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Working Towards an ITIL Compliant
Configuration Management

Helsinki Metropolia University of Applied Sciences
Master's Degree
Industrial Management
Master's Thesis
10 May 2012

Preface

This Thesis is written for the completion of my master degree in Industrial Management at the Metropolia University of Applied Sciences, Finland. The study has broadened my knowledge of technology and business management.

First and foremost, I thank almighty God for his grace in aiding the completion of this study with great accomplishment.

This thesis work was carried out in a Finnish company in Finland under the supervision of Dr. Marjatta Huhta. My sincere appreciation goes to my supervisor for her support, motivation and encouragement in the successful completion of this work. Her intellectual suggestions and invaluable support towards this study are priceless.

I am also thankful to all my lecturers and staff of the Metropolia University of Applied Sciences for providing a conducive environment to study.

I wish to acknowledge the following individuals for their assistance on data collection: Elf Anne, Pia Koukkula for their kindness and assistance. Our meetings together on the use of those data and other valuable materials are also well acknowledged.

Lastly, I am deeply indebted to my husband Dr. Michael Adebayo Omidiora for his support, advice and inspiration to complete this Master's programme.

Helsinki, May 10, 2012

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| Author | Abimbola Omidiora |
| Title | Working towards an ITIL Compliant Configuration Management |
| Number of Pages | 68 pages + 6 appendices |
| Date | 10 May 2012 |
| Degree | Master's Degree |
| Degree Programme | Master's Degree in Industrial Management |
| Instructor | Marjatta Huhta, DSc (Tech) |
| <p>The objective of this Thesis is to suggest how to implement an ITIL compliant configuration management based on a set of ITIL-oriented recommendations tailored for the case company. Information Technology Infrastructure Library (ITIL) is a de facto standard to manage complex IT systems which comprises best practices from IT Service Management (ITSM). Configuration Management (CM) is an integral part of ITIL processes designed to streamline IT management by systematizing IT environment, and thus increase the reliability of the company IT system. A new, well-defined process is expected to serve as a store-house for the company IT infrastructure assets, provide impact analysis of the changes, and offer the right information to ICT users at the right time.</p> <p>To develop the recommendations for such a process, this Thesis first reviews the relevant ITIL literature on Configuration Management and Configuration Management Database (CMDB). The literature analysis is then followed by data collection via a case study research method. Subsequently, the obtained results are compared to demonstrate and analyze the differences between the current case company practices and the CM-compliant process suggested by ITIL.</p> <p>As its outcome, this Thesis proposes a set of recommendations and managerial implications, based on the literature review and findings from the case company that would help the company during the implementation of a new, pragmatic, ITIL-compliant Configuration Management process. These recommendations include a proposal for building a CMDB, as well draw attention to the areas that deserve special emphasis during the CMDB implementation.</p> | |
| Key words | ITIL, Configuration Management, Configuration Management Database, CM process, CMDB implementation, ITSM |

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Acronyms

| | |
|-----------|---|
| CAB | Change Advisory Board |
| CI | Configuration Items |
| CM | Configuration Management |
| CMDB | Configuration Management Database |
| CMS | Configuration Management System |
| DBA | Database Analyst |
| DSL | Definitive Software Library |
| EA | Enterprise Architecture |
| eCommerce | Electronic Commerce |
| EDI | Electronic Data Interchange |
| ERP | Enterprise Resource Planning |
| KPI | Key Performance Indicator |
| ICT | Information Communication Technology |
| ITAM | IT Asset Management |
| ITIL | Information Technology Infrastructure Library |
| ITSM | Information Technology Service Management |
| MDR | Management Data Repository |
| OGC | Office of Government Commerce |
| PC | Personal Computer |
| RFC | Request for Change |
| SACM | Service Asset and Configuration Management |
| SAP | Systems Applications and Products |
| SLA | Service Level Agreement |
| SQL | Structured Query Language |

1 Introduction

This Thesis focuses on implementing ITIL Configuration Management and its associated Configuration Management Database (CMDB) for a construction material service company.

1.1 Business Problem

"Within the last three years, nearly every vendor and consulting company has dropped competing IT service management methodologies to jump onto the IT Infrastructure Library (ITIL) or ITIL bandwagon; as a result, many companies are now requiring ITIL of vendors."

(Marquis 2007)

Smart organizations around the world have recognized the standard practices and benefits of a well-defined process for configuration management. Some organizations are yet to shift from old IT methodologies onto new best practises of managing organizational configuration items. However, the most popular and most acceptable framework for service and configuration management is ITIL. The ITIL is a collection of best practices that are designed to improve the IT operations within organizations of any type and size (OGC 2007). The case company in this study has already adopted some ITIL processes in the service processes and is willing to extend its use to the ITIL configuration management. ITIL configuration management is defined as

a process of identifying, defining and controlling configuration items (CI) in a system, recording and reporting the status of CIs, and maintaining and verifying the versions and correctness of CIs in existence (Office of Information Technology Services 2007).

The business problem to be solved in this study is that the configuration management process in the case company is not currently documented and ITIL-compliant and the associated configuration management database (CMDB) have not been implemented. The CMDB as will be shown in Section 3.2 is defined as

a logical database which holds a record of all configuration items (CIs) and details of the important relationships between CIs, associated with IT infrastructure (Office of Information Technology Services 2007) while CI is defined as a basic component in the network architecture, such as a switch, server, or even a software licence, that can be described inside a CMDB (Andrew 2005: 54).

Currently, the case company's information data (CI descriptions, ICT service inventory, IT infrastructure information, application and process documentation) is kept in a number of Excel spreadsheets. Several employees have their own spreadsheets. There is no single repository held where information can be accessed by all the ICT staff. Moreover, information about IT processes and how systems are integrated is not fully known by everyone. This results in unexpected downtime and outages, which take time to resolve. In consequence the impacts of IT incidents and problems on the business are often difficult to measure due to lack of standardised documentation on the application as well as the processes. These are the challenges facing the ICT department of the case company.

1.2 Case Company Description

The case company is an expert in comprehensive wholesales of construction materials and services founded in 1913. The case company's product portfolio includes plumbing, heating, cables, lighting, steel, utility, sanitary, ventilation, refrigeration, pipes, fittings, plastic and electrical products. Its customers include, contractors, industry, public organizations and retailers, in Finland, Sweden, Norway, Poland, Russia, Estonia, Latvia and Lithuania. The case company operates in eight countries and also has plans to extend its operation across other parts of the world. Its overall vision is to be the first choice in material services for the customers and suppliers, as well as the first choice as an employer; and its mission is to provide technical goods and services in order to improve its customers with value adding businesses and service concepts. The company's goal is to grow profitability and to reach and keep the position of first choice as partner for its major customers and suppliers. In 2011, the company's turnover was 1.5 billion Euros, and at year-end the company had 2800 employees.

The case company's group structure and business model are based on three divisions and four group functions. The divisions are responsible for business operation and the group functions have responsibility for developing the function in question on a group-wide basis. The divisions include: the case company Finland, which is in charge of business in Finland. The company also has an outlet in Scandinavia, which is in charge of business in Sweden and Norway. Other branches are in Poland, Russia and the Bal-

tic countries (Estonia, Latvia and Lithuania). The group functions include: Logistics, Group ICT, Finance and HR and Communication. Although the company operates its business service beyond Finland and has also four group functions, this study will focus on Group ICT of its Finnish office. The group ICT is responsible for the ICT strategy. It is also in charge of the group's data systems, data communication, IT solutions and services as well as for developing and enhancing these on a group-wide basis. Like other agile companies around the globe, the case company's business needs and activities depend heavily on its ICT infrastructure. The ICT systems support business activities and their developments are central to case company's competitiveness. The increasingly information intensive nature of business and networking with suppliers and customers emphasizes the need for an efficient, reliable and coherent information system.

As the company's business grows, the pressure and expectations on ICT department are continuously growing. However, for the ICT department to continually deliver good quality of service to business as stated in the company's mission and vision, ICT operations need to be continuously improved upon. The case company has recognised a need for the continuous improvement in its operations and processes. In view of this improvement process, the case company has decided to implement ITIL configuration management and build its own configuration management database. This in turn will help to effectively align ITIL configuration management process and CMDB with organizational needs. In addition, as this Thesis is concentrating on Finnish Group ICT, the focus is on the analysis of the current practice of ICT department in relation to configuration management, while it aims at preparing ground for the ITIL configuration management to be set in place.

1.3 Research Objective

This study explores the practice of configuration management in a construction material service company and presents ITIL configuration management as a new concept for the management and maintenance of configuration items.

The purpose of this study is to analyze the current practice of configuration management in a construction material service company by finding out how its ICT department

currently operate in relation to its configuration management as well as the configuration management database (CMDB). Based on the analysis, the study aims at preparing ground for the ITIL configuration management to be set in place by finding out feasible solutions of how the ICT staff members could store and access configuration items to be available to ICT staff use. The research questions for this Thesis are framed as follows:

*What are the current practices of configuration management?
How to build an ITIL compliant configuration management process, including a CMDB?*

To address these questions, the following plan has been designed.

1.4 Research Design and Structure of the Thesis

The research is structured as shown in Figure 1.

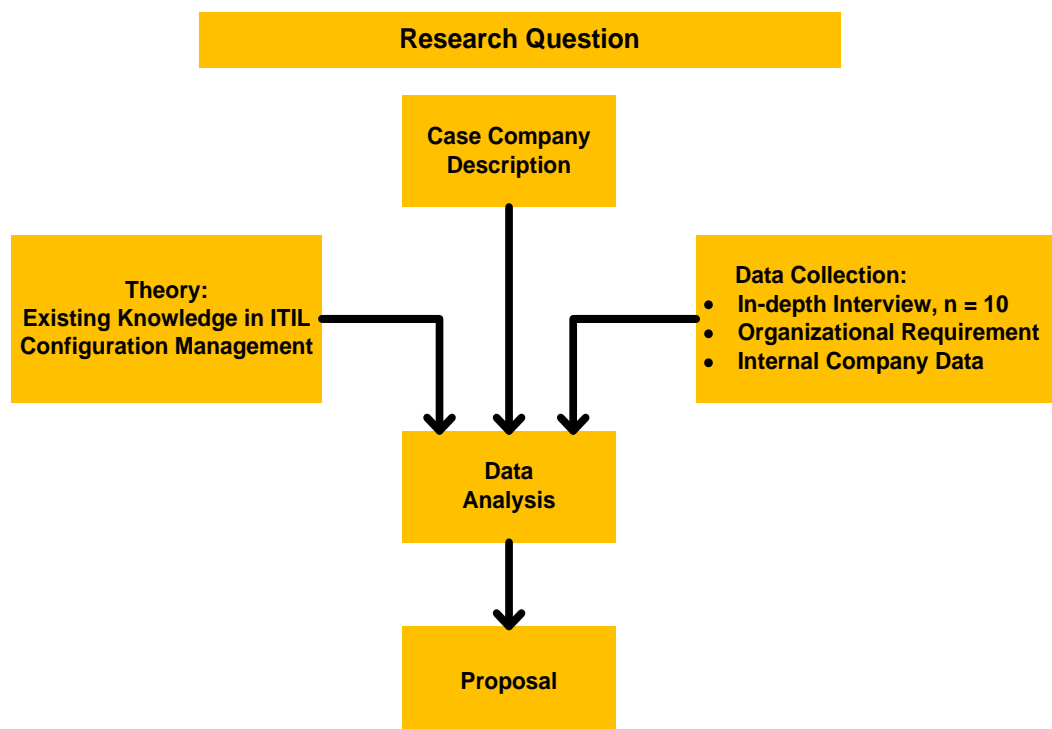


Figure 1. Research design of this study.

To analyse how configuration management is conducted in the case company, the study first explores the theoretical framework of ITIL. The current practice of configuration management is explored by conducting in-depth interviews with the key people of the case company as well as collecting criterial documents from the case company. This is to find out and explore organizational requirements and expectations.

As shown in the Figure 1, the resulting outcome, proposal for the case company is formed through all the relevant literature, data collection, data analysis, ITIL best practices for configuration management and requirements of the case company.

The structure of this Thesis is as follows. Section 1 provides introductory material and illustrates a research design. In this section, the description of the case company is provided in order to give a clearer picture and the main objective of the study. Section 2 presents the research method and material adopted in this Thesis, including the validity and reliability considerations. Section 3 discusses best practices of ITIL configuration management and shows findings from the existing literature on how to build configuration management database. Subsequently, different aspects of best practices of configuration management process are evaluated in Section 4 based on existing theory. Section 5 analyzes and summarizes the findings from the qualitative interviews conducted with the case company. The data collected from Section 5 is used to answer the first research question already outlined in Section 1. Section 6 presents proposal and recommendation for the configuration management process and CMDB. At this stage, the second research question is answered based on the data collected from Section 3, Section 4 and Section 5. Finally, Section 7 provides the discussion and conclusions. It also gives the summary of this study, managerial implications as well as validity and reliability of this Thesis.

2 Method and Material

This section discusses the data collection and analysis process. The structure of this section is as follows: First, the research approach employed in this Thesis is discussed. Second, the research process is described. Third, the methods and material used in data collection are discussed in details. Fourth, the data analysis method and the reasons for selecting the method are well detailed. Lastly, the validity and reliability of this study is described.

