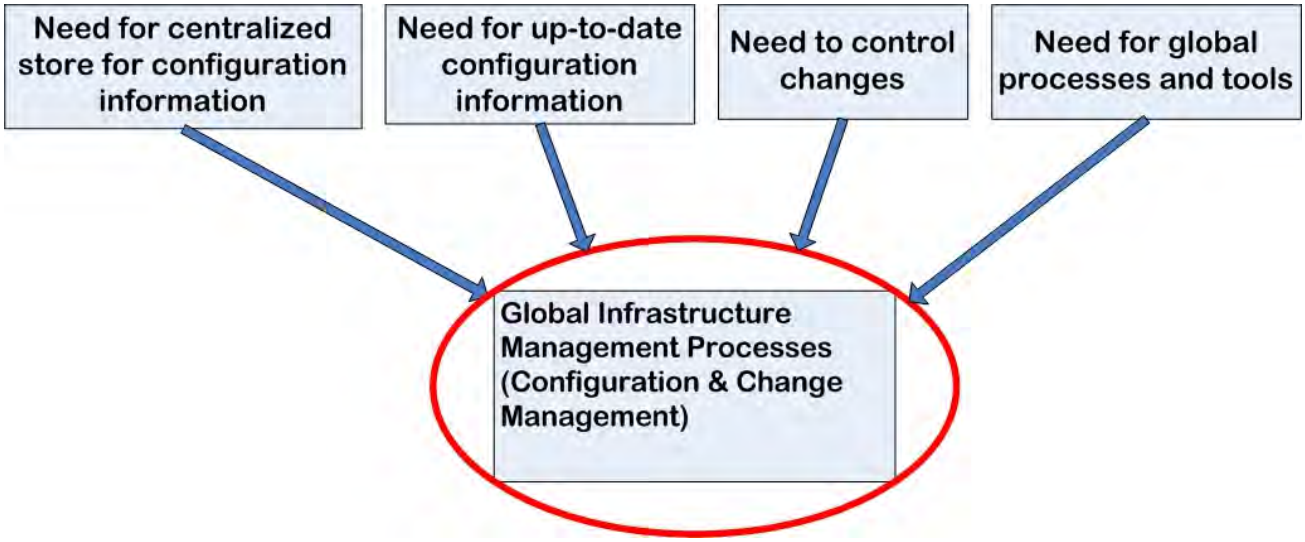

Figure 25 The need for Global Infrastructure Management Processes

Network specialists have tried to support users at different regions but the problems with missing information and varying and unspecified processes have prevented the efficient use of global Konecranes network team. Common methods for network specialists also mean productivity and thus better working network infrastructure for the corporation globally. Different office hours and support organizations can be seen from *figure 26*. It shows that using a global network team with members in major Konecranes locations would mean almost 24-hour support during office days throughout the world.

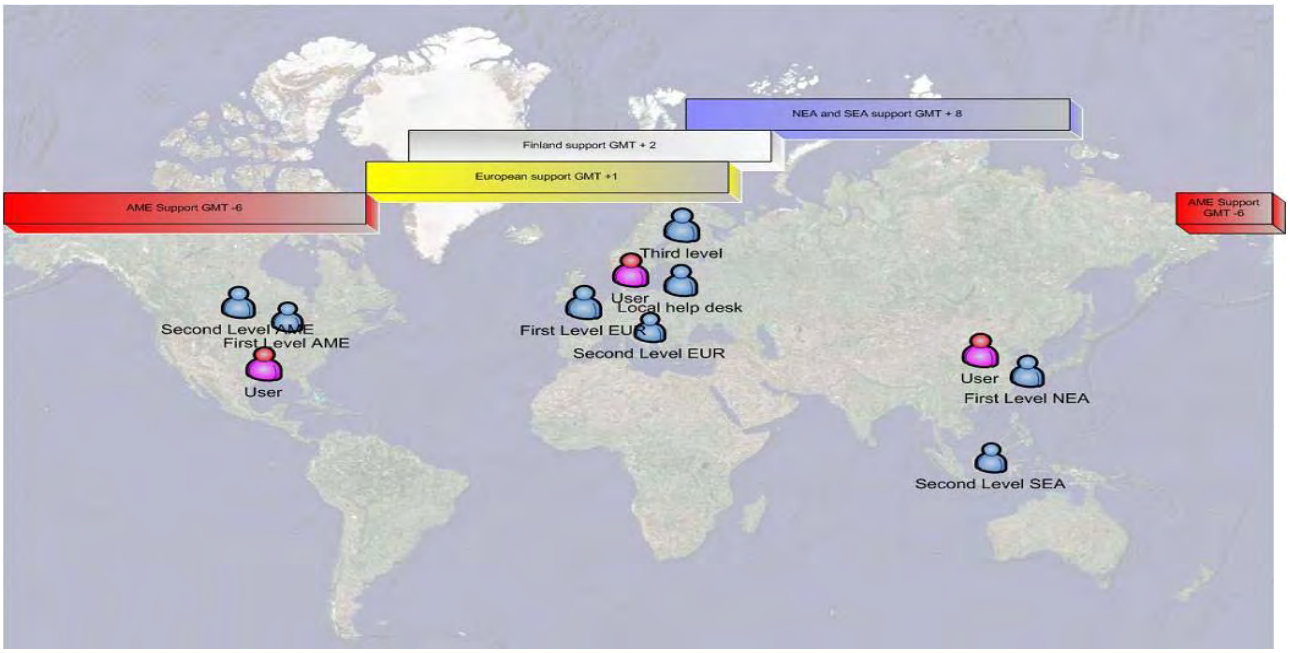

Figure 26 Konecranes IT support and time zones (normal office hours 8h as colored bars)

Solution for Network Infrastructure Management using ITIL best practices presented in this thesis consists Configuration and Change Management practices tailored specifically for Konecranes IT. Objective is to introduce these processes so that they bring the desired benefits without making the infrastructure management too complex and rigid. The purpose would be to advance on the CMMI levels and thus to make Konecranes IT more mature so it could serve business needs better.

3.4.1 Konecranes Network Infrastructure

Since Konecranes IT services are more and more centralized to regional headquarter tier 1 data centers continuous network service for the users is becoming essential. Konecranes has a core network connecting tier 1 and tier 2 data centers globally with a single operator Multi-protocol Layer Switching (MPLS) WAN (see *figure 27*. MPLS solution offers Quality of Service (QoS) through label switching [25, p.2]. QoS enables network Konecranes to categorize the network traffic between data center locations according to the business needs and has made videoconferencing services possible. Servers are connected to data center switches, which are connected to routers.

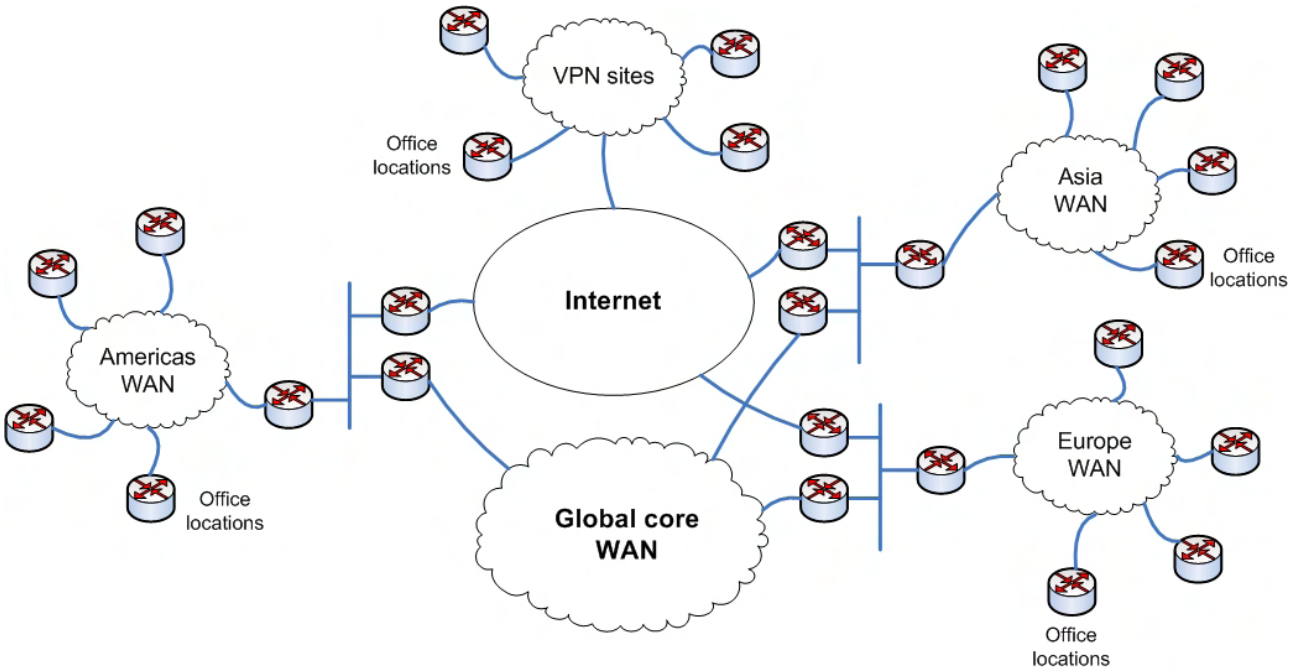

Figure 27 Konecranes network structure

Smaller remote offices are connected to data centers using various technologies. Subscriber line technology is mostly xDSL (a family of technologies that provide digital data transmission over the wires of a local telephone network [26, p. 53]) for cost reasons. Network traffic for smaller remote offices is routed in the Internet using Virtual Private Network (VPN) tunnels. In the larger offices end users are connected to switches, but in the smallest offices end users can be connected directly to the remote office routers, which usually have a limited amount of LAN ports.

3.4.2 Konecranes Network Infrastructure Management - Former Situation and Problems

The human resources of Konecranes network team have been very limited worldwide. Hyvinkää Corporate IT employs two people specialized only in network service management. In other regions network service management is done by people with other IT responsibilities. Thus they are not able to fully support network service management and development. The way network service support and development is done has been varying between locations. Uniform processes have not existed or have been inadequate and inconsistent with Corporate IT processes. Also the network devices have been purchased from many different network equipment manufacturers, which brought challenges for the infrastructure management.

Previously configuration information has only resided in the network devices themselves and it has been very scattered. Obtaining the information for troubleshooting and planning has required too much work. Software levels for network devices were unknown. Finding the management address for a specific device was difficult. If configuration information was stored, for example, Excel-sheets were used. This information however became outdated quickly because no processes to keep the information up-to-date existed. Documents for network connection agreements have been located in various locations. When these documents were needed it could take extensive amount of time to find them.