To answer the research questions highlighted in Section 1.3, a qualitative case study methodology was chosen as a major research strategy for this Thesis.

2.1 Research Approach in the Thesis

Case study is defined as "an intensive study of a single unit with the aim of generalizing across a larger set of units" (John 2004: 341). Yin (2003: 13) defined case study as an empirical inquiry that "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident."

The case study method is also about theory construction and building, and it is based on the need to understand a real-life phenomenon with researchers obtaining new holistic and in-depth understandings, explanations and interpretations about previously unknown practitioners' rich experiences, which may stem from creative discovery as much as research design (Riege 2003: 80). In addition, Dan et al. (2002: 4-5) describes case studies as an approach for the collection and documentation of evidence and suggests that a high quality case should demonstrate ten characteristics which include: a case study is a story; a case study draws on multiple sources of evidence; a case study's evidence needs to be based on triangulation of these sources of evidence; a case study seeks to provide meaning in context; a case study shows both an in-depth understanding of the central issue(s) being explored and a broad understanding of related issues and context; a case study has a clear-cut focus on either an organization, a situation or a context; and finally, a case study must be reasonably bounded. It should not stretch over too wide a canvas, either temporal or

spatial, and should not require the researcher to become too immersed in the object of the research. A case study may draw on either quantitative or qualitative tools or both for either evidence collection and/or analysis, but it will not be exclusively quantitative, and it needs to have a thoroughly articulated protocol. Thus, the case unit of this Thesis is defined as configuration management process, and the research method adopted was based on the above concepts as detailed in the next section.

2.2 Research Process

Figure 2 illustrates research process implemented in this study.

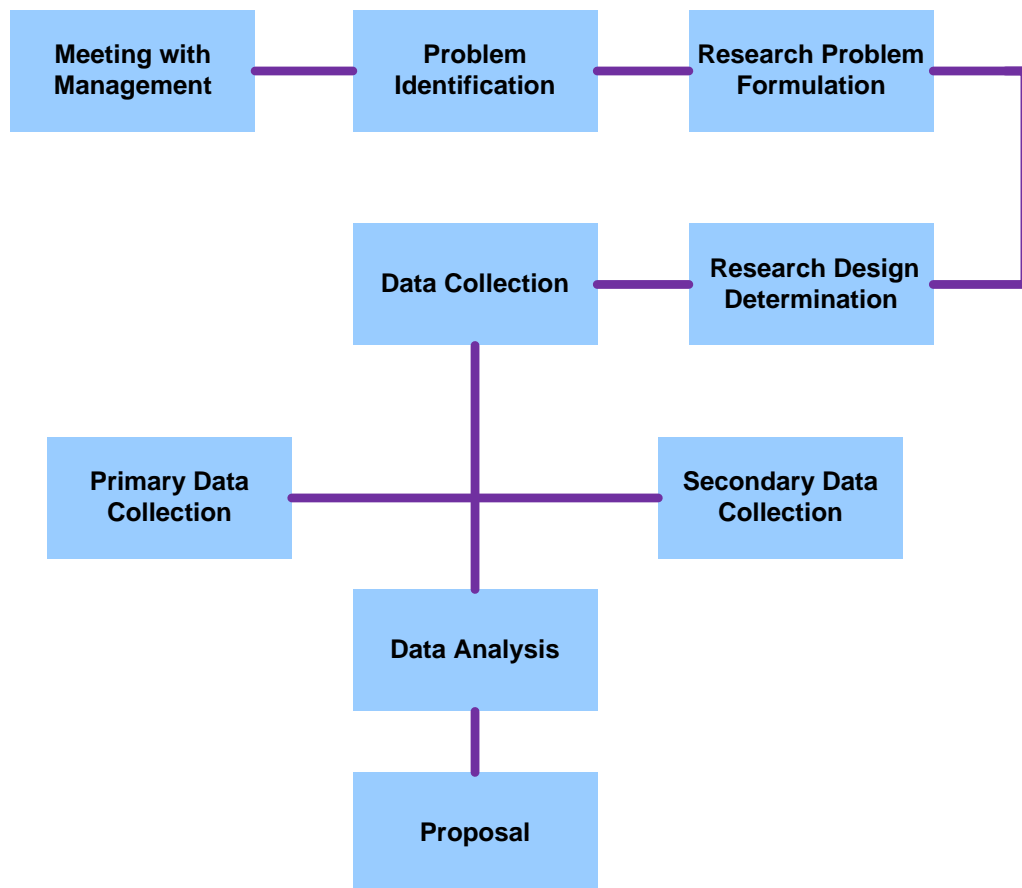


Figure 2. Research process in this study.

Figure 2 shows how the research has been conducted and how outcomes are drawn.

The research process started with a kick-off meeting with the case company's management regarding the topic to be researched. In the meeting, the state of ICT department was described by the managers representing the company. The current operations of the department in relation to configuration management then revealed some problems facing the department. The problems identified are the focus of this research. After the problem identification, the research problem was formulated and approved. The next step was to determine the research design as detailed in Section 2.1. After designing the research, both primary and secondary data were collected as detailed in Section 2.3. The final step involved analyzing the result of the findings and presenting the proposal.

2.3 Data Collection Method

In order to obtain rich data for this study, the researcher had drawn from several data sources. First, semi-structured interviews were conducted with the case company, and second, the company internal documentation was reviewed and analyzed in order to identify the main challenges facing the case company in relation to configuration management.

The case company provided the list of interviewees prior to the interview and their respective functions in the company. The list of interviewees included representatives from various ICT units and vendor. The interviewees were selected based on their experience on the research topic. However, as the interview progressed the list of potential interviewees grew in order to gather more information about the research topic.

Data were collected over a two week period through a face-to-face interview with each interviewee. All interviews were, with the interviewees' consent, audio taped and subsequently transcribed. In-depth interviewing is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation (Boyce and Neale 2006: 3). The interviews were conducted using the general interview guide approach by Longfield (2004). The interviews were carried out for two purposes: 1) to find out current operation of ICT in relation to configuration management and 2) to ensure the management perspectives form part of the proposed recommendation.

Hence, the focus of this paper is to analyze the data collected from the case company interviews.

Specifically, the interviews were carried out in March 2012 on the premises of the case company situated in Vantaa, Finland. Nine managers in the ICT department and one vendor were selected for the interviews. Table 1 shows the list of interviewees. The interview questions were sent beforehand to the interviewees in order to turn their mindset to the Thesis topic before the meeting. The interview questions were carefully designed based on the research questions in Section 1.3. As mentioned earlier, the interviews were conducted face-to-face and being recorded. At the beginning of each interview, the selected interviewees were informed about the objective of the interview. Interviewees were then asked to give their views about the project topic. The recorded information and notes from the interviews were transcribed and analyzed by the researcher.

In interviewing the ICT employees for the project, the following questions were used:

- What is your view on configuration management or describe ITIL configuration management?
- What are your current practices in relation to configuration management?
- How do you think ITIL configuration management can be implemented?
- What are the current difficulties in your work/how do you currently function without the in-house CMDB?
- What are the mission and vision for building CMDB?
- What are your expected benefits from CMDB?
- What is your business goal to be reached once the CMDB is built/how will the proposed in-house CMDB impact your everyday work?
- Is there anything else I need to know/ is there anything more you would like to add?

Full details of the interview questions can be found in Appendix A.

The above questions were the general questions for all the interviewees. These interview questions help the researcher to find out the current practice of the ICT department in relation to configuration management, the main objective of building CMDB, the challenges interviewees are currently facing individually, and the interviewees' ex-

pected benefits and needs. This in turn helps in establishing the purpose of this study. In addition, the interviews also helped to develop research strategy for implementing ITIL configuration management from the management point of view. All of the interviewees from the case company and the vendor who were interviewed for this study are listed in Table 1.

| Person | Position | Date | Length of Interview | Documentation |
|--------|---|------------|---------------------|---------------------------|
| A | Application Manager for Integration | 20/03/2012 | 2 hours | Recording and note taking |
| B | Service Manager (Infra platform management) | 21/03/2012 | 2 hours | Recording and note taking |
| C | Infrastructure and Application Manager | 22/03/2012 | 2 hours | Recording and note taking |
| D | Infra Service Manager 1 | 22/03/2012 | 1.5 hours | Recording and note taking |
| E | Infra Service Manager 2 | 22/03/2012 | 1.5 hours | Recording and note taking |
| F | Infra Service Manager 3 | 22/03/2012 | 1.5 hours | Recording and note taking |
| G | Incident and Problem Manager | 23/03/2012 | 1.5 hours | Recording and note taking |
| H | Test Manager | 28/03/2012 | 1 hour | Recording and note taking |
| I | Application Manager for eCommerce | 28/03/2012 | 1.5 hours | Recording and note taking |
| J | Service-Now.Com Developer | 29/03/2012 | 1 hour | Recording and note taking |

Table 1. List of interviewees from the case company and its partners.

Table 1 shows the key managers of the ICT department in the case company and one vendor that were selected for the interview. The interviewees were carefully selected in order to get a variety of perspectives regarding current practices of configuration management in the case company. The interviews were carried out with the representatives of various units of the ICT department. The main reason for the selection was to generate data from different people within the ICT department. This has helped the researcher to capture all the current challenges facing all the ICT staff members in relation to configuration management.

2.4 Data Analysis Methods

The case study data was analyzed through content analysis of the interview transcripts. The data analysis method used in this Thesis consists of content analysis of the collected in-depth interviews. Content analysis is defined as "a set of procedures for collecting and transforming non-structured information into a format that allows analysis (GAO 1989: 3)." In other word, content analysis helps analysts to draw inferences about the meaning of written and recorded information.

Content analysis can be used to study any recorded material as long as the information is available to be reanalyzed for reliability checks (GAO 1989: 11). In addition to other established method of analyses, the interview data collected were also analyzed using grounded approach (that is, open coding, axial coding and selective coding). Open coding refers to the process of generating initial concepts from data. Axial coding refers to the development and linking of concepts into conceptual families (coding paradigm) while selective coding refers to the formalizing of these relationships into theoretical frameworks (Strauss and Corbin 1990; 1998. Cited in Calman 2011: 16).

After the interviews were conducted, the recorded data were transcribed subsequently. Transcription entails a translation or transformation of sound/image from recordings to text (Duranti 2007. Cited in Davidson 2009: 4). However, according to Strauss and Corbin transcription should be selective (Strauss and Corbin 1990: 30) because it is impossible to record all features of talk and interaction from recordings (Davidson 2009: 38). Thus, all these suggestions were followed and the interview data from audiotape were transcribed as earlier stated. Although, interview questions were sent beforehand so as to prepare the interviewees, as the interviews were conducted, new questions emerged, insight increased and the perceptive of the researcher in relation to research themes changed. These new research themes are the main focus of this study and will be discussed in detail in Section 5.

During the interviews notes were taken and different opinions of interviewees were being gathered. As a result, the current practices of ICT department in relation to configuration were explained to the researcher in details. Several challenges facing ICT department were mentioned, their purpose and the needs for building CMDB were re-

vealed and the specific configuration items they plan to store in the CMDB were stated. However, the case company' current practices in relation to configuration management were then analyzed and compared with conceptual framework including best practices of ITIL configuration management and other relevant literature. Hence, the comparison showed a gap that needs to be filled.

2.5 Validity and Reliability Considerations

While collecting various data, it is imperative to ensure that the data are gathered in the most reliable and relevant way. Validity and reliability remain the two appropriate concepts for this. Validity is defined as "the ability of the survey questions to accurately measure what they claim to measure" (Lee 2004: 211). Validity includes the correctness and credibility of the description, conclusion, explanation, interpretation (Maxwell 1996). According to (Patton 1999: 1190), there are three variables that affect the validity and reliability of a qualitative research: data gathering method, credibility of the researcher and philosophical belief in the value of qualitative enquiry. To take all these concepts into consideration, case study was used as a method of research for the data collection. Ten respondents were selected for the interviews in order to obtain significant and broad information about the research topic. In addition, all the interviewees selected are conversant with the current practice of the case company in relation to configuration management. The secondary data gathered are well grounded in relevant theoretical literature. The collected data and outcome drafts of the Thesis were validated before the final outcome.

The initial proposal of this study was validated by the managers of the case company on April 30, 2012. Incident manager and quality assurance manager organized the validation meeting. The agenda for the meeting included: a) researcher presents the configuration management and CMDB outcome draft; b) comment and feedback regarding the initial proposal and presentation and c) discussion and planning for final presentation session on May 30, 2012.

First, the initial proposal and outcome of this Thesis were presented. Second, after the presentation, there were comments and discussions regarding the outcome draft. During the discussion session, it was decided that some relevant configuration items gath-

ered from the interviewees should be categorized as specified by ITIL, including the levels of configuration items. Third, the outcome drafts were accepted and the final presentation of the Thesis in the case company has been scheduled for May 30, 2012. The final presentation was organized by the case company in order to ensure all ICT staff members do see the outcome of this study.

The above approaches were used to measure the validity and reliability of this Thesis as will be detailed in Section 7.3.

The following section presents the theoretical framework of this Thesis.

3 Configuration Management and Configuration Management Database

This section provides the conceptual framework of ITIL configuration management for this study. The section comprises of seven subsections. First, a brief history of ITIL is provided. Second, overview of configuration management is presented. Third, the details of configuration management database, including the CMDB tools and implementation process are well provided. The section then presents the CMDB relationship to other ITIL processes. Fifth, configuration items and CI levels are defined along with the rules for selecting the appropriate level of CI details. Sixth, benefits and possible problems of CMDB are well presented. Lastly, the section summarizes findings in this section.

3.1 Overview of Information Technology Infrastructure Library

The ITIL was developed by the United Kingdom's Office of Government Commerce (OGC) in the 1980s as a new approach to IT management. Its concept emerged due to the fact that IT was becoming increasingly important to business and that there was still a lot of confusion about how IT services should be delivered and managed (Randy et al. 2006: 1). ITIL provides libraries that can help IT organizations collaborate more efficiently across silos, address customer requirements more effectively, align more closely with the business IT supports, and proactively take control of change (Enterprise Management Associates 2006: 4). After twenty years of ITIL practice, it remains the most widely adopted and recognized framework for IT Service Management (TSO 2007: 15; Johnson et al. 2007).

In May 2007 a new version of ITIL called ITIL V3 was released by OGC which was comprised of five volumes: service strategy, service design, service transition, service operation and continual service improvement. Configuration management appears in ITIL V3 under service transition as Service Asset and Configuration Management (SACM). Just as ITIL is a resource for IT organizations, ITIL developed the concept of a CMDB as a resource that is critical for enabling best practices for not only configuration management, but also a wide range of other disciplines and ITIL processes (Enterprise Management Associates 2006: 4). The ITIL configuration management is the integral part of all other IT Service Management (ITSM) processes (Giese et al. 2009,

ITIL Service Support 2000: 11) and provides a storehouse for keeping information about the managed IT infrastructure to be managed both up-to-date and accurate (Wenzel et al. 2009).

3.2 Configuration Management

Configuration management (CM) is defined as “a logical model of the infrastructure or a service by identifying, controlling, maintaining and verifying the versions of Configuration Items (CIs) in existence” (ITIL Service Support 2000: 121).

Configuration Management is one of the most important ITIL processes (Marquis 2007) which provides a whole framework of the IT infrastructure and information service management so that the IT infrastructure can support the information service operation effectively and management staff can comprehend the changes of every configuration item (Wu et al. 2011: 956). Configuration management identifies who uses what PC, which server the PC is assigned to and which applications provide particular services to the business. CM provides information about ICT infrastructure to be able to support all management disciplines, for example, incident management, financial management and service level management (Hommel and Knittl 2008: 2). It is worth to know that many organizations have some form of configuration management in operation, but it is often spreadsheets, local databases or paper-based system. For large and complex infrastructures, configuration management will operate more effectively when supported by a software tool that is capable of maintaining a configuration management system (ITIL Service Support 2000: 124).

According to ITIL, the main goals of Configuration Management are: to account for the all the IT assets and configurations within the organization and its services; provide accurate information on configurations and their documentation to support all the other Service Management processes; provide a sound basis for Incident Management, Problem Management, Change Management and Release Management and verify the configuration records against the infrastructure and correct any exceptions (ITIL Service Support 2000: 121). Configuration Management plays a crucial role, on which decisions in all other IT Service Management (ITSM) processes are based (Brenner et al. 2010: 2). Configuration Management is the discipline responsible for the Configuration Management Database (Dettmer et al. 2006: 3). The tool responsible for the storage of

all configuration items is called CMDB. CM heavily relies on tool support, using a CMDB as its "information nexus", which stores the state of and relationships between Service Assets respectively (Hommel and Knittl 2008: 2).

According to Moreira (2012: 51), configuration management offers benefits to organization in various ways: it offers management a way to identify the cost of a change prior to making the change; it offers a place to store and manage products assets; it reduces maintenance costs, provides a window into changes and visibility into the release process, provides auditing capabilities, provides reporting capabilities and provides traceability of CIs.

3.3 Configuration Management Database

Configuration management database (CMDB) is defined as "a database, which holds a record of all CIs and details of the important relationships between CIs, associated with IT infrastructure" (OGC 2007).

The CMDB is fundamental in taking organizational processes to the next level by bringing asset and service management together and informing configuration management (Numara n.d.: 4). The CMDB is critical to success with virtually all the other ITIL processes. This means organization simply cannot succeed in ITIL processes without a true CMDB (Marquis 2007: 1). This view is shared by other researchers including (Blokdiijk 2008: 34); who point out that configuration management and its associated CMDB play a major part in the quality of control of the project. By incorporating a Configuration Management Database (CMDB), businesses have taken a major step towards creating an information repository to manage the alignment of IT with the business (Messineo and Ryder 2008: 3).

In addition, the CMDB contains information about CIs and their relationship (Brenner et al 2010: 1) making it the definitive reference mechanism for all IT decisions by providing business visibility into the dependencies among business processes, users, applications, and underlying IT infrastructure (BMC et al. 2008: 8). The CMDB serves as the blueprint for how the entire IT infrastructure is structured, how various CIs (hardware, software, incidents, agreements, service levels, documentation, and so on) are related, and how the entire system functions (Randy et al. 2006: 3). In other word, the CMDB

becomes the basis for finding infrastructure information quickly, and making effective management decisions based on it. A CMDB is much more than a database storing information about equipment configuration. According to Messineo and Ryder (2008: 2), there are seven fundamental use cases for a CMDB: impact analysis, root cause identification, change governance, auditing and compliance, resource optimization, services mapping and services performance planning.

Furthermore, a true CMDB stores the dependencies and relationships among these assets, which are called configuration items (CIs) by the ITIL. And CIs are not just hardware and software assets, but also the documentation, processes and people that compose, support and consume IT services (Marquis 2007: 1). The configuration items could be as simple as a single computer or as complex as a whole department (ITIL Service Transition 2007). CIs are manageable elements of the managed systems, which can be services, incidents, problems, hardware, software, buildings, persons, etc.). Without it, managers have little or no control over the products being produced e.g. what their status is, where they are, what version it is (Giese et.al. 2009: 1).

In line with the ITIL best practices, there are many benefits of CMDB such as: management of IT resources; economical, quality services (less mistakes, therefore less "double costs"); effective and efficient problem solution; effective and efficient processing of changes; optimal support on security issues; help ensure compliance to legal obligations; optimal support on issues of budgeting and spending and CI information relating to incidents, problems, known errors, changes, releases; store house for CI relationship (Blokdijs 2008: 30). CMDB acts as the platform for IT process automation by storing and collecting all the configuration elements needed to execute IT processes as well as describe the relationships between the resources and which business services they support (Carlson 2005: 16).

3.3.1 CMDB Tools

CMDB implementations are rapidly on the rise due to the complexity of IT environment. At the same time, many organizations are still confused about what a CMDB really is. Most of the CMDB tools found in the market are not what they claimed to be. Coupled with this, some vendors intentional market their existing IT asset management (ITAM) products as if they were CMDB tools (Marquis 2007). What make a CMDB

different from an ordinary asset management are the relationships, or links, that define how each CI is interconnected and interdependent with its neighbors. (Rudd 2004: 18). Therefore, in selecting a CMDB tool, care must be taken so as to avoid unsuccessful CMDB project.

There are four key capabilities that make a CMDB different from other ITAM, asset inventories, device configuration files or relational database tools: *federation, reconciliation, synchronization* and *mapping and visualization* (Marquis 2007: 55).

Federation

Federation is a means of bringing in multiple data sources directly by linking to various sources. As the infrastructure scales up, it is not practical to store all detailed configuration data in the CMDB. Instead, best practice is to store only core data in the CMDB, with links to trusted data sources that is kept in local domains. A true CMDB provides full federation capability and supports multiple vendor data sources. It not only integrates information from across the network into the CMDB; it also provides a complete understanding of the relationships all components (iET Solution n.d.).

Reconciliation

Reconciliation is defined "as the process that ensures there are no duplicates and maintains the correct nomenclature for any given CI" (Marquis 2007: 56). Reconciliation ensures consistency across CI components by synchronizing and matching two or more database segments in order to avoid duplicates. Information about ICT assets can come from various sources, resulting in duplication or conflicting data. A true CMDB reconciles various occurrences, avoids conflicts and duplication and ensures that the correct configuration items are available and stored in the CMDB.

Synchronization

Synchronization ensures the same version of the truth across integrated systems. A true CMDB automatically discovers changes made to the contents of the IT components by distinguishing between approved and unapproved changes. (Marquis 2007: 56). An approved change is established when there is a Request for Change (RFC) in the CMDB. Unapproved changes usually alert all the CMDB owners such as Change Manager, Change Advisory Board (CAB) Member, Service Desk Agent, Problem Manag-

er, Service Level Manager, etc. of the risks associated with the change (Marquis 2007: 56). Thus, a true CMDB synchronizes infrastructure configurations, detects and validates changes in a CMDB.

Mapping and Visualization

A true CMDB provides full explanation about the relationships between various CIs by screening individual's components in a CMDB. CMDB gives a single logical view of infrastructure items. In other word, visualized CMDB logically and physically illustrate the relationships between CIs without any difficulty.

Colville (2006) includes additional three key functions to the previous four key features of a true CMDB, which are: access controls, versioning and audit trail capabilities, shown in Table 2.

| <i>Bottom Level Functionality</i> | <i>Top Level Functionality Enabled</i> | <i>Description</i> |
|--|---|---|
| 1.Reconciliation | Data Quality and CI unicity | Should provide ways to prevent the creation of redundant data like the import of two CIs that are in fact the same element but that came from different sources. This feature is responsible the data quality in the CMDB, which is commonly spoken as the Achilles' heel of this tool. Actually, there are situations where only people can decide whether an introduced CI already exists in the CMDB or not. |
| 2. Federation | Allows specific data stores for example to each architecture in an Enterprise Architecture (EA) | Having relationships to CIs that are not stored in the own CMDB but in an external one. This enables a better management of all CIs in an organization as it allows the construction of domain specific CMDBs with less complexity than the general one. |
| 3. Access controls | Data Security allowing only authorized personnel to access it | Ensure that only appropriate roles or actors have access to data both for read and/or write. |

| | | |
|------------------------------|--|---|
| 4. Versioning | Access to the evolution of the CIs through time | Allows the presentation of all states that a CI have passed since was created till now |
| 5. Mapping and Visualization | Visualization capabilities | Allows a spatial view of the relationships between CIs and its attributes. It is also necessary that this layer of the CMDB allows the definition of different views of the data. Being a dashboard of the organization in terms of its CIs is important to allow that different stakeholders can access to views that really mean anything to them. |
| 6. Audit Trail Capabilities | Reporting Capabilities | Should be possible, in any period of time, to produce an audit trail report with who did what and when in the system, allows the awareness of exactly who was responsible for a certain change made in the system. |
| 7. Synchronization | Integration with other tools for simulation, test changes and different configurations | Being able to update the CMDB with changes that were in study. This is basically a structure of branching for the data stored in the CMDB and, merging and reverting capabilities enabling the creation of alternate branches for test changes and then commit them to the baseline. Once an appropriate change is detected, a notification to change management workflow should be triggered, in order to alert the responsible for the IT domain where the change will take place, to remediate the situation. This test changes' branches could be produced in and external tool, so the CMDB need to have a way for inserting data in the system. |

Table 2. CMDB's functionalities table (Colville R.J 2006).

Table 2 shows a list of functionalities included in a true CMDB. All of these functionalities are fundamental to the success of a CMDB. With these key features in a CMDB tool, the CMDB users can benefit the following: the CMDB solution will function more than just ICT assets, helps organization to know the impact of changes, helps analyze the impact of incident on business as quickly as possible, avoids CI duplications in a CMDB, links sources of information together, keeps records of changes, provides relations between CIs, detects and validates changes.

The overview of the CMDB concept is suggested in Figure 3.