Changes to network infrastructure were done without proper planning and many times resolutions were improvised. Impacts of the changes were not properly evaluated. Needs for the changes were not reviewed. This caused some unnecessary downtime for the network and resulted in problems. It was not easy for the IT management to find out what type of changes were planned and what were the schedules for them. Without relationship information between infrastructure devices a change to a device could cause abrupt consequences.

3.5 Summary

In this chapter a case study corporation Konecranes was introduced. Its current IT situation and network infrastructure were portrayed in a general level as well as problems with previous network management methods. Konecranes IT Service Management project was is introduced and Change Management and Configuration Management situation is presented. Also related processes Incident Management and Service Catalog are introduced shortly. This information was needed to build a background for the solution. The solution for Network Infrastructure Management builds on the needs and current situation of the Konecranes Network Management. After these were introduced the design of the solution can begin.

4 Solution

In this chapter background for the solution is represented followed by the actual solution for Network Infrastructure Management at Konecranes IT organization using ITIL best practices as a basis. This includes description of proposed Konecranes CMDB structure, definition of Configuration Item lifecycle process and Change Management process for Konecranes concerning network infrastructure.

4.1 ITIL Best Practices and Konecranes

4.1.1 ITIL Configuration Management and Konecranes

Managing IT infrastructure that is becoming more and more complex is a challenge. Keeping infrastructure information “in someone’s mind” does not work for large organizations. Employees change positions, get sick, have their holidays etc. When a new IT employee starts with the company the process of teaching the employee about infrastructure must be made as straightforward as possible so that the new employee can start working as efficiently as possible at an early date.

It has become evident that the information of the infrastructure must reside in some central location. For Konecranes adapting ITIL best practices this central location is called Configuration Management Database (CMDB). CMDB does not only hold the description of the devices in the infrastructure; it also holds configuration of the devices. Configuration information should be included in CMDB because in large organizations configuration information must be readily available and changes to configuration must be carefully planned. Also if problems occur it will be easier to determine if some recent change to configuration has caused this problem in question.

All of this comes with a price: CMDB must be kept up to date. One must be able to trust the information in CMDB otherwise it becomes unusable. Creating a central database for IT infrastructure is not enough itself. Processes for keeping the CMDB up to date must be introduced with CMDB. There must be clear processes for how to introduce new devices to CMDB and when configuration changes are needed how these changes are handled and how they will be recorded to CMDB.

4.1.2 ITIL Change Management and Konecranes

There has not been a structured process for changes made in Konecranes IT infrastructure. General Change Management project related to Konecranes ITSM project was started at the beginning of Fall 2007. Goal of this project is to define Konecranes IT Change Management processes so that Konecranes IT could handle and implement changes to IT services in a consistent manner.

When Change Management process is implemented Konecranes IT Change Management can control and monitor changes to IT production environment in a predetermined way. Introducing Change Management process means that changes become measurable and the whole general IT change process can be developed further. The Change Management process also creates an image for everyone how changes to IT infrastructure are executed in the Konecranes IT service organization. The process also makes it possible to categorize and therefore prioritize the changes that are most important for the business. This need has become more and more important over the years. Categorization is also needed because small impact changes can not require as much documenting as changes with larger impact or else IT personnel will be swamped with documenting having no time for the actual implementations.

Konecranes IT management sees that implementing a Change Management process would bring the following benefits for the IT service organization globally:

- IT support organization has fewer changes to be backed out, because changes are prepared in a more structured way.
- Only justified changes are applied to IT infrastructure, because every change request requires justification.
- Increased productivity of users, because there is less disruption and downtime for the IT services when changes are planned in a more strict way.
- Improved productivity of key IT personnel, because they have less distraction to repair faulty changes
- Greater ability to handle a large volume of changes, because there is a structured process to handle changes and the process should be easy to follow.
- Dependencies are known, because impact analysis is required for all the changes.
- Provide operations model to external service providers and synchronize activities with them, which makes it easier to outsource the implementation of the IT infrastructure changes.

4.1.3 Other Related Current ITIL Processes at Konecranes

Infrastructure management and thus Change and Configuration Management are also closely linked to other current ITIL processes that are rolled out together with them simultaneously at Konecranes, which are Incident Management and Service Catalog. ITIL Service Support book [7, p.71] defines incident as follows:

"Any event which is not part of the standard operation of a service and which causes, or may cause, an interruption to, or a reduction in, the quality of that service"

Objective of Incident Management is to:

"Restore normal operations as quickly as possible with the least possible impact on either the business or the user, at a cost-effective price."

Incident Management provides needs for making changes to IT infrastructure and thus is related to Change and Configuration Management.

Service Catalog [7, p.56] is a list of IT services that an organization provides to its employees and customers. Service productization process is responsible at Konecranes to find that information and keeping the information up to date. Service Catalog relates IT services to actual infrastructure components and is thus closely related to Configuration Management and CMDB. *Figure 28* shows the initial ITIL processes implemented at Konecranes IT.

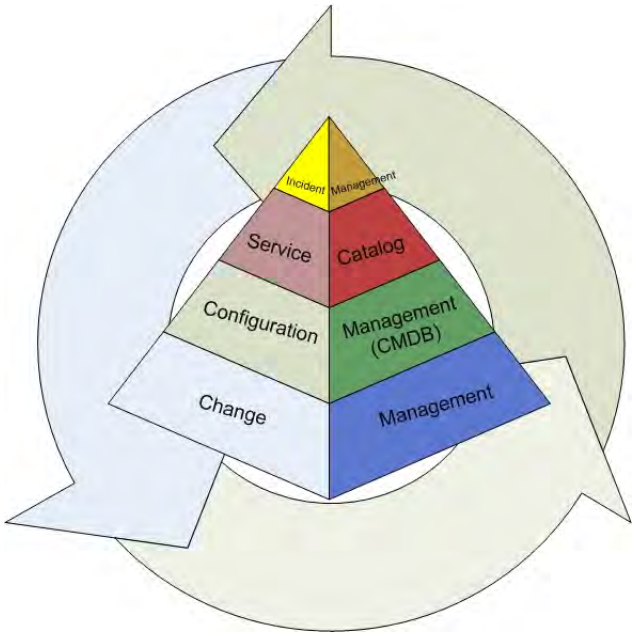

Figure 28 Konecranes initial ITIL processes

Although closely related to infrastructure management Incident Management and Service Catalog are not discussed any further in this thesis. They are a separate part of process development.

4.2 Description of Konecranes CMDB

One of the objectives of Konecranes Configuration Management is to develop CMDB that serves IT support organization, including network service support in the best possible way. Every infrastructure component should be linked to a larger system providing a meaning for the existence of the individual component. Systems should be linked to services that they provide for end users. Relations are bidirectional so that it is possible to see what systems are needed to provide services and to see what components are needed to build up the systems (*see figure 29*)

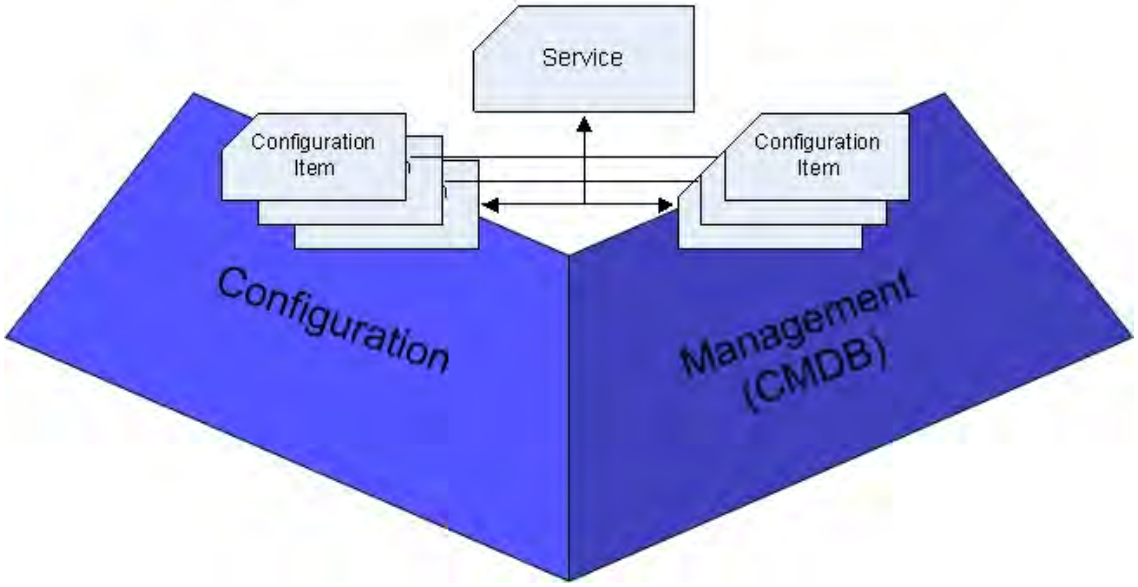

Figure 29 Configuration Management and Services

Information in the CMDB is used for other IT Service Support processes. Incident Management uses the information in the CMDB for troubleshooting and to link incident tickets to services and components. This information provides means for Problem Management to find out which services and infrastructure items have problems and might launch the need for changes in the infrastructure. Change Management uses the information in the CMDB for example for impact analysis and change planning. IT Management needs the information in the CMDB for reporting to be used for example for planning and financial management.

4.2.1 Level of Detail

Choosing the right level of detail for Configuration Items is a matter of achieving a balance between information availability, the right level of control, and the resources needed to support it. If the information at the detailed level is not valuable enough then a decision should be made not to store it. The organization should however plan to review the CI level on a regular basis – to confirm that information down to a detailed level is still valuable and useful, and that the handling of Changes and Problems and the management of assets are not deficient because CMDB does not go to a sufficiently detailed level.

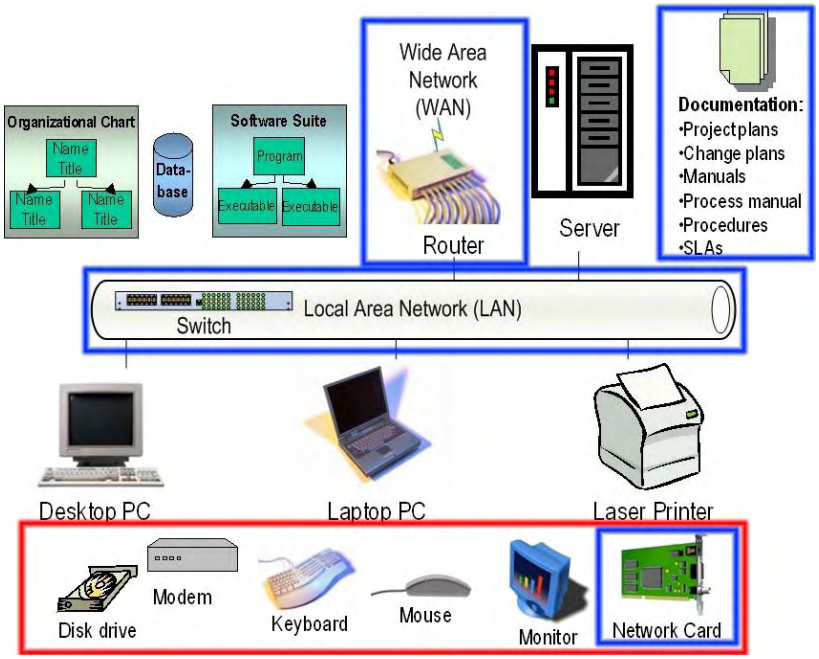

Figure 30 Example of level of detail in Konecranes CMDB

Figure 30 shows the selected initial selected level of detail in Konecranes CMDB (Based on *Figure 4*). Items that reside inside red box are considered to be too detailed to be included in CMDB. Items that reside inside blue boxes are to particular interest of Network Infrastructure Management.