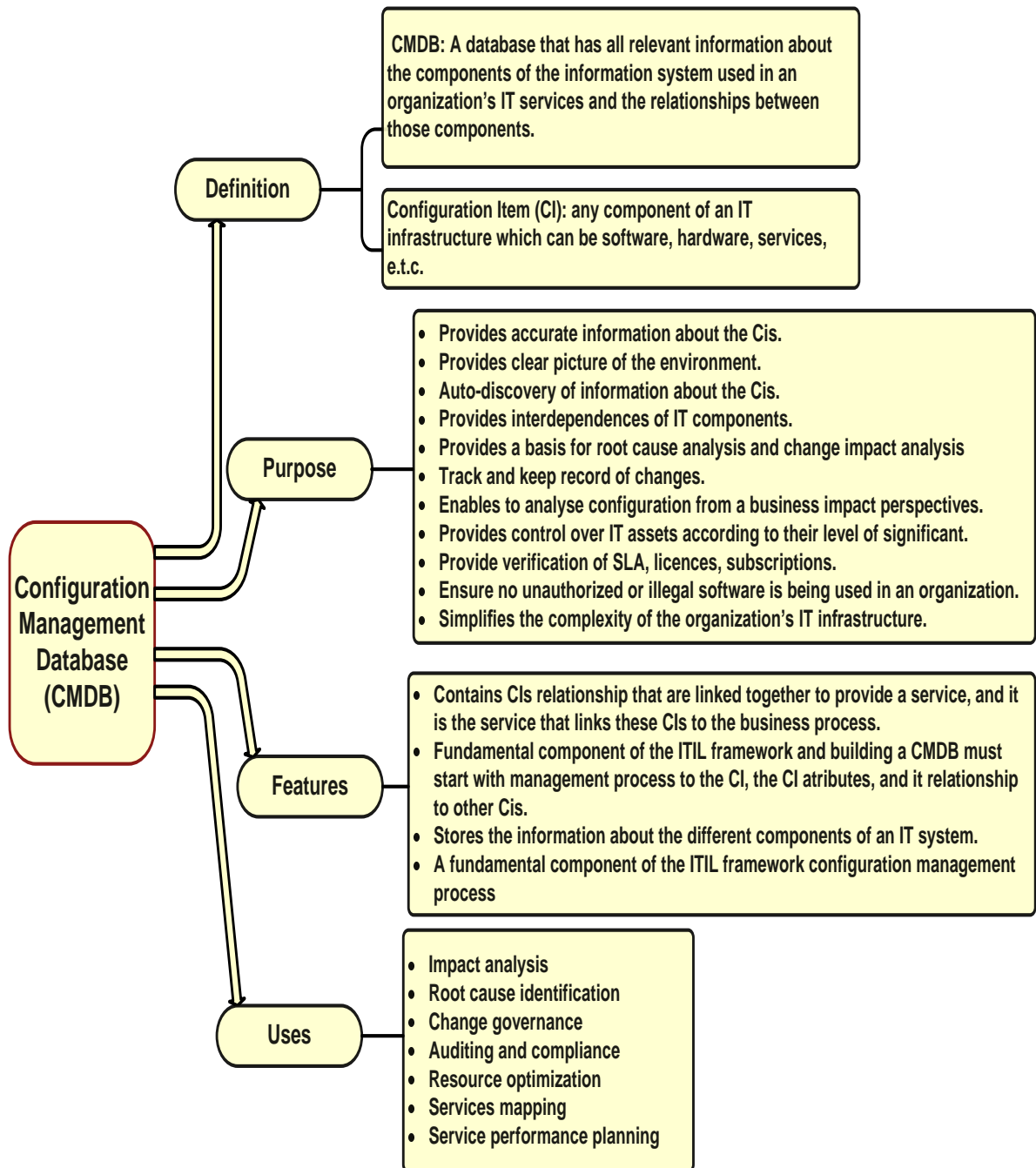


Figure 3: Overview of CMDB.

Figure 3 summarizes and presents the key features and capabilities of a true CMDB.

In summary, a true CMDB provides clearer picture of CI attributes and relationship provides impact analysis, remains a true source of information about IT infrastructures, helps resolve incidents faster, track and keep records of change, and ultimately support all other ITSM processes.

3.3.2 Building A Configuration Management Database

Dettmer et al. (2006: 7) suggests that CMDB can be implemented in five steps as detailed in the following: *defining goals and objective; assignment of responsibility; the right approach; defining CMDB contents and filling the CMDB with data*. Each of these five steps is discussed below.

Step 1. Defining the Objective and Goals

The first step in implementing a CMDB is by defining objectives and goals. It is critical that the goals of the CMDB are aligned to a specific business benefit and that they are measurable. The CMDB objective definition is fundamental to know how to build the CMDB and what the implementation priorities are. Additionally, the current status and performance of the IT organization requires analysis so as to ensure the reasons behind implementing a CMDB are clear and justifiable (Dettmer et al. 2006: 7; Blokdijk 2008: 73; Bonneville 2011: 8).

Step 2. Assignment of Responsibilities and Staff Motivation

Change is uncomfortable and results in additional work. Getting IT staff members to change their way ways is not always easy (Dettmer et al 2006: 8). All employees are expected to be carried along right from the start of the project with the inclusion of interdisciplinary team. Responsibilities should be clear enough and organization is expected to designate project manager. Configuration Management and Change Management are expected to work closely. In addition, the designation of a Change Manager is also encouraged at this stage. Detailed record of CIs needs to be provided by conducting thorough analysis of all CIs. Each IT team is required to identify the data they have, how they maintain them and if these data are useful. As soon as the items of all IT infrastructure are recorded, the maintenance and management process need to be put in place. Otherwise, the consistency of the CMDB cannot be guaranteed and the its benefits may be realized" (Bonneville 2011: 9; Dettmer et al. 2006: 8).

Step 3. The Right Approach

The best approach firmly depends on the size of the companies, number of configuration items and overall configuration management project. In recording of CIs, focus is expected to be on the infrastructures components that have the greatest impact on the quality of service delivery. Goals and expectations need to be checked so as to know the right content of the CMDB. Generally, the automation of IT infrastructure that companies are being forced to implement always result in a more complex IT environment, difficult to manage. Since the case company in this study manages an outsourced data center, IT operations in the case company have even become harder to manage. To simplify the complexity of IT infrastructure, the records of all configuration items, including their history need to be made available for ICT staff (Dettmer et al 2006: 9).

Step 4. Defining Contents

In defining the content of CMDB, the main question to ask is: which information does the ICT department need to successfully deliver its ICT services? With this in mind, the question becomes a necessity because the depth of information is virtually unlimited (Dettmer et al 2006: 10).

The content of the CMDB is structured as shown in Table 3:

| | |
|--------------------------|--|
| Configuration Items (CI) | Hardware: PCs, laptops, printers, servers Network: Cables, switches, router, hubs Software: Operating systems, application Documentation and contracts. |
| Components | Graphic or network cards: These elements of the IT infrastructure should not be recorded as CIs so as to reduce the data volume of the CMDB and to simplify the maintenance. |
| Attributes | Physical attributes: manufacturer, model and serial number Logical attributes: cost center, purchase price, etc. |
| Relationship | Service to CI relationship CI to CI relationship CI to ITSM processes, for example, to incidents and changes. |

Table 3: Summary of a CMDB contents. (Dettmer et al. 2006: 10).

As can be seen from Table 3, the contents of CMDB are best categorized as configuration items, components, attributes, and relationships. The next step is filling the CMDB with data.

Step 5. Filling the CMDB with Data

Considering the complexity of today's IT infrastructure, an organization will hardly enter all information manually in the CMDB. Inventory discovery solutions allow the gathering of most of the Configuration Items by scanning the IT infrastructure and deliver the data for the initial population of the CMDB and the subsequent reconciliation with the CMDB. However, the quality of the CMDB increases if the following is done: 1) determine the "leading systems" from where data shall be imported; 2) automate data import and synchronization; 3) define the maintenance process and use tools to implement it and 4) reduce the number of interfaces to easily support administration and maintenance (Dettmer et al. 2006: 12)

Thus, in building a CMDB, it is very important to consider the above steps, especially step 3 and step 4. Organization is advised to apply wisdom during the selection of configuration items (CMDB contents). Too few configuration items in the CMDB may not justify the cost of investment while too much configuration items can lead to overloading of CMDB, making it too complex to manage. In consequence, the benefits of CMDB and the cost of investment may not be realized.

3.4 Configuration Management Database Relationship to Processes

The relationships between configuration management, incident management, problem management, change management, and release management are vital to the success of IT processes (Blokdijs 2008: 71). The success of these processes is determined by the functionality of a CMDB as detailed in Figure 4.

Figure 4 details the summary of CMDB relations to other ITIL processes.

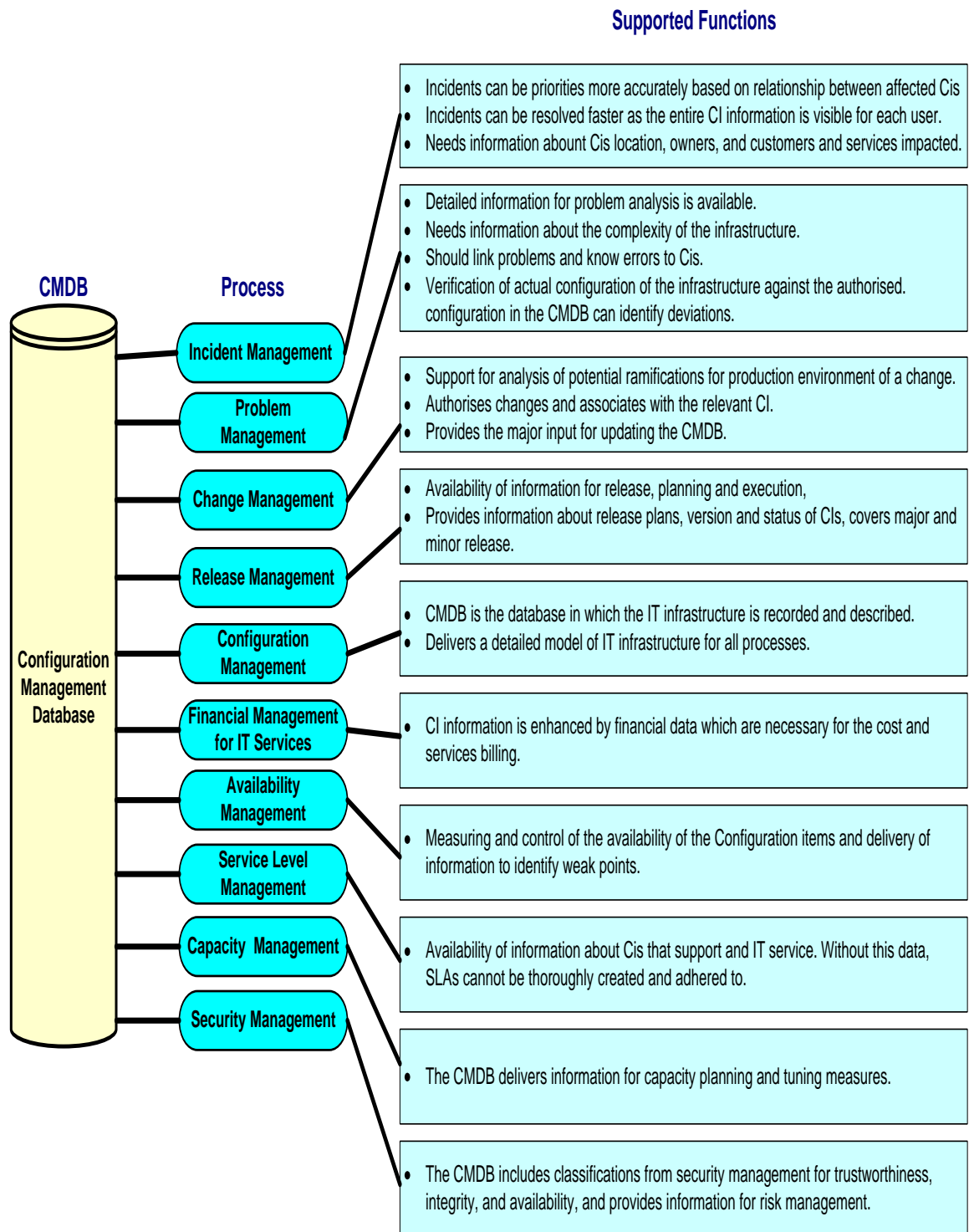


Figure 4: CMDB relationship to other processes.

As shown in Figure 4, a CMDB is a pillar that supports all other ITIL processes. Without its support to other processes, ICT managers may experience difficulties in achieving good quality of service delivery. CMDB provides a detailed map of the IT infrastructure

which simplifies the complexity of IT environment and ensures the integrity of configuration items. This has made a CMDB a must-have tool within the organization.

3.5 Configuration Items and Configuration Items Level

CI level is defined as “the process of recording and reporting of CIs at the level that the business requires” (Blokdiik 2008: 11). CIs are the main infrastructure or items, such as a server, associated with an infrastructure, that is (or is to be) under the control of configuration management (ITS 2007). CI forms the foundation of a CMDB and defines the information used to populate the database (Andrew 2005: 54). Optimum level for CIs (both service CIs and infrastructure CIs in the CMDB) needs to be defined from the start of the CMDB project. The highest level of CI represents the overall IT infrastructure while the lowest level is the most detailed level at which control must be exercised. Choosing and defining the right level of CIs is not always easy. However, the CI level chosen usually depends on the business and organization objective. ITIL recommends that organization needs to decide in advance the lowest CI level that will be required for service requirements before populating a CMDB (ITIL Service Support 2000: 138). Figure 5 shows an example of CI level breakdown.

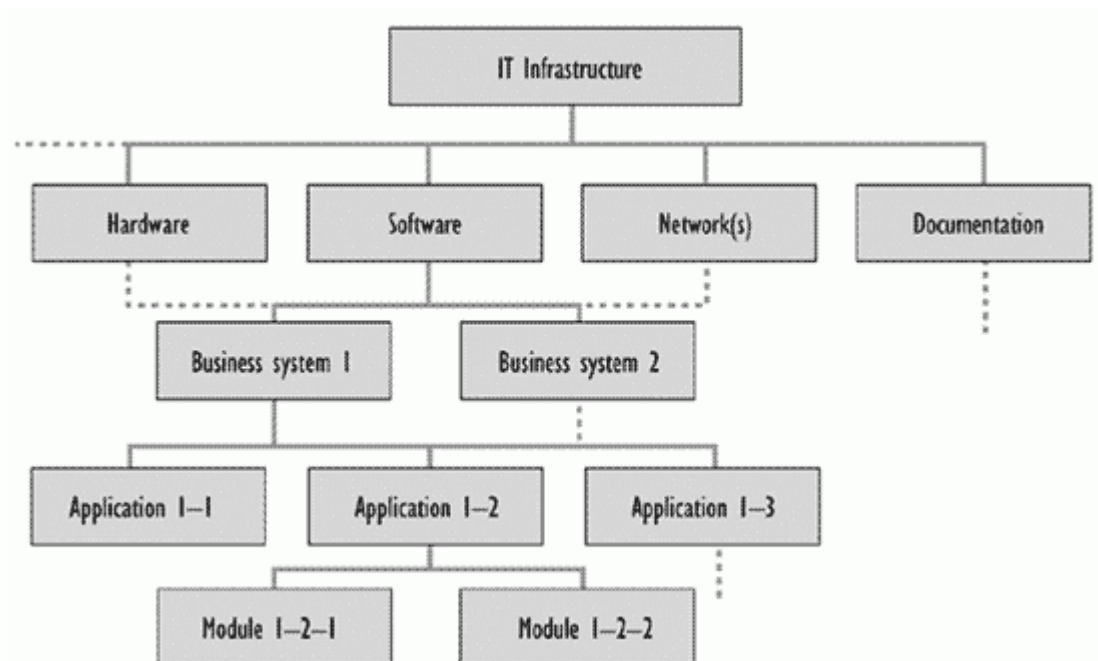


Figure 5. Example of configuration breakdown structure (ITIL Service Support 2000: 139).

Figure 5 shows how configuration items can be broken down to a level that the business required. The highest level is seen to be the IT infrastructure level while the lowest level in this arrangement is at the module level.

Choosing the right CI level is a matter of achieving a balance between information availability, the right level of control, and the resources and effort needed to support it. For instance, if a change is to be made to module 1-2-2, it is better to record the change at module level rather than program level.

Likewise, if it is decided that the CMDB will record software at program level, changes should be done at this level. For example, 'if a single module is to be changed, it will be necessary to recompile the whole program to make the Change at program level'.

In addition, if information at a low CI level would not be relevant, for example, if a keyboard is not regularly exchanged independently, or the company sees it as a consumable, ITIL recommends that its detail does not need to be stored in the CMDB. "CI information is valuable only if it facilitates the management of change, the control of incidents and problems, or the control of assets that can be independently moved, copied or changed".

Periodic review of CI level is usually needed to confirm that information down to a low level is still valuable and useful, and that the handling of changes and problems and the management of infrastructure items or assets are not lacking because the CMDB does not go to a sufficiently low level (ITIL Service Support 2000: 140).

There are four rules for selecting the appropriate level of CI details: record all what that will be needed (also in the future); do not record what will not be needed; only record what can be measured and watch the effort regarding data maintenance. (BMC et al. 2008: 48).

Thus, the integrity of CIs and a well-defined CI levels determine the overall success of a CMDB. A well-defined CI level guarantees the control of CMDB while un-defined CI level brings confusions to the CMDB users.

3.6 Benefits and Possible Problems of Configuration Management Database

The use of CMDB has its benefits and challenges. They are discussed separately below.

3.6.1 Benefits of Configuration Management Database

The benefits of a CMDB extend across various IT functions that benefit from access to consolidated and accurate data about the IT infrastructure, its users, and the services it enables (BMC et al. 2008: 14)

According to ITIL, the benefits of building a CMDB include the following: it provides accurate information on CIs and their documentation. It controls valuable CIs. It facilitates adherence to legal obligations. It helps with financial and expenditure planning. It makes software changes visible. It contributes to contingency planning. It supports and improves Release Management. It improves security by controlling the versions of CIs in use. It enables the organization to reduce the use of unauthorized software. It allows the organization to perform impact analysis and schedule changes safely, efficiently and effectively and providing Problem Management with data on trends (ITIL Service Support 2000: 125-126).

Additionally, configuration management brings value to business by optimizing the performance of service assets and configurations improve the overall service performance and optimizes the costs and risks caused by poorly managed assets, e.g. service outages, fines, correct license fees and failed audits (ITIL Service Transition 2007: 77).

3.6.2 Possible Problems of Configuration Management Database

According to ITIL, there are also challenges and potential problem in using CMDB. These possible problems in Configuration Management include: definition of CI at the

wrong level with too much detail (so that staff become involved in unnecessary work) or too little detail (so that there is inadequate control). Another possible problem is implementation is attempted without adequate analysis and design. The end result is, consequently, not what is required. The third possible problem is tactical schedules are over ambitious. Configuration Management may be perceived as bottleneck if adequate time is not built into schedules to allow staff to carry out their duties. When Changes and Releases are being scheduled, past experience of the time taken to complete Configuration Management activities should be taken into account.

Another potential serious challenge for using CMDB is commitment lacking. Without a firm commitment to the processes from managers, it is difficult to introduce the controls that some staff would prefer to avoid. Moreover, the CMDB process is often perceived to be too bureaucratic or rigorous, or inefficient and error-prone. This is often the case where manual processes are in use. In almost all cases it is advisable to choose an automated solution from outset.

Yet another challenge is if Configuration Management is implemented without Change Management or Release Management, which is then much less effective and the intended benefits many not be realized. It is especially obvious if the expectations of what the Configuration Management process are unrealistic. Asset and Configuration Management cannot and should not be expected to make up for poor project management or poor acceptance testing. Poorly controlled installations and test environment will affect the quality of Releases and result in additional Incidents, Problems and Changes, which will in turn require additional resources and lead to another possible problem, when proper configuration control is not in place. For instance, Configuration Management may be difficult where users have the ability to purchase, download and install software from the Internet (ITIL Service Support 2000: 126-127).

Thus, these issues make it really challenging to implement ITIL Configuration Management because of the challenges of using CMDB.

3.7 Summary

Advances in technology have caused Information and Communication Technology (ICT) infrastructures to become very complex to manage. In order to simplify the complexity of IT operations, many organizations believe outsourcing is a perfect solution to improve IT efficiency. The case company in this study happens to be one of these companies who see outsourcing as the appropriate option for ICT services. Although outsourcing provides benefits to the organization, at the same it poses some challenges and even disadvantages to those using it. Eventually, organizations can even lose the control of their IT assets, for example, through outsourcing. For IT service manager to be able to effectively control the ICT assets, measure the performance of external vendors, resolve technical issues before impacting business and manage the entire IT infrastructures at low cost, detailed information about the ICT infrastructures and services should be made available.

In today's complex IT environment, the most recognized framework with proven records of success in IT Service Management which is designed to simplify the complexity of IT environment is ITIL. ITIL Configuration Management Database helps keep tracks of all the IT infrastructure items as well as their relationship. With the latest version of ITIL, CMDB can be used to store IT services and business processes. For outsourcing purposes, CMDB helps organization understand the relationship between vendors as well as those services offered. CMDB provides information for inter-firms collaboration. Hence, with the CMDB and a well-defined configuration management process, the case company's outsourced IT services can be improved upon and efficiently managed. The next section aims at presenting the overview of the configuration management process, including the configuration management roles and activities.

4 Best Practices of ITIL V3 Configuration Management Process

This section concentrates on how the configuration management process can be managed according to the best existing practices in the IT industry that is ITIL compliant.

4.1 Activities in Configuration Management Processes

According to ITIL best practices, the entities vital to service provisioning and the management thereof – servers, software, but possibly also services, service level agreements and documentation need to be put under the control of the Configuration Management process, that is, treated as CIs (Brenner et al. 2010: 3). The configuration management process, therefore, will require a number of special activities, which to ensure the quality and reliability of the information stored in the CMDB. These activities are detailed in Figure 6.

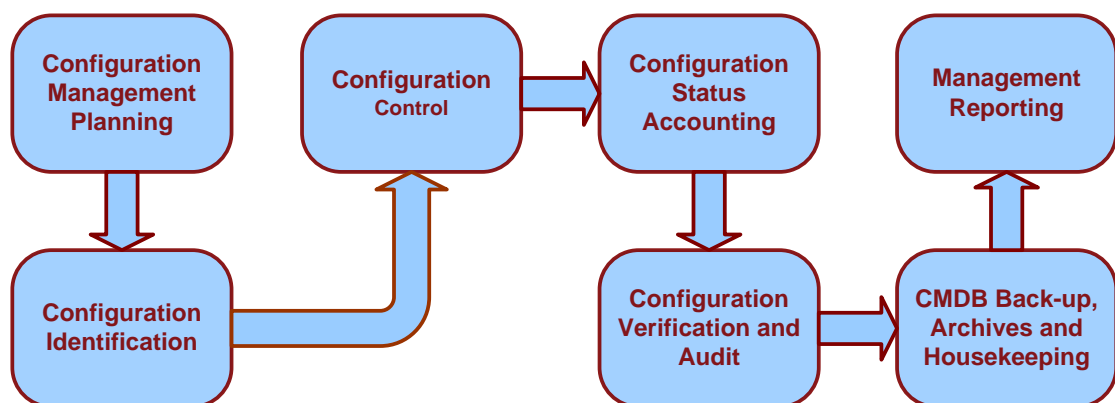


Figure 6: Activities in Configuration Management Process.

Figure 6 exemplifies the seven main activities in CM processes. All of these processes are usually carried out in a CMDB project or implementation.

4.1.1 Configuration Management Planning

According to ITIL, a configuration management plan needs to define the purpose, scope and objectives of Configuration Management. CM planning also includes defining related policies, standards and processes that are specific to the support group. In this stage, CM roles and responsibilities are usually defined and assigned to CM staff members. The interface control with the third parties, e.g. Change Management, suppliers needs to be defined as well. Other important process plans at this stage include: housekeeping, such as license management, archiving and the retention period for CIs. Additionally, configuration baselines, major Releases, milestones, workload and resource plan for each subsequent period need to be defined. This phase is vital so as to ensure the cost of the project implementation is kept as low as possible (ITIL Service Support 2000: 136).

4.1.2 Configuration Identification

All IT infrastructure information configurations are typically identified to enable effective control, recording and reporting of CIs to the level that the business requires. By identifying CIs, a baseline of software-related items will be established. This way, changes to the baselines can easily be controlled; audited and reported (Moreira 2012: 39). Organizations usually choose and classify the configuration structures for all the infrastructure's CIs, including their owner, their interrelationships and configuration documentation. This includes allocating identifiers such as serial numbers, version numbers for CIs, labeling and naming each item, and entering it on the CMDB (ITIL Service Support 2000: 137).

4.1.3 Configuration Control

Control of data is vital to ensure that it can only be changed by authorized individuals. The objective of configuration control is to ensure that only authorized and identifiable CIs are recorded in the CMDB upon receipt. Thus, all changes to the infrastructure systems are subject of the Change Management which ensures that no CI is added, modified, replaced or removed without appropriate controlling documentation, e.g. an ap-

proved change request, and an updated specification (ITIL Service Support 2000: 144).

4.1.4 Configuration Status Accounting

Status reports of all CIs under control, including their current version and Change history require proper documentation on a regular basis. Status accounting allows changes to CIs and their records to be visible, e.g. tracking the status of infrastructure items as it changes one state to another for instance 'under development', 'being tested', 'live', or withdrawn (ITIL Service Support 2000: 147).

4.1.5 Configuration Verification and Audit

Accuracy and integrity of data information in the CMDB are assured when are being verified occasionally. Physical configuration audits are usually carried out to confirm that 'as-built' configuration of a CI conforms to its 'as-planned' configuration and its associated documents. Period analyses on configuration items and their documentation are usually carried out to ensure that the documentation reflects the current status (ITIL Service Support 2000: 148).

4.1.6 CMDB Back-ups, Archives and Housekeeping

Regular backup of CMDB is usually carried out and copies of the backup need to be securely stored at a distant location for use in the event of a disaster. The regularity of backups and retention policy depends on the size of the organization. The amount of historical data to be archived depends on its usefulness to the organization. It is advisable to delete CIs that are useful for the organization. Also a copy of CMDB backups is kept far away from the original CMDB for use in case of emergency (ITIL Service Support 2000: 149).

4.1.7 Management Reporting

Management report for Configuration Management usually covers the following: results of configuration audits, information on any non-registered or inaccurately registered CIs that have been detected and the corrective action, information on the number of registered CI and CI version, growth and capacity information, information on the rate of change of CIs/CMDB and the DSL, details of any backlogs of Configuration Management work or any delays caused by CM activities, and proposed remedies, the Configuration Management staffing position, the amount of authorized work done out of hours by other IT services staff, the results of efficiency/effectiveness reviews, growth reviews and audits of the Configuration Management system and proposals for tackling actual or potential Problems, data analyses on the number of CIs by type, the value of CIs (assets) and the location of CIs by business unit, support group or service (ITIL Service Support 2000: 150).

Overall, as can be concluded from the description of these best ITIL practices, configuration management process needs to be formalized for analyzing and maintaining configuration items.