Choosing the level of detail too general might mean problems for IT functions needing more detailed information. Choice was made not to include for example actual configuration information of the infrastructure. It is easier to implement CMDB first as a more general asset management type of database and if the need to include more detailed information becomes evident to include more detailed information in the form of actual configuration information etc.

4.2.2 Konecranes CMDB Structure

Konecranes CMDB structure was decided to be split into four main categories: Group, Service Catalog, Software and Documents (see *figure 31*).

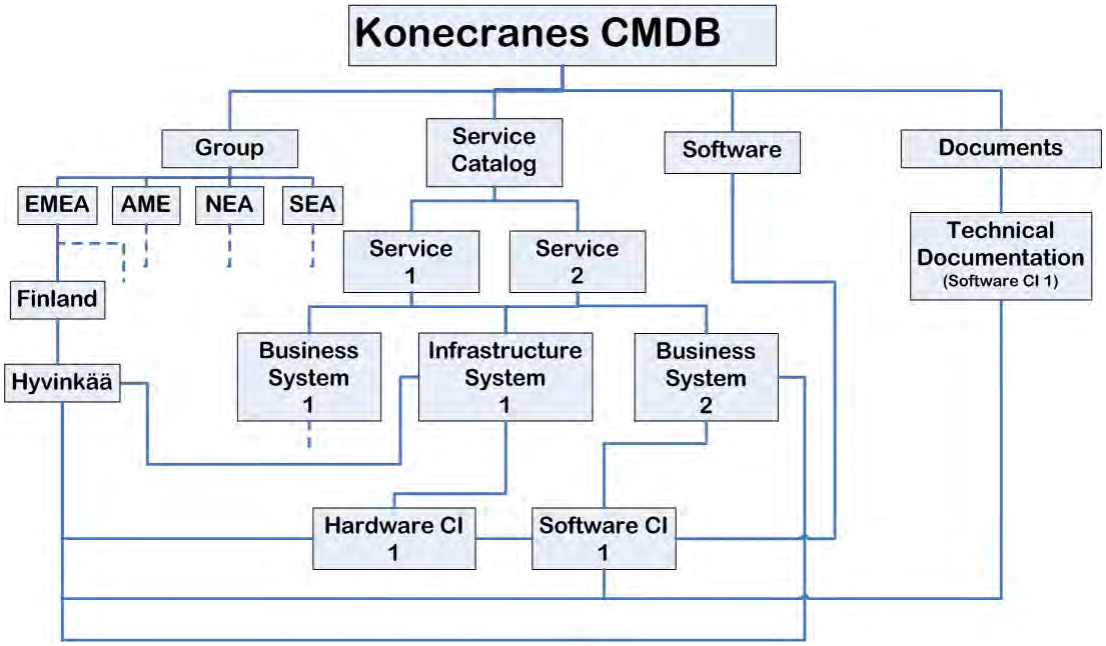

Figure 31 Konecranes CMDB structure breakdown

- Group: Contains hardware and system CIs, which are organized to office folders according to their actual physical location. Exception was made for workstations, which are placed to country level because automatic subnet scans would require too much administrative work. Folder structure has four levels Group, Region, Country and Office.
- Service Catalog: Contains the descriptions of IT services offered by Konecranes IT. Service catalog has two levels: Services and Sub-services. Services are more general services that would be easier to understand for end-users. No product names or technology terms are used on this level. See the next section for a network related example.
- Software: Contains the software library for computer software used at Konecranes. Software library is planned to be extended to Definitive Software Library (DSL) in the future. ITIL Service Support terminology [7, p.267] explains DSL:

  "*DSL is the library in which the definitive authorized versions of all software CIs are stored and protected... ...Only authorized software should be accepted into the DSL, strictly controlled by Change and Release Management. The DSL exists not directly because of the needs of the Configuration Management process, but as a common place for the Release Management and Configuration Management processes.*"

Initially Konecranes CMDB Software folder will only contain CI cards for server side software for example server operating systems and databases. CI cards only hold information about the installed software; the actual installation files etc. are not yet to be included in the CMDB. Firmware versions for network equipment are not included at first and workstation software will also be included in the future because of the enormous number of different workstation software and the lack of Release Management process.

- Documents: Contains all CI related documents. For example technical documentation, service descriptions, helpdesk instructions for each service, architectural descriptions and agreements etc. The documents are linked to CIs, which are also back-linked to the documents. Documents are usually accessed through the actual CIs under Group- or Service Catalog-folders, but they can be also searched under the Documents-folder, which gives practical view of all the specific document types.

4.2.3 CMDB Structure Network Example

Network Infrastructure components (Configuration Items) are placed to a folder depending on their actual location. For example switches and routers located in Hyvinkää headquarter and factory area are placed in Hyvinkää-folder, which is located under Finland and region EMEA (see *figure 32*). Firmware software CI for the switches and routers are located under Software folder, but the firmware CI is linked to the network component, for example a switch, using the firmware. Technical documentation for the switches or routers is located in the Documents folder, but the actual CI documents are linked to network components that the documents are related to.

The whole Hyvinkää LAN forms an infrastructure system. The system is placed also in the Hyvinkää-folder in the CMDB. The network components that form the Hyvinkää are linked to Hyvinkää LAN system. Hyvinkää LAN system is linked to the LAN sub-service in the Service Catalog. LAN sub-service is linked to the main service Network.

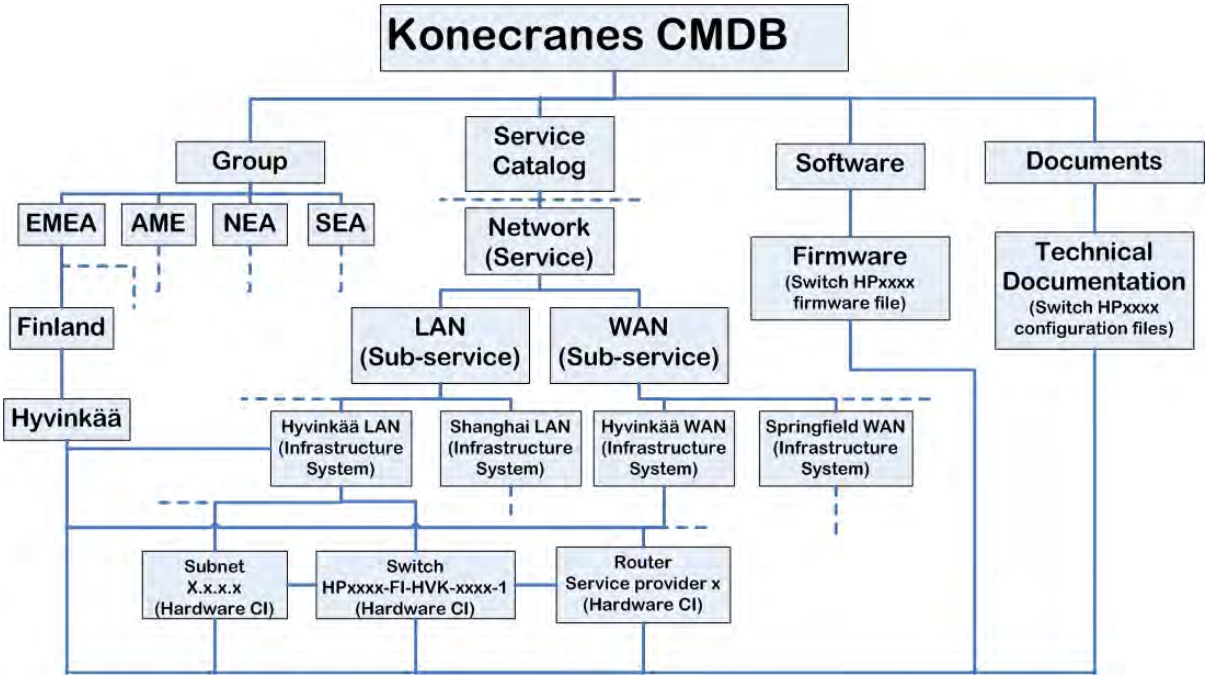

Figure 32 Konecranes CMDB Network Infrastructure Management viewpoint

Figure 32: Switch HPxxxx-FI-HVK-xxxx-1 is connected to a router. The switch uses the Subnet X.x.x.x, is located in Hyvinkää, has HPxxxx switch firmware file (Software) and contains the configuration file switch HPxxxx (Documents). The switch is part of Hyvinkää LAN infrastructure system, a child of LAN Sub-service. LAN Sub-service is a part of Service: Data communications. The switch HPxxxx-FI-HVK-xxxx-1 is thus a component of the Data communication service.

4.2.4 CI Types Related to Network Infrastructure Management

When types of the Configuration Items to be stored in CMDB were planned Network Infrastructure Management was considered as a separate area. CI types needed for Network Infrastructure Management were chosen to be:

1. Router
2. Switch
3. WLAN Access Point
4. Video Conference
5. Network Security device
6. Network Cabinet
7. Subnet

Each of these CI types has their own template with different attributes. However according to Konecranes Configuration Management and CMDB process all of the CI types in CMDB will have some common attributes. These common attributes are:

1. CI Name
2. CI Status
3. Team responsible
4. Documents
3. Additional information

Network infrastructure hardware devices (1 - 5) also have some additional common attributes:

1. IP address
2. Manufacturer
3. Model
4. Vendor
5. Management URL
6. Subnet
7. Connected to devices
8. Purchase date (Not applicable to Router. Routers are owned by telecom operators)
9. Warranty end date (Not applicable to Router. Routers are owned by telecom operators)

See *Appendix 1* for recommendations of ITIL for CI attributes. Konecranes Network Infrastructure Management related templates and attributes are shown in *Appendix 2.*

4.2.5 CMDB Relations

Configuration Items are linked and form relations in the CMDB. This is especially important for large organizations where for example impact analysis for IT infrastructure changes are considered. List of related IT components and services can be enormous.

In Konecranes CMDB relationships are handled through attributes. An attribute in CI card is linked to another attribute in another CI card and thus forms a relationship in the CMDB. This link can be one-way or two-way. Usually links should be made two-way, which means that when you create a link in one CI card the other CI card attribute link is updated automatically. The links in the attributes are hyperlinks that can be navigated through the WWW-browser. CI card also shows all related referrers for the card so if link is only made one-way it is still possible to see a list of the CIs that the CI in question is related to. The use of attributes and two-way links makes viewing relations easier, because the attribute field name can express what the type of the related CI is and also relations can be grouped according to that type.

Example:

- **Switch A** is connected to **Router B** (meaning **Router B** is also connected to **Switch A**)
- When updating **Switch A** CI card information **Router B** is added to attribute "Connected to devices" (see *Appendix 2*).
- **Switch A** attribute "Connected to devices" attribute is connected to **Router B** attribute "Connected LAN devices" (see *Appendix 2*). When **Switch A** CI card is saved also **Router B** CI card is updated and saved automatically.
- If one now views the **Router B** CI card he can see that **Router B** is connected to **Switch A** ("Connected LAN devices" attribute)

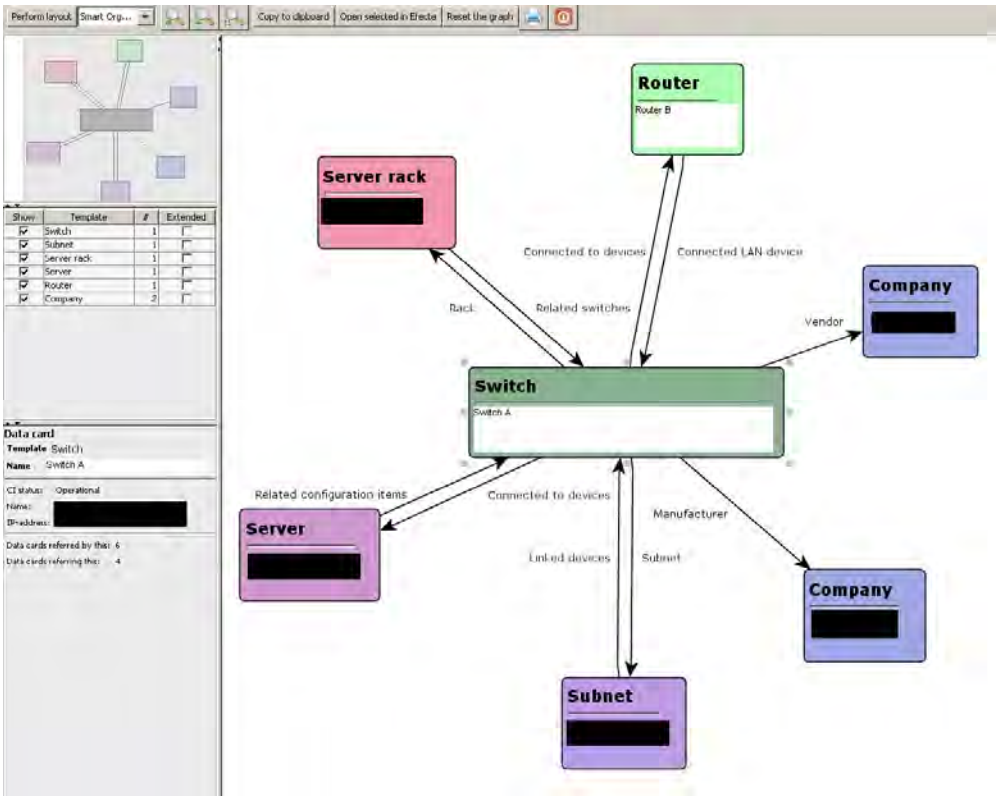

Figure 33 Actual visual relations in CMDB

In the *figure 33* one can see an actual visual view of all relations from Konecranes CMDB for **Switch A**. Names are covered for security reasons. It is easy to see that **Router** B is related to **Switch A** and relationship type is a physical connection "Connected to devices". One can also see that the LAN device the **Router** B is connected to is **Switch** A ("Connected LAN device"). Visual view for relations is very practical to visualize larger entities.

4.3 Configuration Item lifecycle

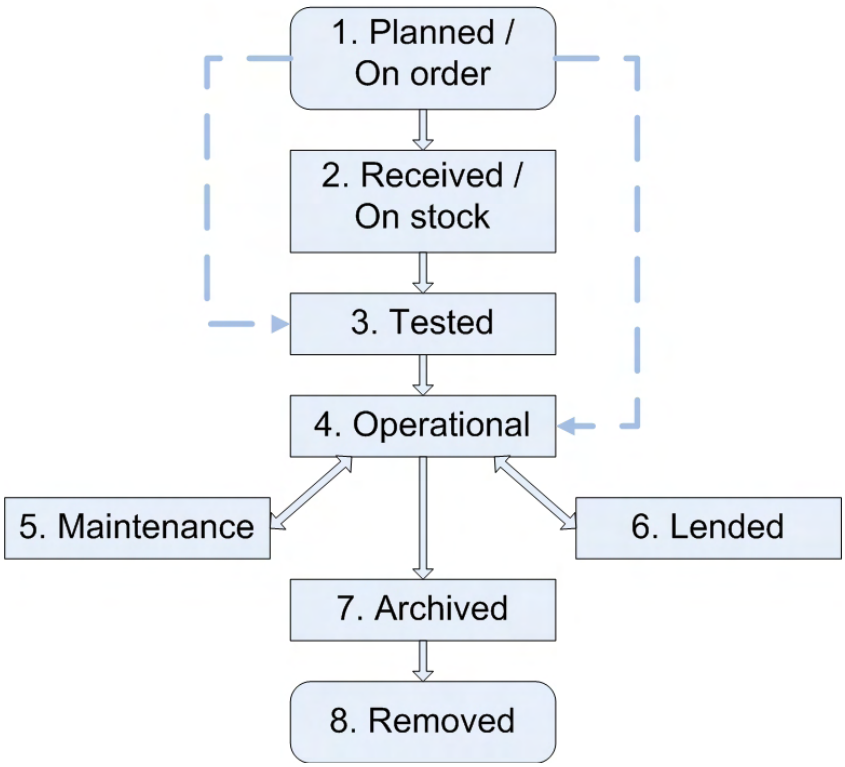

Figure 34 Lifecycle of hardware CI at Konecranes

Lifecycle of network related CIs follows a certain lifecycle (*see figure 34*). This lifecycle is stored in the CI attributes and is changed when the status of the real life network hardware changes. Example for a network device lifecycle can be the following for a network switch:

1. Switch is ordered from the vendor. A CI item card is created in the CMDB with the attributes found in *Appendix 2.* Status of the switch CI is set to **Planned / On order**.
2. Switch is received. If switch is not installed immediately status of the switch CI is set to **Received / On stock**.
3. Switch is powered on and tested to see that it is functional. Current Konecranes standard firmware version is installed if switch is not already on that firmware level. Switch is configured with the standard Konecranes switch settings. If some special settings are used they are recorded in the switch CI. A backup of the switch settings is taken and the file is linked to switch CI. Status of the CI is set to **Tested**.
4. Switch is installed to its location and tested on-site. A third party can be used for the installation, but final testing must be done by a Konecranes IT expert. After final testing when the switch is considered to be fully functional status of the switch CI is set to **Operational**.

5. If switch is to be used by a sub-contractor or minority shareholder company but maintenance is done by Konecranes Network team status of the switch CI is set to **Lended.**
6. If switch needs maintenance for an extended period of time (more than few hours) the status of the switch CI is set to **Maintenance.** This might mean that the switch is sent to vendor for warranty repairs or replacement. When the switch is taken back to use status of the switch CI is set again to **Operational**. If the switch unit is replaced the reason for the replacement is documented to switch CI and the status is changed to **Archived**. The new replacement switch is tested according to the procedure explained earlier.
7. When switch reaches its end of lifecycle for some reason and is removed from the production environment the status of the switch CI is changed to **Archived.**
8. When switch has been on **Archived** status for a calendar year CMDB tool automatically removes the switch CI from CMDB.

4.4 Change Management Process

Change management gets input from Incidents and Service Requests and produces changes to IT infrastructure and thus to CIs in the CMDB (*see figure 35*). Konecranes general Change Management process was documented into Change Management process description document during fall 2007. Konecranes Change Management process from Network Infrastructure Management perspective is introduced in this section.

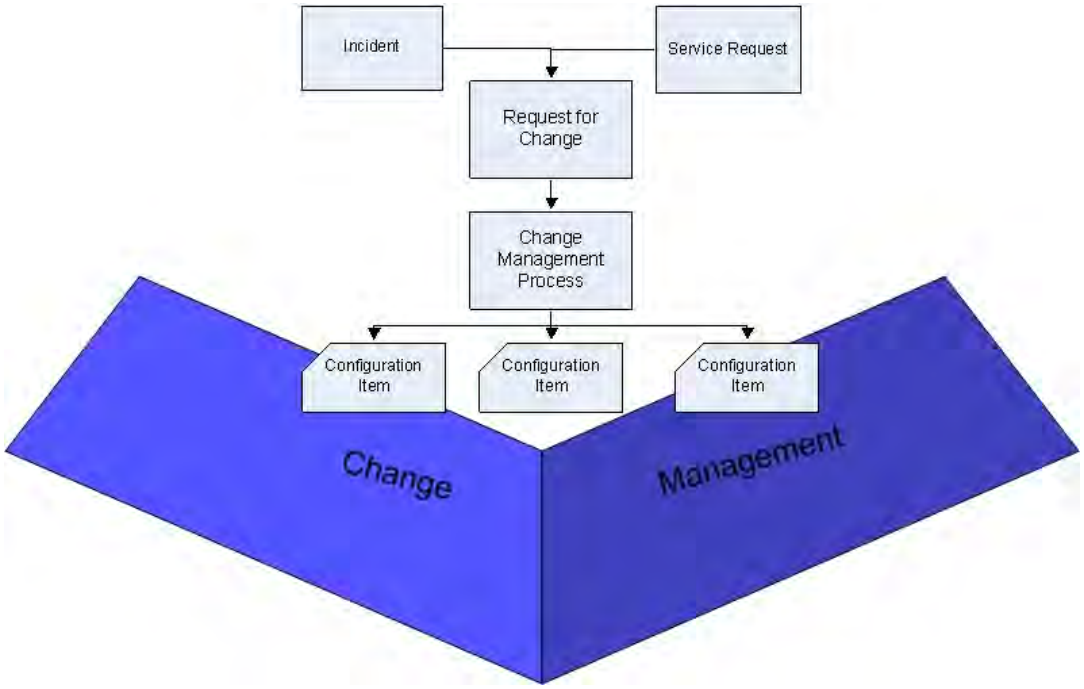

Figure 35 Change Management inputs and outputs

Changes to IT services have been handled with RfC tickets by IT support, including network team for some time already. This has not worked very well in reality:

- A lot of changes were done without RfC tickets
- Ticket template was not serving its purpose
- Confusion what fields were required
- Confusion how the process works (or if there was a process at all)
- Responsibilities were unclear
- A need to categorize the IT infrastructure changes was becoming evident
- Documenting repetitive changes with small impact on the end-users took too much work
- Changes with large impact were not handled so that the changes would be evaluated, approved, planned, implemented and reviewed correctly

4.4.1 Change Management Process Overview

Change Management process needed a document that explained the process that would take these matters in to consideration. General Change Management process flow was introduced. Overview of the Konecranes Change process for IT infrastructure changes at Konecranes is presented in the *figure 36*. It is based on the more detailed version of the Change Management process presented in the *Appendix 3*.