4.2 Roles in Configuration Management Process

As any IT project, configuration management requires qualified and skilled people with standardized processes (Numara n.d.: 7) who will adopt a painstaking approach and pay due attention to detail (ITIL Service Support 2000: 130). Many organization overlooked this important aspect of implementation in the rush to find perfect CMDB tool (Numara n.d.: 7). Based on ITIL, there are top ten roles for ITIL configuration management best practices as detailed in Table 4:

| | |
|------------------------------------|--|
| Configuration Management Architect | A strong technical leader who can be counted on as the expert in configuration management. Also plays a major role in setting up the CMDB. |
| Requirements Analyst | Helps determine all the requirements needed to configure the environment. |

| | |
|--------------------------------|---|
| Process Engineer | This may be more important at the onset, but Version 3 of ITIL calls for continuous process improvement. |
| Logical Database Analyst (DBA) | DBA is needed for gathering, controlling and accessing information. |
| Trainer | Creates materials and instructs all IT staff on how to access and support configuration management. |
| CM Integrator | Every CMDB is built from data stored across many sources. The integrator supervises the reconciliation rules that bring those sources together. |
| Tools Support | Eventually, the entire staff will depend on information in the CMDB, and thus on the availability of the tools. |
| Impact Manager | This role specifically focuses on helping make configuration data intelligible to the rest of the IT organization. The key task here is to make sure relationships between configuration items are well defined, helpful, and accurate. |
| Reporting Support | Because the CMDB is a database, many users will want to create custom queries and specialized reports. Someone who understands the data will help make this possible. |
| Data Quality Analyst | ITIL rightly points out that the best practice in configuration management is to constantly verify data and audit the database. |

Table 4. Top ten roles in configuration management process (Numara n.d.: 7).

Table 4 shows the roles and level of responsibilities involved in configuration management process. According to this summary, there are factors to be considered when planning staff numbers for configuration management, for example: whether configuration management can be assigned with other responsibilities, or whether it requires the undivided attention of specific individuals; whether the configuration management team is to be responsible for projects as well as the IT infrastructure and services; whether the group is to be part of a joint change, configuration and release management team. It is also needed to consider what should be the size of the IT infrastructure, the level at which control is to be maintained, and hence the number of CIs to be

controlled; what should be the number of staff who will be performing control activities in other groups and projects; the extent to which support tools will be available and the size, frequency and complexity of change and releases (ITIL Service Support 2000: 130).

Hence, experts usually recommend that

"after implementation, clearly written and supported Configuration Management processes (e.g. using the CMDB) should be developed, communicated and disseminated to ensure that the CMDB maintains its accuracy. A loss of accuracy in the CMDB can have long term negative implications for the Configuration Management process and your ITIL implementation." (Blokdiik 2008: 29)

4.3 Summary

The main purpose of CMDB and configuration management process is to ensure organization manages its IT environment effectively and also provide real-time impact analysis information on processes and business. Configuration management process is the foundation of IT support and services. This process ensures no modification is done to IT infrastructures and components without authorization. Thus, when the right CMDB tool is matched with a well defined configuration management process for CMDB implementation, organizations can assure themselves that they will have a reliable source of information of their entire IT infrastructure.

The configuration management process in the case company is usually in form of Excel spreadsheets, Microsoft word files as well as some local databases. Not only are all these files difficult to maintain, there is no reliable means to share information within the organization. The impact of changes is usually very difficult to understand. In addition, the impact of IT interruption on business is also very difficult to know. With a well-defined configuration management process in place, the case company or any organization (large or small) is assured of a true source of information. The key findings from the case company are discussed in the next section.

5 Results and Analysis for Building a CMDB

5.1 Overview of the Results

The case study data was analyzed through content analysis of the interview transcripts as earlier explained. In addition, to better understand the area of focus and needs of the case company, the requirements and the expected outcomes of this study were specified by the case company. The below are the questions and suggestions raised by the case company.

Questions:

- How does ICT department operate and manage in relation configuration management?
- Who are the people responsible for collecting the configuration items?
- How do the configuration items store?
- How do the ICT employees understand companies' configuration items?
- How do ICT employees collect data of configuration items?

Suggestions for expected outcomes:

- Configuration management process (process chart, activities, roles)
- Configuration items levels
- Usage of configuration items in other processes: change, problem, incident, asset management, vendor management, etc.
- Proposal for the right CMDB

Suggestion for work methods:

- Interviews with the case company
- Study ITIL best practices
- Possible solutions found in literature or internet
- Researcher's personal experience

The case company expected the researcher to analyze and present current practice of configuration management, the challenges facing every ICT staff in relation to configuration management and proposal for improvement. Finally, the researcher was also asked to analyze and present all requirements needed for the implementation of configuration management database that is capable of supporting services provided by the

company. Thus, this Thesis was carried out and result analyzed based on the above specifications.

After thorough analysis of the collected data, six primary areas of key findings relative to configuration management emerged. These areas are shown in Figure 7.

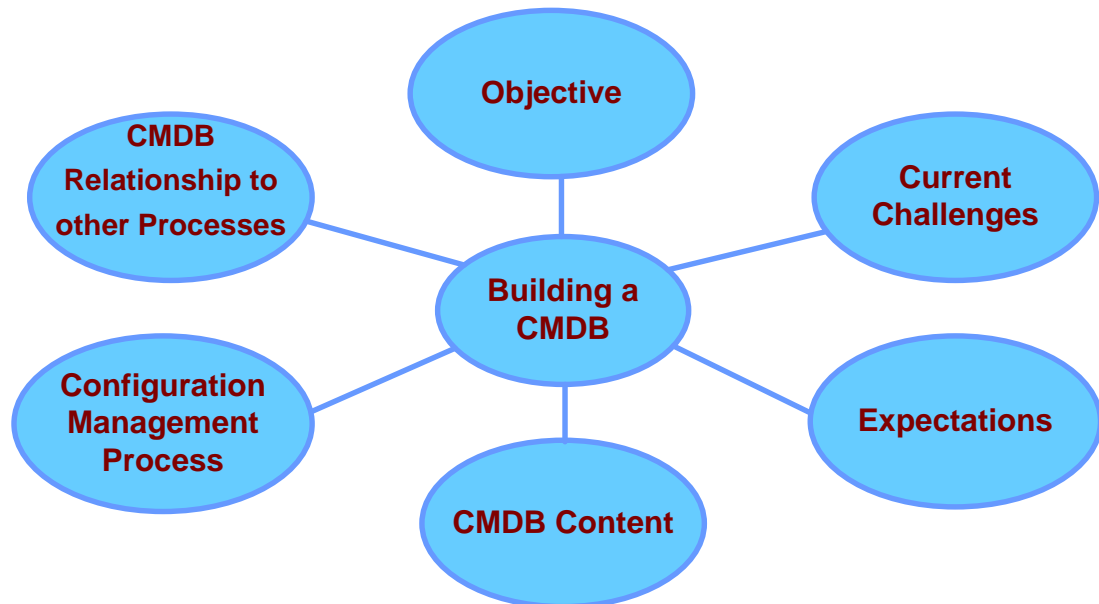


Figure 7. Interview themes.

The interview analysis is now reported in the order of the items presented Figure 7.

5.2 Objective of CMDB

In the interviews, the informants were asked about the objective for building a CMDB. The interviewees specifically outlined the purpose of building CMDB and goals that they strive to achieve. Several objectives were mentioned such as faster issue resolution, better IT and business alignment, process optimization, improved quality of service, better control of IT assets, proactive management of changes, cost reduction of IT operation, true and reliable source of information, single databank for information, better asset management and for knowledge sharing. Table 5 presents the output of the questions discussed during the interviews regarding the objective for having a CMDB.

| | |
|--------------------------------------|--|
| IT environment | <p>"What are the primary objectives of building CMDB?"</p> <p>"We have a need for it to understand the environment which we are supporting."</p> |
| Cost Saving and Process Optimization | <p>"The majority of cost incurred on resolving IT infrastructure issues would have been saved if accurate information on IT processes is readily available on time". "With CMDB, ICT department will achieve good quality of service delivery with low cost."</p> |
| Services interrelationship | <p>"We need to know, if we have services, what kind of relation are within the services."</p> <p>"We need to see the dependence of one component related to other."</p> |
| Change management | <p>"From infra service point of view, we will be able to handle our changes with very little risk."</p> <p>"With CMDB, application manager can easily understand the impact of local changes of IT infrastructure components on related applications."</p> |
| Application Management | <p>"From the application services point of view, the reason for CMDB is to see the relation, the interfaces, the dependency and to secure better quality operation and the smoother and flawless changes are being searched by the management."</p> <p>"With CMDB, applications will be properly defined, designed and easily supported to meet customer expectations."</p> |
| Incident Management | <p>"With CMDB, incident process will not be too difficult to know."</p> <p>"In relation to SAP (Systems Applications and Products), we have about 100 printers in Finland. We have 2 scanners. Those devices are having integration with SAP, thus if someone says that his scanned documents are not coming to SAP, our core key-users (ICT key-user 2nd level supports) need to understand who are related to this services. The CMDB will be so useful for the support process, for the incident management process."</p> |
| Service Management | <p>"From service point of view, there is a need to know all the services that are available, what kind of relation are</p> |

| | |
|--|--|
| | <p>within the services.”</p> <p>“The services provided by the vendors need to be understood, managed and maintained more efficiently than ever before.”</p> <p>“I need CMDB because the whole framework of the IT infrastructure requires a clearer picture for effective service operation and management.”</p> |
|--|--|

Table 5. Interviewees views regarding CMDB objectives

As seen in Table 5, the above objectives highlight the relevance of having a CMDB in the case company. As earlier discussed in the Section 3, the above objectives are in line with CMDB advantages outlined by ITIL.

In addition, by understanding where the ICT department wishes to position itself within the company space, vision and mission needed to be captured. Therefore, in order to know if the interviewees understood the vision and mission for having CMDB built, the question about knowledge of mission and vision for building CMDB was asked. Their responses are shown in Figure 8.

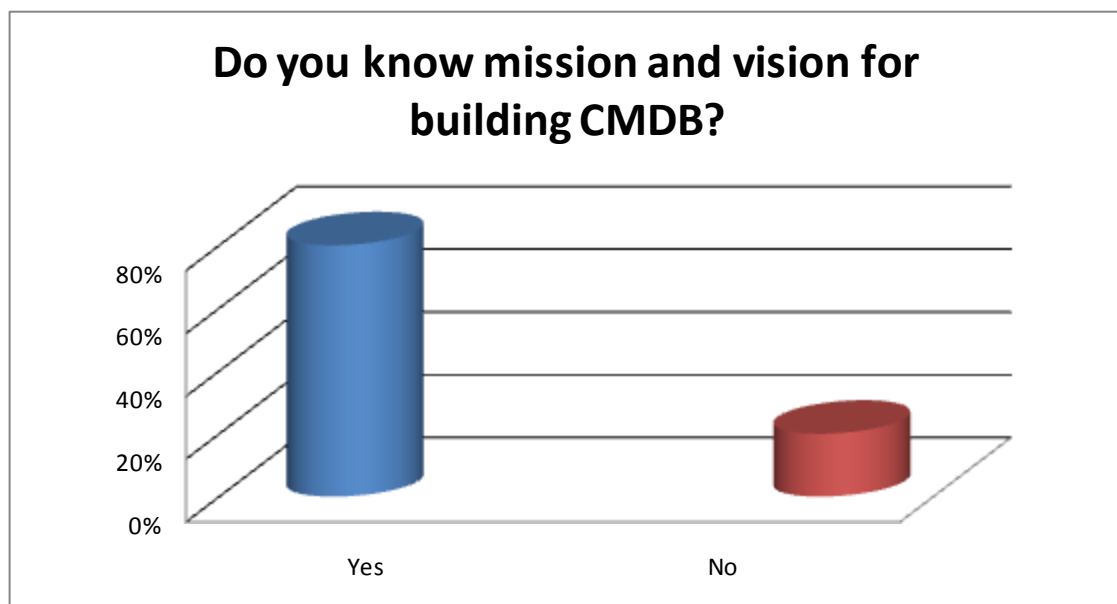


Figure 8. Knowledge of mission and vision for building CMDB.

Figure 8 shows the percentage of respondents that have the knowledge of mission and vision for building CMDB. It was gathered that the organizational mission and vision for having CMDB and ITIL configuration management process in place has not yet been communicated to a few people. 80% of respondent have the knowledge of it, while

20% have no idea about the management decision to have CMDB built. This means that some people in the ICT department of the case company still have no idea of the key purpose of having a CMDB in place.