Comparing the figure to ITIL example of Change Management process in the section 2.4 (*figure 9*) shows the similarities. This is evident because the ITIL version of the process has been used as a background for Konecranes process, but the Change Management process for Konecranes needed to be tailored specifically for Konecranes business needs. Roles and responsibilities regarding the process are presented after the process description.

Figure 36 Change process overview

1) Change Originator requests for a change by using a web form in the intranet or by sending e-mail to the Service desk. Change initiator can be anyone from the Konecranes organization or a vendor that initiates the need for change in the IT services or infrastructure. RfC ticket is created.
2) Change coordinator reviews the Request for Change (RfC) ticket.
3) Change coordinator evaluates the RfC, classifies it, and categorizes it based on the impact and urgency. Change classification: Normal, Major.
Impact x Urgency (High, Medium, Low) =
Priority (Critical, High, Medium, Low)
Change coordinator does the initial planning of the change implementation by describing the change and by assessing the change necessity and feasibility based on the business, financial and technical viewpoints.
4) The change request is approved for implementation either by the Change coordinator or the Change Advisory Board (CAB). Need for CAB approval depends on the change impact for the business, the scope of the investment, the amount of resources needed for implementation, and the amount of risk related to the change implementation.

5) Change coordinator plans the change implementation by defining the tasks needed to complete the implementation, the work effort, resources, schedule, budget and acceptance criteria. Change implementor plans the change implementation from the technical viewpoint by defining the technical solution, test and back out plans.

6) The change is implemented according to the implementation plan and "Build and Test" and "Release to Production" methods:

- "Build and Test" is the change preparation process where impact of the change is verified and also what will be done and how. It also includes testing if feasible.
- "Release to Production" is the process of taking changes to production. It also involves defining if the change can be considered successful or not and deciding if implementation of back-out plan is needed.

Technical implementation part of the process will be addressed in more detail when Release Management process is introduced in the future.

7) The change implementation success and impact are reviewed in cooperation with the Change Originator. The RfC ticket and related information is updated, and the change ticket closed.

4.4.2 RfC Roles and Responsibilities

Change Management process defines roles and responsibilities related to RfC handling:

Change Originator: Incident Management, Problem Management, Service Request, CI owner, Business IT, vendor, user or any other interest group who has noticed a defect or enhancement target. Responsibilities of Change Originator:

- submitting the change request
- accepting the completed change

Change Coordinator: Service owner, Application key-user, Infrastructure manager, Project manager or Business IT Manager. Change coordinator takes care that the change is applied according to agreed procedures (acceptance, outage, SLA). Responsibilities of Change Coordinator:

- reviewing and filtering RfCs
- assessing and evaluating RfCs
- planning the change implementation (e.g. tasks, resources, costs, schedule, acceptance criteria)
- coordinating the technical planning
- accepting and qualifying Normal change plans
- coordinating change implementation
- determining success of the change
- changing RfC status to Resolved after customer satisfied with the change
- reviewing and completing RfC in Efecte
- updating the service description and related material according to the change

Change Implementor: Internal expert / expert team, external supplier or Business IT. Responsibilities of Change Implementor:

- planning the change technical solution
- applying the change according to agreed procedure
- updating CMDB CIs after changes

Change Advisory Board (CAB): For IT infrastructure changes CAB consists of Back End Services team (including workstation manager) of the datacenter in question. CAB meetings are held as a part of regular BES meetings. If authorization from Business application owner is needed CAB meeting participants are considered separately. In this case CAB consists of IT Managers, Business IT Managers, CI Owners and Change Implementors from BES team depending on the requested change. These meetings can be held as a part of business application control meetings. Responsibilities of CAB:

- authorizing Major changes to implementation
- Post Implementation Review (PIR) after resolved RdCs
- closing RFCs

Regional CAB Participants:

- Regional IT Manager (chair)
- Change Coordinator(s)
- Other Subject Matter Experts (SME) (When needed)
- Service Owner(s) (When needed)
- Business IT Manager (When needed)

Global CAB Participants:

- Chief Information Officer (chair)
- Region Europe IT Manager
- Region Americas IT Manager
- Region Asia-Pacific IT Manager
- Business IT Managers
- Global data center architect

Meetings are documented in meeting minutes created by a CAB member agreed separately in each meeting. Meeting minutes will be distributed to all participants and saved electronically in a centralized shared document repository. Regional CAB meeting minutes are forwarded also to global data center manager.

Emergency Change Advisory Board (ECAB): Accepts major changes which are prioritized as critical and which could cause substantial harm to business if not applied immediately. ECAB has the role of reviewing and accepting these Major changes that cannot wait until the next CAB meeting. ECAB consists of service key user, service owner and if service has related services their service owner(s). ECAB members are contacted by e-mail or in extremely urgent cases by phone. If person is unavailable his superior is contacted for approval of the change. After emergency implementation change returns to normal Change Management process. Responsibilities:

- authorizing Major and urgent changes to implementation

Service Owner (SO): Person appointed to be responsible of the service. Service owner is the single-point-of-contact for a specific service. Name of the SO for specific service can be found in Konecranes Service Catalog service requirements document. Responsibilities of Service Owner:

- owning and representing service
- understanding which components make up the service
- attending CAB meetings if changes are relevant to his service
- acting as a Change Coordinator for changes in his area of responsibility

Process Owner (PO): Person appointed to be responsible of the process.
Responsibilities of Process owner:

- looking after that organization follows the agreed Change Management process.

Key Application User (KAU): The person who knows the IT application in such a depth that he can assist others. Name of the KAU can be found in Konecranes Service Catalogue service requirements document. Responsibilities of Key user:

- service support and development
- updating the service description in the Konecranes Service Catalog after changes if needed
- may act as Change Implementor together for example with Backend Services or external vendors

4.4.3 RfC Categories

Konecranes IT had the need to make sure that changes with large impact on business are handled correctly; evaluated, approved, planned, implemented and reviewed. But also a need to make sure that small impact changes do not require as much documenting as changes with larger impact, because that would overburden the IT staff. That is why changes were categorized into 3 different levels: **Normal**, **Major** and **Emergency** change.

However not every request for modification is treated as a change. Daily routine tasks that are clearly defined and covered by pre-defined operational procedures that have a small impact on business are handled as Service Request tickets. Service Requests are handled by Helpdesk or 2nd level specialists and the tasks are conducted by procedures and related instructions created by the 2nd level support, IT service key users or IT service owners who are also responsible for training them to the Helpdesk and 2nd level support specialists. Examples of network infrastructure related changes to be conducted as Service Requests:

- Connecting a user workstation to corporate LAN
- Ordering and installing a work desk switch
- Installing a certificate for a user to connect to corporate WLAN

Descriptive to **Normal** changes is that they will be planned and implemented by a predefined procedure. Typically these changes are implemented by IT 2nd level support. Change is applied according to predefined procedures (instructions how to apply change), which have been created by the 2nd level support or the IT service key user. The procedure has to be pre-approved by the IT service owner. **Normal** changes are repetitive with known outcomes and known staff who are authorized to implement. Examples of network infrastructure related changes to be conducted as a **Normal** change:

- Ordering, installing and testing a data center switch
- Upgrading a network connection at a remote office
- Updating a firmware of an office LAN switch

Any change which is not a **Normal** change that will or has the potential to interrupt multiple business critical services. Typically these are changes, which have impact for the business services, costs, resource requirements or which may cause technical risk. All Major changes have to be approved by Change Advisory Board (CAB) prior to detailed planning and implementation. In case of conflicts e.g. in resourcing the implementation CAB is responsible for prioritizing the changes depending on their criticality to the business. Examples of network infrastructure related changes to be conducted as a **Major** change:

- Move of a data center switch connected to several servers
- Changing a network operator at a medium to large sized office with more than 5 users (limit set by Konecranes IT Management)
- Updating a firmware of a data center switch connected to several servers

Some **Major** changes have such a big impact on the business that CAB has to be escalate them to the Konecranes IT board for an approval. Network Infrastructure Management related example would be the change from a multi-operator Internet VPN connections to a single-operator MPLS connections at a region for all the remote offices.

Major change is considered an **Emergency** change if it may cause a severe risk for the service continuity if not implemented immediately. Change becomes **Emergency** change if RfC ticket has Critical priority. Priority Critical if the RfC fields Impact and Urgency are both considered to be high. Despite the potential hurry in implementation RfC has to be created and change has to be planned. After the change implementation RfC returns to normal Change Management process.

Emergency changes have to be approved by people in corresponding ECAB, which consists of IT service owner and key user. If they cannot be contacted superior of the service owner is contacted for the approval. Examples of network infrastructure related changes to be conducted as an **Emergency** change:

- Konecranes core Internet router needs to be replaced
- Konecranes data center switch connected to several server needs to be replaced
- Fiber module of a fiber connection to an office building with tens of users needs to be replaced.

4.4.4 Request for Change (RfC) Ticket Template

RfC ticket template is used to document the changes in the tickets into Konecranes IT support tool. It is constructed so that it directs the IT support staff to follow the process. General direction to fill the document is to advance from top downwards when the process for the individual change is actualized. The RfC ticket template is presented in the *Appendix 4*.

A quick-chart for the IT support employees, which explains in general level how the RfC ticket is handled throughout its lifecycle, is presented here in the *tables 2-4*. This example is based on a **Normal** (category) change. More detailed user guidebook was also made to guide IT support through the RfC ticket handling process along with the actual Change Management process description document.

PHASE OF THE RfC:	**1. CREATION**	**2. PROCESSING**
PHASE OF THE RfC PROCESS	1 Request for change	2 Review and filtering
RESPONSIBILITY	Change originator	Change coordinator
MINIMUM INFORMATION TO BE FILLED IN AND CHECKED (According to the Konecranes RfC process)	Subject RfC description RfC arguments Change originator Support Group	Change coordinator Levels Change review date Related services Related systems Related configuration items Related INC/SR Parent RfC Child RfCs RfC status
STATUS	1. RFC Untouched	2. RFC Solving

Table 2

PHASE OF THE RfC:	3. EVALUATION 4. APPROVAL	5. PLANNING
PHASE OF THE RfC PROCESS	3 Assess and evaluate 4 Change Authorization	5 Change planning
RESPONSIBILITY	Change coordinator	Change implementor
MINIMUM INFORMATION TO BE FILLED IN AND CHECKED (According to the Konecranes RfC process)	Change implementor RfC Impact RfC Benefits RfC Resources RfC Risks Impact, Urgency Priority Count RfC Category RfC initial Start date RfC Required finish date RfC status	RfC Change plan Required Service Requests File Attachments Implementation plan Test plan RfC status
STATUS	5. RFC Accepted for implementation	2. RFC Solving

Table 3

PHASE OF THE RfC:	6. IMPLEMENTATION	7. CLOSING
PHASE OF THE RfC PROCESS	6 Change implementation	7 Change Review
RESPONSIBILITY	Change implementor	Change originator Change coordinator CAB
MINIMUM INFORMATION TO BE FILLED IN AND CHECKED (According to the Konecranes RfC process)	Internal comments Add (while solving) RfC status --- Internal comments Add (implementation successful) RfC status	Internal comments Add (customer acceptance) RfC status --- Implementation review (check fields to be filled in according to Konecranes RfC – process) Post Implementation Review PIR date RfC status
STATUS	2. RFC Solving 3. RFC Waiting for acceptance	7. RFC Resolved 8. RFC Closed

Table 4

4.5 Summary

In this chapter background for the solution was presented. Chapter included proposed solution for Network Infrastructure Management at Konecranes IT organization using ITIL best practices as a basis. This consisted of a proposal for Konecranes CMDB structure, definition of Configuration Item lifecycle process. Change Management process consisted of the process steps for the changes, roles and responsibilities, change categorization and Request for Change ticket template and instructions of using the ticket for the changes according to the Change Management process. These individual practices form the complete Network Infrastructure Management solution for Konecranes. In the next chapter the solution is validated.

5 Validation of Solution

In this chapter results of the thesis are discussed. Overall current situation is reviewed after introducing new processes for Change and Configuration Management together with implementation of CMDB from the Network Infrastructure Management viewpoint. Research objectives are repeated and the results are reviewed against objectives specifically for Configuration Management and CMDB and Change Management.

5.1 Situation

Rollouts of ITSM processes are still on going at Konecranes. This includes Change and Configuration Management, which covers also Network Infrastructure Management. Benefits for the global processes are therefore for the most part still to been seen. However some benefits can already be seen.

The practices have only been introduced to the Headquarters IT team, which includes also the region Finland network team. Rollout for Change and Configuration processes for Konecranes USA IT team, which includes also the specialist responsible of Network Infrastructure Management, was done in December 2007 and the pilot for that is ongoing. Challenge is to introduce these processes globally. A lot of training is needed for these although good outcome from HQ helps to state the reasons the benefits in real life. Problem has been and will be for employees to really take these processes in use in everyday Network Infrastructure Management and follow the processes also in the future. Rollout for Shanghai, tier 1 data center is planned for February 2008. Rollouts for tier 2 data centers are planned to be done during the Spring 2008 and early Fall 2008.

For Konecranes Network Infrastructure Management CMMI maturity target level 3 "Defined" can now be consider as a reached objective. Processes are now defined and tailored from the Konecranes IT set of standard processes. Process improvement information contributes to organizational process assets.

5.2 Research objectives

This thesis aimed at answering the following questions:

- How to construct Network Infrastructure Management processes using ITIL best practice guidance as a background for a global corporation?
- How to construct and describe Change Management process ·to enable common and consistent way of managing changes in the network infrastructure?
- How to construct and describe Configuration Management process and CMDB so that information about network infrastructure is globally accessible, relationships between infrastructure items are known and the information about the infrastructure is kept up-to-date?

5.3 Configuration Management and CMDB

ITIL process objectives (*Table 1*) for Configuration Management are reviewed here for actual results and current status of Konecranes Network Infrastructure.

Objective 1. Undertake configuration management planning:
Konecranes Configuration Management process document describes the general configuration management planning for Konecranes. Configuration Management for Network Infrastructure Management follows this general process.

Objective 2. Identify configuration items:
Information of all routers, subnets, videoconferencing equipment and Managed Security Service (MSS) devices has been gathered. Information of switches and WLAN access point is still incomplete globally. Information shall be gathered together with roll out planning for Configuration Management for individual regions.

Objective 3. Establish CMDB and DSL:
Konecranes CMDB now includes all the routers, subnets, videoconferencing equipment, MSS devices of Konecranes and their Configuration Item cards with required information globally. These are known to Konecranes corporate IT. CMDB only includes switches and WLAN access point equipment for some geographical areas. All of the switches and WLAN access points shall be added

to global CMDB after Configuration Management and CMDB have been rolled out globally. Definitive Software Library (DSL) is not included in Konecranes CMDB at this point.

Objective 4. Control configuration:

Configuration baselines for network infrastructure devices are now formed in the CMDB and whenever there are changes to the attributes of the configuration items these changes are addressed through Change Management process.

Objective 5. Maintain and track CI status:

Maintaining and tracking of network infrastructure CI statuses is now possible, but implementation of Configuration Management is still at a too early stage that tracking CI status would have been used. CI status should be updated through Change Management process already. Tracking of CI status is therefore possible but has not been widely used yet.

Objective 6. Verify and audit CIs against CMDB records:

Verify and audit for network infrastructure will be planned globally once Configuration Management and CMDB have been introduced globally. However an actual verification of devices in the Hyvinkää data center is underway as a part of data center disaster recovery project. This includes also network infrastructure. Information gathered will be verified against CMDB and any inconsistencies are corrected. Also the reason behind each inconsistency should be investigated.

Objective 7. Manage libraries and licenses:

Definitive Software Library (DSL) was not part of the Konecranes Configuration Management process at this point. Therefore there is no software storage for managing libraries and licenses regarding network infrastructure at this point.

All in all most of the Configuration Management practices are planned and waiting for the implementation in the immediate future. Definitive Software Library design and implementation is not however done at this stage.

5.4 Change Management

ITIL process objectives (*Table 1*) for Change Management are reviewed here for actual results and current status of Konecranes Network Infrastructure.

Objective 1. Establish change approach, advisory board and procedures:
Konecranes Change Management process document describes the general change management approach for Konecranes, including Change Advisory Board (CAB) roles and responsibilities and also procedures for change management. Change Management for Network Infrastructure Management follows this general process. CAB always includes also representative(s) from network teams.

Objective 2. Assess and prioritize change:
Konecranes Change Management process document describes the method for assessing and prioritizing changes also for Network infrastructure. Changes are done using four categories. Changes that follow a pre-defined procedure and have a small impact are done using Service Request-tickets. Changes with larger impact are done using Request for Change (RfC) tickets. Changes with a midsized impact are categorized as Normal changes and follow a defined process. Changes with the highest impact are categorized as Major changes and follow a defined process with Change Advisory Board (CAB) processing involved.

Urgent changes with highest impact are categorized as Emergency changes. Handling these changes involves permission from Emergency Change Advisory Board (ECAB) and once the permission is received planning and executing the necessary change rapidly. After the urgent change is done the change handling reverts to same process flow as Major changes.

Objective 3. Approve change:
Changes to Network infrastructure that have a small impact and follow a pre-defined process and so are handled as Service Request-tickets do not require an approval before-hand. Normal changes are approved by Change Coordinator, Major Changes by CAB and Emergency changes by ECAB. Changes are approved by the customer after implementation.

Objective 4. Plan change:

Change Management process at the moment requires some defined information in the required change plans for Network infrastructure changes. Planning and implementing the change is not covered in fine detail in the Change Management process.

Objective 5. Maintain forward schedule of change:

Release Management is not practiced presently, which would mean actually planning the changes so that they would be gathered as releases and implemented together to the production environment during service hour windows. Forward schedule of change, which is a schedule that contains details of all the Changes approved for implementation and their proposed implementation dates, is not used at the moment. CAB has a general list of the planned dates for Major changes regarding Network infrastructure.

Objective 6. Co-ordinate change implementation:

Change Coordinator for Network infrastructure changes coordinates the implementation of Normal, Major and Urgent (if applicable) changes. Coordinating responsibilities of Change Coordinator are described in the Change Management process document.

Objective 7. Review change:

After the change implementation and approval from the customer Change Coordinator presents the change for CAB. All Normal, Major and Urgent Network infrastructure changes are reviewed at a CAB Post Implementation Review (PIR) session.

Objective 8. Report on change metrics:

Receiving metrics on Network infrastructure changes is possible through the ticketing system for Service Requests and RFCs. However at this point of Change Management process implementation IT management has not yet used these metrics for reports.

All in all most of the Change Management practices are planned and waiting for the implementation. Change metrics reporting has not been considered enough and should have been part of the process from the start. This should be a focus of improvement for Change Management process.

6 Conclusion

In this chapter results of the thesis are assessed and conclusions are made. Also the further development possibilities are discussed.

6.1 Assessment of the Results

When reviewing the process design some parts could have been done differently. The global implementation of the Change and Configuration Management processes are still on going so these ideas can be used during the implementation.

My part of the project has been to construct the Change and Configuration Management processes based on the requirements and wishes from the IT management. This work has been done with the help of consulting experts from Konecranes partners. Process descriptions have gone through a number of checks and rewrites. When the process has been ready the task has been to plan the actual implementation pilots for the different areas. In the future the task is to start the pilots in the various locations.

It has become evident that people behavior is in the core when taking processes in use in the real production environment. IT managers have a difficult task of motivating their staff to actually do things in a coherent way. The change from employees obtaining silent knowledge and keeping that information to themselves is pretty drastic. People have considered that having skills and knowledge that no one else has about IT infrastructure is useful for them because they become irreplaceable. Modern IT organizations however cannot be dependent on individual employees. Psychology of motivating people was not discussed in this thesis enough. It is an integral part of the process implementation. Consultancy from experts for the IT managers would be beneficial.

Processes can be implemented initially, but continuing to follow the new work methods also in the future is essential. Konecranes IT support tool Efecte offers many different possibilities for reporting. Reporting was not covered in this thesis, but building clear reports for the IT management should have been considered from the start. Some suggestions for the possible indicators should be suggested for the IT managers and they should follow the process implementation continuously. When it is seen that some parts of the process is not followed some actions should be taken to find the root cause for the reasons. If the process itself is not functioning

it might need to be updated and these updates have to be communicated globally. IT managers have to prepare also to take some disciplinary actions if an employee continuously refuse to work in a common way that is agreed by the management even after the employee is warned about his behavior.

Outsourcing the part of the IT functions is also growing. Even though having clear processes for Network Infrastructure Management helps discussions with outsourcing partners following these processes should also be included when designing agreements with the partners. Follow-up of the outsourcing should include reports of the processes and if problems arise they should be handled promptly. Implementation of the IT Service Management processes is a project but after the processes have been implemented they have to be followed up and the improvement of Network Infrastructure Management should be a continuous process that should never be forgotten.