5.3 Current Challenges

The second category of the findings from the case company is current challenges. The interview questions were structured so as to capture the real problems the case company is currently having in relation to configuration management. There were several problems that were raised to justify the needs for having a CMDB. All the interviewees explained different issues that account for the lack of a CMDB. Table 6 presents the responses to the questions related to the challenges facing the case company. Figure 9 summarizes the key challenges mentioned by the informants.

| | |
|--|--|
| Complexity | <p>"How do you currently function without the in-house CMDB?"</p> <p>"I have it (systems documentation) written in excel sheet, but it is difficult for me to understand. There are so few people in the company who have the information and understand it."</p> <p>"It is very important to have CMDB, because currently only very few people know how the systems are built (i.e. the connection and relation between the systems)."</p> |
| Difficulty in measuring the impact of incident on business | <p>"The issue is that when vendors informed us that they have problem with one server, and I ask them; what is its impact on business? They do not know. They just know that they are having problem with one server but they do not know what the impact on business is. Then I try to find out its impact on business. Since I do not have a place to check this, I approach the infra guys and I ask about the impact of the server problem on the company's business. They might know it sometimes, but not all the time. So when I need to inform the business about the problem which might have impact on the services, I do not have any fact within my reach. I cannot find it anywhere, thus I must count on information from the infra guys, not fact at hand. The Vendors are not about to tell which services are run with the servers. They are only providing us with server capacity. That is the problem I and other ICT people are really facing."</p> <p>"The impact of incident on business is usually difficult to measure"</p> |
| Unknown dependency of | <p>"Currently all the vendors and ICT staff do not know which components we have related to which service. The problem may be solved</p> |

| | |
|---|--|
| systems | <p>with CMDB in place.”</p> <p>“We need to know the service provided by the vendors and the inter-relationship of this service between vendors.”</p> <p>“The connection between platform, capacity and application services is missing.”</p> |
| Lack of understanding about business applications | <p>“Because different Systems Applications Product (SAP) is in different servers, it is very difficult to identify the particular server that hosts the faulty application. We have five servers for SAP alone. We have different environment in SAP and they all connected to different servers. It takes more time to get vendors to look into faulty application (SAP) or to get application information. We should be able to create a databank (CMDB) to identify the problem automatically.”</p> |
| Lack of knowledge and information sharing | <p>“We have intelligent personnel who have collected information on the top of their heads. They know the system and can master them whenever required. The knowledge is the personnel's heads but not documented.”</p> <p>“My point here is that if we have CMDB where we can describe things, the information will be readily available to anyone.”</p> |
| Slow resolution of incident | <p>“When I run critical incident process, for example, if we have problems that business is not able to use this service and we do not know yet if it is because of the application, server, network? So I need to call all vendors about the problem. So, for me it's more all less to get more understanding for this service which are components for these service and who is supporting those, and to know the exact vendor to call when we have a particular problem, and what are the service time for those.”</p> |
| Scattered process documentation | <p>“From data communication service point of view, “basically we can get information we need for our work, but the problem is that we have to look all around to know where the information is. One problem we have is that if someone from ICT needs information from us and we cannot be reached, then there is no other place to look for.”</p> <p>“There are quite a lot of connections between one server to another servers, different firewall settings, user ID. The information on these IT component are being scattered along different service providers.”</p> |

Table 6. Interviewees' current challenges in relation to configuration management.

As seen from Table 6, the result from the current challenges shows unambiguously the most important reasons why the case company should adopt ITIL compliant configuration management. The challenges can be summarized as follows: difficulty in measuring the impact of incident on business, the complexity of IT infrastructure, scattered process documentation, slow resolution of incident, lack of knowledge and information

sharing, unknown dependency of systems, difficult accessibility to CI information and unknown relation between capacity service and application service. All these challenges can be eliminated with a CMDB in place in the case company.

To clarify the experienced challenges the following graph shows the point of view of various responses.

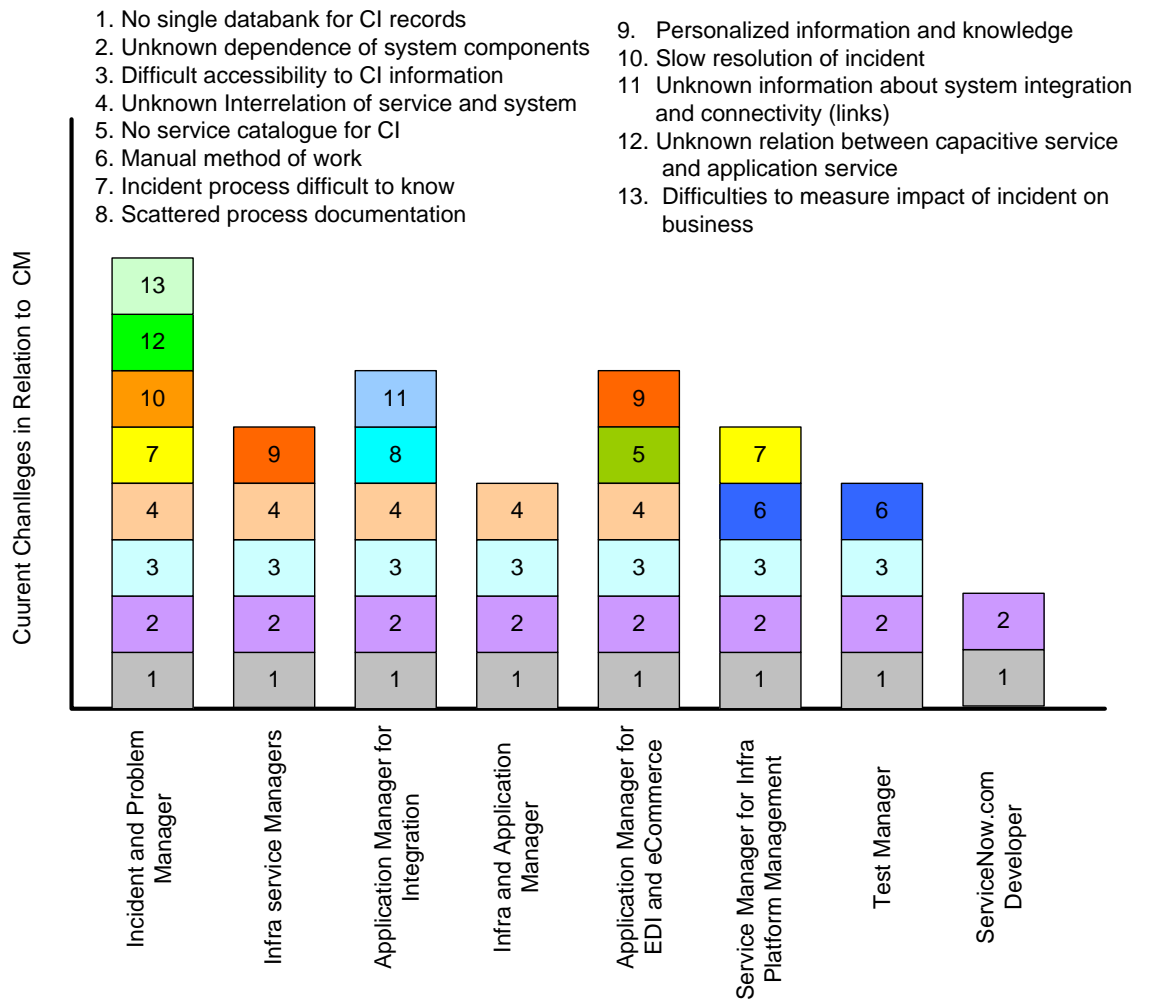


Figure 9. Current Challenges in Relation to CM.

In Figure 9, the horizontal axis shows the ICT staff representatives of various ICT units within the case company, while vertical axis represents the current challenges facing each unit of ICT department.

Each block in Figure 9 represents the level of challenges of each respondent. The level of challenges in relation to CMDB was considered to be very high especially for incident

and problem manager. With CMDB in place, incidents and problems can be resolved faster by understanding the possible cause of the failing or problematic infrastructure item. It can also be concluded that the entire service support group did not have a single place of accessing configuration documentation or records. Some reported lack of understanding about dependencies of the entire system components. Some did not know what their assets worth. Some CI records are personalized due to lack of single data storage. However, all the challenges indicated above affirm what most literature have established as the possible challenges any IT department without the CMDB and a well-defined configuration management process will face. Based on this, it becomes clearer that with the implementation of an ITIL compliant configuration management, organization can effectively and efficiently manage its IT architecture and environment.

5.4 Expectations of having a CMDB

The third theme which emerged from the interviews is detailed below. Table 7 represents the responses to the question related to expected benefits of having a CMDB, while Figure 10 summarizes the expected benefits of a CMDB.

| | |
|--|---|
| Single and true source of information | <p>"What are your expected benefits (expectation) from CMDB after its successful implementation?"</p> <p>"It will be very vital to have information in one place instead of being scattered everywhere."</p> <p>"With the help of CMDB, the integrations and interdependencies of systems will be easily understood."</p> <p>With CMDB "information will be readily available to anyone."</p> |
| Service provision | <p>"With CMDB, IT service will be easily supported and maintained."</p> |
| Understanding of relation between IT component | <p>"I look forward to get proper understanding of systems dependencies, because it will helps us to get better service to the business."</p> <p>"integration of processes can be a key benefit of having CDMB."</p> |
| Better and quick level | <p>"It will be as a database for problem solving, and it will pro-</p> |

| | |
|---|---|
| of support | <p>vide contacts for vendors to call in case of problem.”</p> <p>“If we have the CM of our own, we will take of our systems, network, servers and so on. But now vendor 1 is the one providing us with the workstation services and the platform, and also the support and help desk for the workstations. We have another company called vendor 2 who is hosting our servers. Of recent, vendor came along with our SAP installations and started hosting those. All most of the vendor 1 hosted servers are now move to vendor 2. Some of the servers are still with vendor 1 but other windows servers are now with vendor 2. Vendor 3, who is kind of sitting on top of the network, working in inclination with vendor 1, taking care of our network. The reason for the above explanation is that , if we have to build our own CMDB, we will have to somehow incorporate the data from our vendors.”</p> |
| Statistical information and documentation | <p>“I need CMDB to enable me have access to more statistics: How many customization for customer, What is our service capability (browse it as a service catalogue), how many new capability we have develop during some time span, what is our level of development, how effective we are. But mostly this is a tool for those who have hands-on with the systems; they would really need to know what alteration are made for specific customer and specific vendor, because it will be faster for them and accessible intervention. This will produce benefit for the business, whereas my knowledge of the statistics would give direct benefit to the business.”</p> |
| Business agility | <p>From eCommerce point of view, CMDB will make our business more agile by enabling faster access to information and, faster access to information may lead to better service level to businesses, which are indirect business benefit.”</p> |

Table 7. Interviews quotations regarding the expected benefits.

Table 7 shows some of the most important benefits of having an ITIL compliant configuration management according to the interviewees. The expectations of various units within the ICT department are categorized as shown in the below graph.

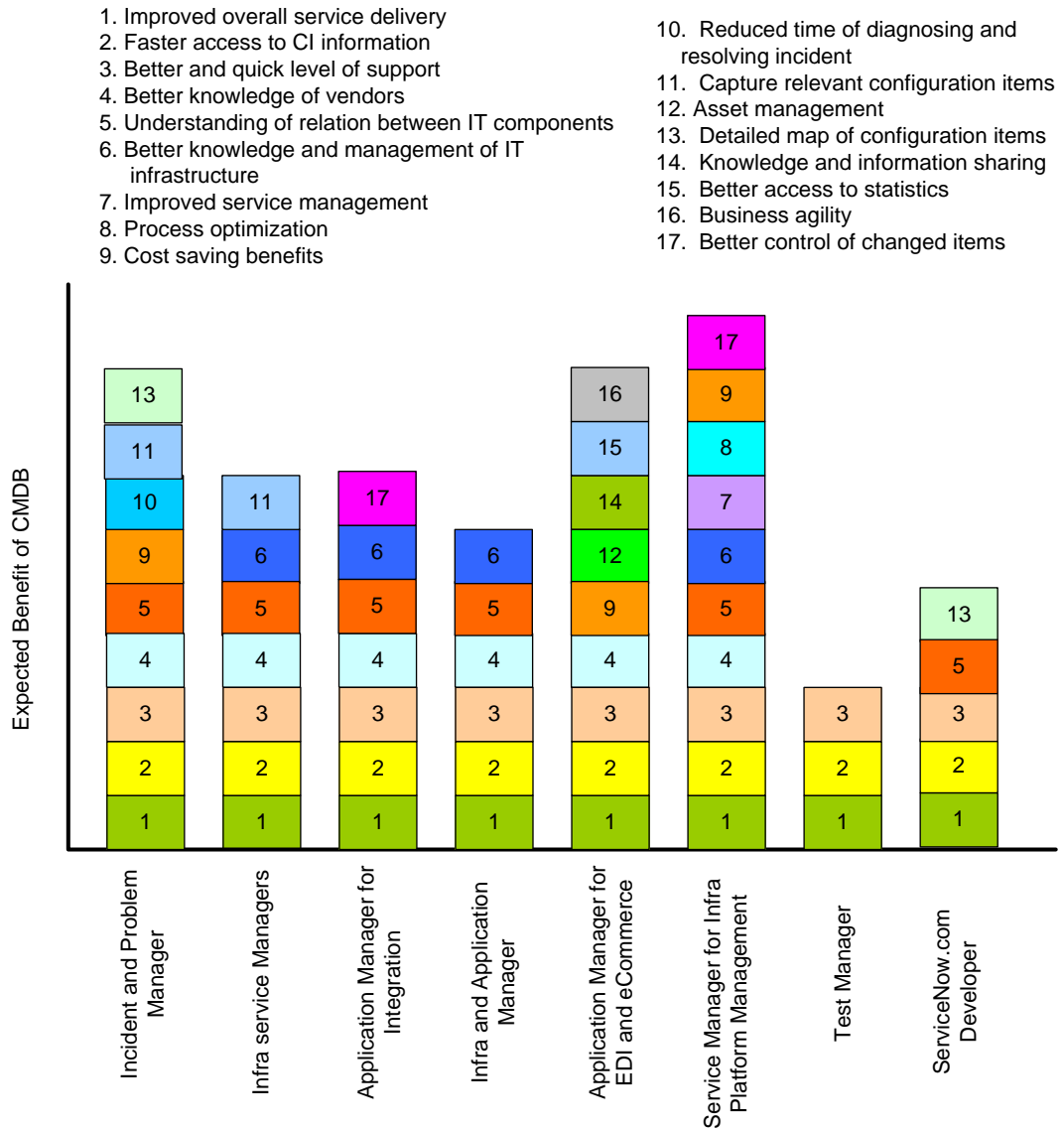


Figure 10. Interviewees views regarding the expected benefits of having a CMDB.