6.2 Further Development Possibilities

In the ITIL literature Release Management for changes is usually tied tightly with Change Management. During the initial ITSM project launch Release Management was left out of scope because it would have made the project too vast, but it was stated that Release Management procedures are needed in the future after the first phase of ITSM rollout was done. First phase of ITSM project rollout included the areas that were considered to be most important at first: Global Incident Management and Service desk processes, global IT Service productization and thus global IT Service catalog and global processes for Change and Configuration Management, which included also Network Infrastructure Management.

Purpose of Release Management would be to gather changes to the IT-infrastructure as release packages and thus take control over releases. This would mean more proactive planning for changes and the introduction of perhaps monthly or quarterly maintenance windows. Release Management process development is scheduled to start in the third quarter of 2008. *Figure 37* shows the whole ITIL best practice portfolio, which is expected to be in use after 2009.

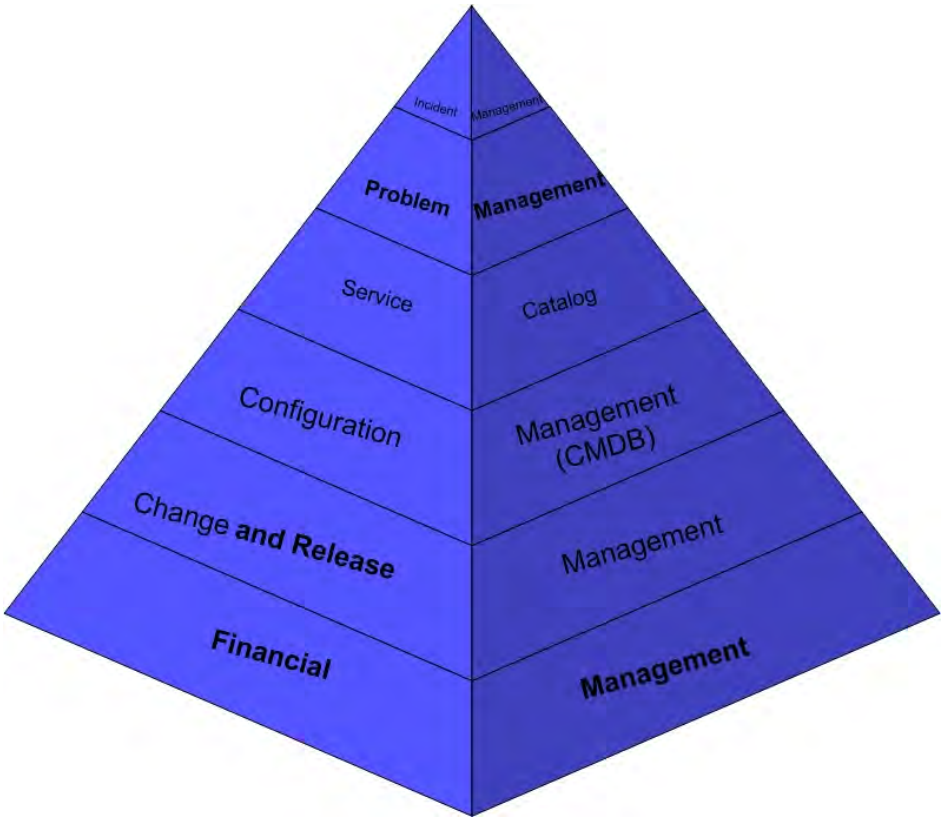

Figure 37 Full Konecranes ITIL service stack. Planned processes in bold

Problem and Financial Management process development are also planned related to IT Service Management process development, but they are not part of infrastructure management directly. Problem Management brings Incident Management a bit further by finding possible weaknesses in the IT service. Financial Management is needed to define cost for IT services and to measure cost effectiveness. With Financial Management and full Konecranes ITIL service stack IT department is able to function as an internal service provider for Konecranes business. Problem Management process development is scheduled to start in the third quarter of 2008 and Financial Management in the year 2009.

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Appendix

Appendix 1: Suggested CI Attributes [2, p.164]

Appendix 2: Network Related CMDB Templates and Attributes

Appendix 3: General Change Management Process Flow for Konecranes

Appendix 4: RfC Template

Appendix 1: Supported CI Attributes

The following attributes are examples that could be used in CMDB. Note that hardware CI types will have different attributes from software CI types.

Attribute	Description
CI Name	The unique name by which this type of CI is known
Copy or Serial Number	The number that uniquely identifies the particular instances of this CI - for example, for software the copy number, for hardware the serial number
Category	Classification of a CI (e.g. hardware, software, documentation)
Type	Description of CI type, amplifying 'category' information (e.g. hardware configuration, software package, hardware device or program module).
Model Number (hardware)	Model of CI (corresponding, for example, to supplier's model number e.g. Dell model xxx, PC/aa model yyy).
Warranty expiry date	Date when the supplier's warranty expires for the CI.
Version Number	The version number of the CI.
Location	The location of the CI, e.g. the library or media where the software Cis reside, the site/room where a service is located
Owner Responsible	The name and/or designation of the owner responsible for the CI
Responsibility Date	Date the above owner became responsible for the CI.
Source/supplier	The source of the CI, e.g. developed in-house, bought in from company xxxxx etc.
Licence	Licence number or reference to licence agreement
Supply Date	Date when the CI was supplied to the organisation
Accepted Date	Date when the CI was accepted by the organisation as satisfactorily tested
Status (current)	The current status of the CI; e.g. under 'test', 'live', 'archived'.
Status (scheduled)	The next scheduled status of the CI (with the date or indication of the event that will trigger the status change).
Parent CI(s) relationships	The unique CI identifiers(s) - name/copy/number/model/number/ of the 'parent(s)' of this CI.
Child CI(s) relationships	The unique CI identifiers(s) of all 'children' of this CI.
Relationships	The relationship of the CI with all Cis other than 'parent' and 'child' (e.g. this CI 'uses' another CI, this CI 'is connected to' another CI, this CI is 'resident on' another CI, this CI 'can access' another CI).
RFC Numbers	The identification number of all RFCs affecting this CI.
Change Numbers	The identification number of all Change records affecting this CI.
Problem Numbers	The identification number of all Problem records affecting this CI.
Incident Numbers	The identification number of all Incident records affecting this CI.
Comment	A comment field to be used for textual narrative; for example, to provide a description of how this version of the CI is different from the previous version.

For RFCs, Change records, package Release records, etc, the names, copy numbers, model numbers And version numbers of CIs affected by the Change, and how they are affected, should be recorded in the CMDB. A reversion path, and the consequences of reversion, should also be recorded.

Appendix 2: Network Related CMDB Templates and Attributes

Router

Router template in CMDB contains information of Konecranes WAN routers. Router template attributes:

1. CI status
2. Name
3. Rack / Blade
4. Space needed
5. Coordinate
6. Connection type
7. Connection provider
8. Service level
9. Bandwidth
10. LAN IP-Address
11. Subnet
12. WAN IP-Address
13. WAN Default Gateway
14. Management URL
15. Team responsible
16. Location
17. Network costs
18. Network information
19. Connected LAN device
20. Link to DHCP server
21. IP helper
22. Documents
23. Additional information

Switch

Switch template in CMDB contains information of Konecranes LAN switches. Switch template attributes:

1. CI status
2. Name
3. Rack / Blade
4. Space needed
5. Coordinate
6. Manufacturer
7. Vendor
8. Model
9. Serial Number
10. Team responsible
11. Subnet
12. IP-address
13. MAC-address
14. Connected to devices
15. Management URL
16. Purchase date
17. Warranty end date
18. Documents
19. Additional information

WLAN Access Point

WLAN Access Point template in CMDB contains information of Konecranes WLAN devices. WLAN Access Point template attributes:

1. CI status
2. Name
3. Manufacturer
4. Vendor
5. Serial Number
6. Team responsible
7. Subnet
8. IP-address
9. MAC-address
10. Radius server
11. Switch
12. Management URL
13. Location
14. Purchase date
15. Warranty end date
16. Documents
17. Additional information

Video Conferencing

Video Conferencing template in CMDB contains information of devices needed for Videoconferencing: Backend devices and actual video conferencing equipment in the meeting rooms. Videoconferencing template attributes:

1. CI status
2. Name
3. Rack / Blade
4. Space needed
5. Coordinates
6. Subnet
7. IP-Address
8. Manufacturer
9. Vendor
10. Model
11. Serial number
12. Team responsible
13. Management URL
14. Connected to devices
15. Location
16. Purchase date
17. Warranty end date
18. Documents
19. Additional information

Network Security device

Network security template in CMDB contains information of devices needed for network security: Firewalls, Web filtering, Antispam, Antivirus, Intrusion Protection. Device can contain multiple functionalities. Network Security device template:

1. CI status
2. Name
3. Rack / Blade
4. Space needed
5. Coordinates
6. Subnet
7. LAN IP-Address
8. WAN IP-Address
9. Manufacturer
10. Vendor
11. Model
12. Team responsible
13. Management URL
14. Services
15. Connected to devices
16. Purchase date
17. Warranty end date
18. Documents
19. Additional information

Subnet

Subnet template in CMDB contains information of Konecranes IP network subnets. Subnet template attributes:

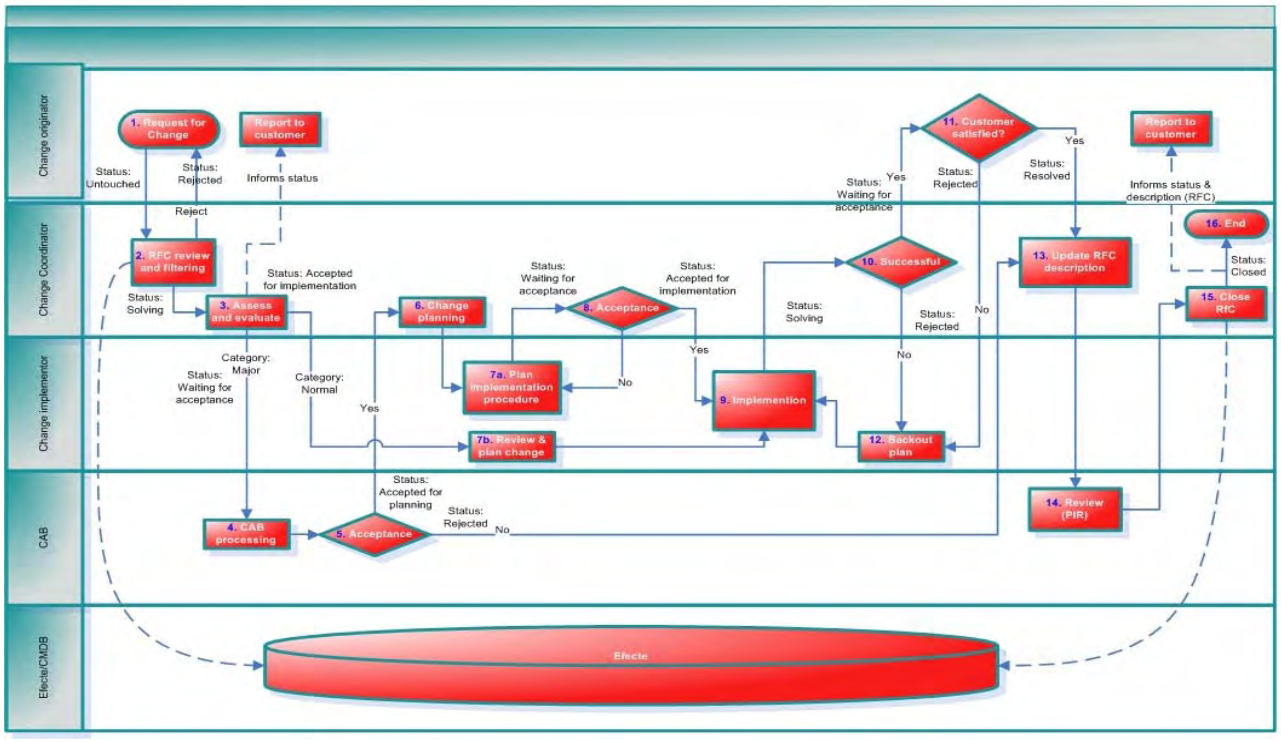
1. CI status
2. Name
3. Subnet
4. Subnet mask
5. Team responsible
6. Management URL
7. Connected to devices
8. Country
9. Documents
10. Additional information

Network Cabinet

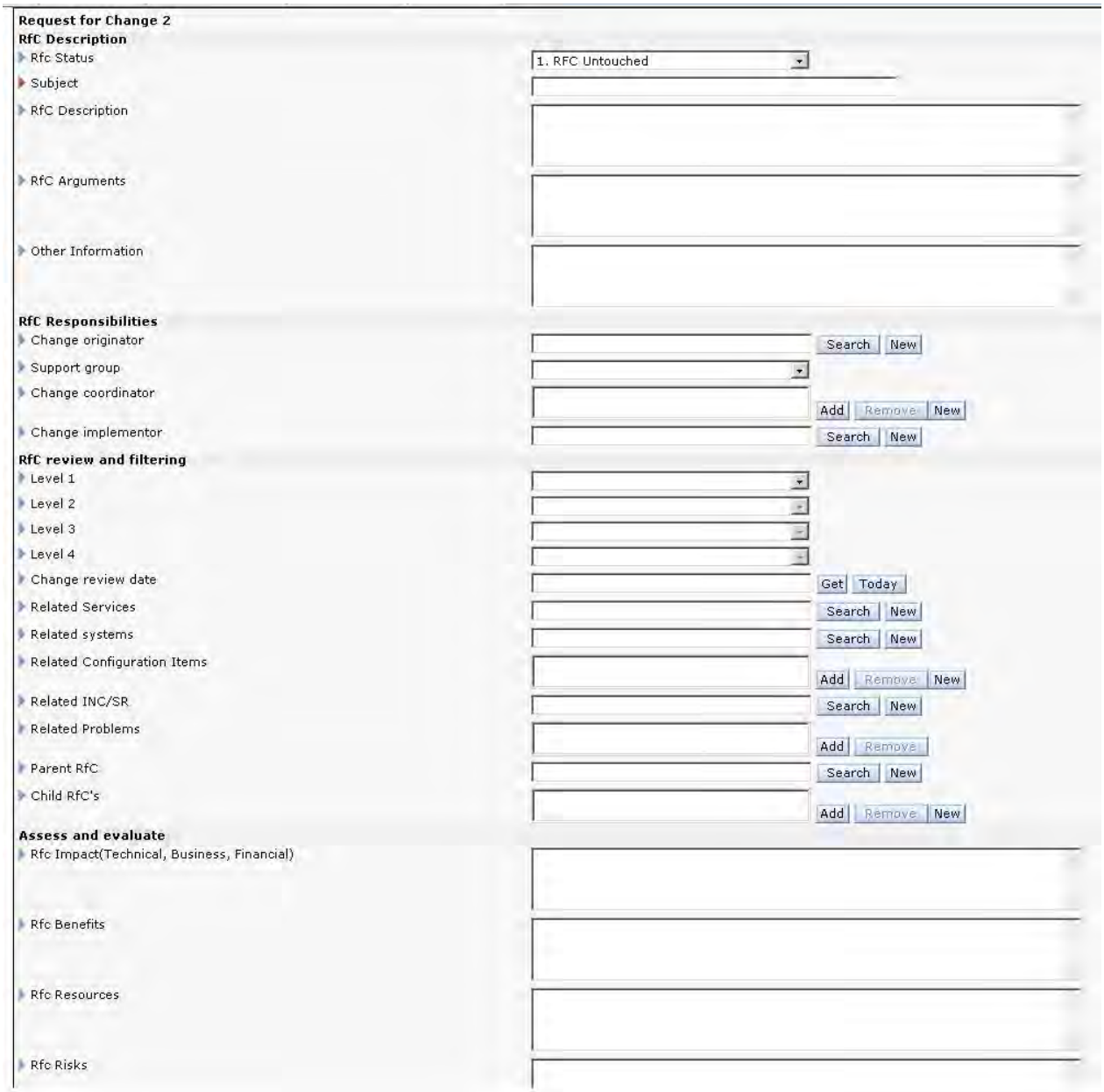
Network template in CMDB contains information of network cabinets needed to house different network related components. Network Cabinet template attributes:

1. CI status
2. Name
3. Location
4. Team responsible
5. Connected to devices
6. Documents
7. Additional information

Appendix 3: General Change Management Process Flow for Konecranes



Appendix 4: RfC Template



Request for Change 2

RfC Description

Rfc Status	1. RFC Untouched
Subject	
RfC Description	
RfC Arguments	
Other Information	

RfC Responsibilities

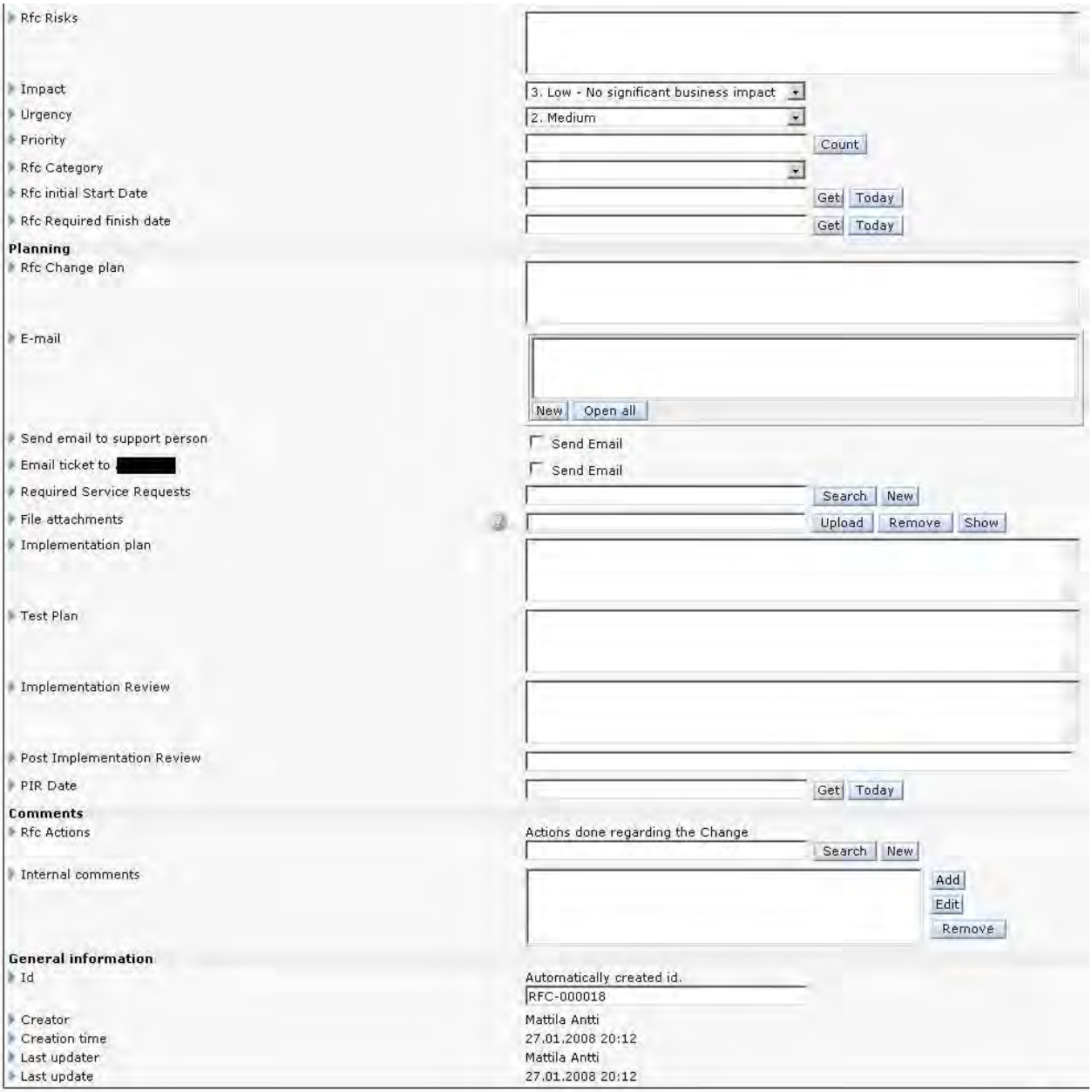
Change originator	Search New
Support group	
Change coordinator	Add Remove New
Change implementor	Search New

RfC review and filtering

Level 1	
Level 2	
Level 3	
Level 4	
Change review date	Get Today
Related Services	Search New
Related systems	Search New
Related Configuration Items	Add Remove New
Related INC/SR	Search New
Related Problems	Add Remove
Parent RfC	Search New
Child RfC's	Add Remove New

Assess and evaluate

Rfc Impact(Technical, Business, Financial)	
Rfc Benefits	
Rfc Resources	
Rfc Risks	


Rfc Risks
Impact
3. Low - No significant business impact
Urgency
2. Medium
Priority
Count
Rfc Category
Rfc initial Start Date
Get
Today
Rfc Required finish date
Get
Today
Planning
Rfc Change plan
E-mail
New
Open all
Send email to support person
Send Email
Email ticket to
Send Email
Required Service Requests
Search
New
File attachments
Upload
Remove
Show
Implementation plan
Test Plan
Implementation Review
Post Implementation Review
PIR Date
Get
Today
Comments
Rfc Actions
Actions done regarding the Change
Search
New
Internal comments
Add
Edit
Remove
General information
Id
Automatically created id.
RFC-000018
Creator
Mattila Antti
Creation time
27.01.2008 20:12
Last updater
Mattila Antti
Last update
27.01.2008 20:12

Folder