In order to illustrate the interest of various stakeholders, each block of Figure 10 represents the expected benefits of building CMDB as perceived by each informant. In addition, Figure 10 shows that with a CMDB in place, incident processes can easily be followed. Moreover, the impact of incident on business can be easily measured, and Configuration information will be more available to the entire support group. It was also revealed that it will promote knowledge and information sharing. The cost of diagnosing and resolving support issues will be reduced greatly, and it will ultimately improve quality of service delivery. All these benefits are in line with CMDB benefits as stated by ITIL. This brings a valid justification for building CMDB in the case company based on the respondents' views.

5.5 CMDB Content (Configuration Items)

A configuration item is any component that supports an IT service. In the case company, it was gathered that the basic IT was outsourced in 2003 to Fujitsu Services Oy; the data center and its IT infrastructure had also been outsourced to other vendors. For example, servers are located in Tieto's server room. Thus, there was a clarification on what would be the configuration items for the CMDB. Some of the respondents provided the Excel spreadsheets in their custody and suggested they should be stored in a CMDB so that everyone could have access to them. Other respondents verbally mentioned the kind of company's assets or information they wish to access in the CMDB after it has been successfully implemented. In all, detailed information about the integration of processes and systems connectivity was observed to be the top item all respondents are keen to see in the CMDB. This information is summarized in Table 8.

| CMDB ITEMS | |
|----------------------|---|
| Type | Subtype |
| Business Application | SAP ERP Microsoft |
| Database | Oracle SQL |
| Server | Physical Virtual |
| Workstation | Desktop Laptop |
| Router | Router Switches or hubs |
| External Device | Scanner Local Printer Network printer Projector |
| Documentation | Service level agreement (SLA), maintenance contract, service catalogue, process description, Excel spreadsheet, PDF files, database documentation, assets, contracts, history of changes made, by |

| | |
|--|---|
| | who, when, why, etc, incident and problem report, dependencies between components, versioning information |
|--|---|

Table 8. The list of configuration items.

Table 8 shows the list of configuration items identified in the case company. Based on the documentation provided by the case company, CIs should be categorized as detailed in Table 8.

5.6 Configuration Management Process

The current practice of configuration management, in the case company, is in form of an Excel spreadsheet. At the moment, there are no sophisticated tools for managing and recording configuration items. So far, Excel spreadsheet was seen to be the most used and important tool for recording configuration items. Figure 11 demonstrates the percentage values of the answer and Table 9 shows the output of the questions during the interview. Other important information resides in people's head.

After several interviews, it was noted that presently the case company does not have a defined configuration management process in place. The configuration items are also scattered, and as earlier stated, there is a variety of manual methods of managing and maintaining configuration items. The case company certainly has some integration and automation, but not to the level of a true CMDB. Although, ITIL incident management, ITIL release management and ITIL problem management, change management (including development, testing and deployment), release management, project management, project portfolio management, business requirement management, service management, contract management, and identity and access management have been successfully implemented and followed in the case company, ITIL configuration management process is not currently in place.

Based on ITIL, the company internal data or processes should not be personalized by an individual. However, it was discovered that the company internal data are stored in different Excel sheets, and almost all employees have their own separate Excel spreadsheets. Some have vital information in their brain, which is then not open to other staff

members. Furthermore, the case company does not have a single databank where this information can be accessed, when needed, by everyone. And currently, there is no one specifically responsible for capturing and maintaining configuration items.

Presently, a process defined for managing configuration items and changed items is also missing, except for the changes made in the application side. The case company has change management and change process in the application side, but not on the infrastructure side.

Integration between applications is either not widespread in the case company. In relation to integration, one of the main reasons observed was that the ICT center was outsourced to several external vendors, and therefore, the link between these applications is missing.

Additionally, the dependence of business on ICT has made computer network more complicated. The case company deals with many business applications such as SAP (Systems Applications and Products), Microsoft, and Oracle just to name a few, with so many servers housing them. Moreover, all these applications and systems are also supported by different vendors. In consequence, when incidents/problems occur, it sometimes takes more time to resolve due to lack of understanding about how systems are interconnected. Table 9 summarizes the current storage places of CIs.

| | |
|-------------------|--|
| Brain | <p>"Where do you currently store your CI information?"</p> <p>"We have intelligent personnel who have collected information on the top of their brain. They know the system and can master them whenever required. The knowledge is the personnel's brain but not documented."</p> |
| Excel spreadsheet | "I use service provider system, I use Excel. Updating of data is manual work." |
| Local database | "Some data that are not in the network are kept in everyone's computer." |

Table 9. Local database for configuration items.

Table 9 shows all the various local databases for storing configuration items in the case company. The following can be deduced from the table: first, information stored in the individual's brain may probably not be shared with other member of staff. Second, information stored on the Excel files located in the individual's workstations may not be available at all time to other staff member. For example, whenever, the person holding the information is not available, there will no other place to get the information. Third, the infrastructure information stored in the service providers' systems may be too difficult to obtain or even understand. For example, the case company in this study has more than fifty vendors supporting its ICT services. In the case of service interruption, knowing the exact service provider to call for the necessary information is usually difficult. However, with a single databank such as CMDB, information can be put in one place instead of being scattered everywhere. This way, ICT staff members will have a trusted and reliable place of accessing information when needed. Figure 11 shows the distribution of databases for configuration items in proportion, based on the interview results.



Figure 11. Storage location for configuration Items (CI).

Figure 11 shows the current location of CI information in the case company. The question "where do you currently store your CI information?" was asked and, according to the answers, about 34% of the informants use case company Extra-net for storing CI information, 100% use Excel spreadsheet, about 50% use service provider system and

almost 13% use file server for data storage. Based on the above information, it can be deduced that CI records are stored in different locations due to lack of a single data-bank. Tables 8 and 9 show the list of configuration items and their locations, as previously detailed.

5.7 CMDB Relationship to other Processes

The interviewees' responses related to the relationship of CMDB with other processes are detailed below. In the report, the authorship of the responses is not revealed to protect the informants and thus ensure openness and authenticity of the obtained data. The collected responses are group and classified around the following topics:

Topic 1. Incident Management

Incidents and IT-related issues can be resolved faster based on the relationship between the concerned configuration items. According to one respondent,

"With CMDB incidents can be prioritized more quickly before they impact business".

Topic 2. Problem Management

Many respondents emphasized that detailed information for problem diagnosing and resolution will be made available via CMDB. According to one respondent,

"CMDB helps simplify the complexity of the IT infrastructure by linking problems and known errors to CIs".

Topic 3. Change Management

Effectiveness and efficiency of change management depend on the accuracy of configuration items within the CMDB. According to one respondent,

"The CMDB ensures changes to data are controlled and flawless and the record of these changes is kept in the CMDB".

Another respondent claims that CMDB identifies the impact of changes to the system so as to avoid unexpected incidents.

Topic 4. Vendor Management

The interview revealed that the case company has over 50 vendors managing and supporting its ICT infrastructures, data center and business applications. The ICT operations including application hosting services, helpdesk support, infrastructure services and capacity services are outsourced to vendors. Infra team group are in charge of Information about the systems connection. However, the connection between capacity service provided by the vendors and application service is hidden. The information needed to manage the connections can only be provided by the vendors. It was discovered that business applications and IT infrastructures are being supported by external vendors and the case company staff members. The interview revealed different perceptions about the vendors. Some interviewees believed vendors are currently managing and maintaining the configuration items well, while others could not say to what extends this maintenance is being conducted. According to one respondent,

"We have different kind of Excel sheets for them. For applications, services, vendors stored in case company Extra-net. Basically, all our items are being kept with our vendors. So, apart from keeping those data/information in the CMDB, integration of those process can be a key benefit of having CDMD".

Some do not know if the company's assets are being backed up or cannot name the kind of device that is being used for backup. According to another respondent,

"The devices are from the providers, so I do not know what kind of devices they are using."

However, the two scenarios revealed a need for having a CMDB in the case company. With in-house CMDB,

"Everyone would be sure company's data are in a trusted place and properly managed."

All the ICT staff members keep Excel spreadsheet for details of vendors responsible for different service, but the challenge still remains as no one is sure how all the systems are being integrated and to what extent they are managed. For example, in case of an incident, virtually all the vendors need to be called informing the company of the situation. This leads to unnecessary delays in issue resolutions which can have negative impact on business. According to one respondent,

"If one is sure of the real vendor responsible for the particular issue, it will make issue easier and faster to resolve".

Topic 5. Service CI Relation and Interconnections

Lack of understanding about the relation and connection between the systems and vendors was observed as the main challenge in the case company. Many of the respondents claimed that one of the main reasons to have a CMDB in place is the service CI relation. The interview revealed that CMDB provides detailed maps of the dependencies and connectivity between the capacity service and application service. According to the respondents, interconnections are an important part of the overall IT infrastructure community.

Topic 6. Environment

According to the respondents, environment will be impossible to support, control and maintain if the ICT staff members do not understand their environment. However, few people in the case company understand the environment fully and completely.

Topic 7. Storehouse of Information and Single Source of Reference

Information on applications, servers, network is recorded in Excel sheet, and everybody has their own Excel spreadsheets. IT infrastructure documentation is scattered with no single place of storage location. According to the respondents, CMDB is a storehouse of information and "*all other IT service documentation*". Many respondents consider CMDB as a true source of information, as revealed in these quotations below:

"The right information at the right time is a necessity so as to support business service without any issue".

"CMDB provides a single source of information to enable everyone access information when needed."

Topic 8. Infrastructure Management

Some informants explained that the complexity of IT infrastructure can be simplified with CMDB by providing information on different applications and servers. So far, this information written in an Excel sheet has been very difficult to understand for many staff members of the case company.

Topic 9. Resource and Process Optimization

According to some informants, the CMDB would provide a clearer picture of underlying

relationship that exist between IT support and business services that they support. In addition, CMDB will show redundant relationships of physical technologies and help identify the best resource allocation to use.

Topic 10. Impact Analysis

According to some informants, priority is currently determined based on the impact of incident or IT issues on business. When an incident occurs, there is a need to know what other services it will impact to be able to determine its consequence. The interviews revealed that unplanned IT service interruption or incidents sometimes take time to resolve, and its impact on business is usually difficult to measure due to lack of understanding about servers' integration.

According to one respondent, impact of incidents on business in the case company is difficult to understand and measure because vendors only provide server capacity, and they cannot measure the impact of downtimes on business. However, with the described connection and systems integration, the concerned vendor will be called directly and issue may be resolved faster as such. This makes it imperative for ITIL compliant configuration management to be implemented. In addition, according to one respondent,

"Impact analysis capacity is a key to reduce the resolution time of incidents and CMDB improves IT/business alignment".

Topic 11. Training

Training is needed to ensure every staff member of ICT understands the function of CMDB and its use.

Topic 12. Service Catalogue

Some respondents believe that service catalogue describes the list of services which vendors offer to their customers. According to one informant, the main purpose of service catalogue is to capture all information about service provision into a single place. At the moment, the case company does not have a service catalogue in place. One of the respondents suggested that before building a CMDB, a service catalogue needs to be available to ICT staff for proper understanding of service and processes.

“When we have the service catalogue from then we can stand appreciating the need for CMDB.”

In summary of this section, the main objective of this Thesis is to analyze the current practice of configuration management in the case company and prepare a ground for the ITIL compliant configuration management to be set in place. In order to achieve the objective, two research questions were being formulated and this study aimed at providing answers to them. The research questions of this Thesis are:

- What are the current practices of configuration management?
- How to build an ITIL compliant configuration management process, including a CMDB?

To answer the first research question outlined above, key people were selected for a semi-structured interview and all of them represent or head different units of the ICT department in the case company as previously detailed. The emerging key findings from the interviewees elaborated in this section provide answers to the first research question. In addition, the areas that need special attention during the CMDB implementation process, the challenges facing each unit of the ICT department as well as the interviewees' holistic view towards the proposed solutions are well reported in this section. The next section focuses on providing answer to the second research question based on suggestions gathered from the existing literature and interviewees' recommendation.

6 Proposal for Configuration Management Process

This section suggests an approach to building a CMDB by means of the conceptual framework introduced in Section 3 and 4 to meet the needs of the case company.

6.1 Recommendations for Building a CMDB

A five step framework for building a CMDB described in Section 3.3.2 is important in any successful CMDB project. As shown in Figure 12, the five stages for building the CMDB are: *defining goals and objective; assignment of responsibility; the right approach; defining CMDB contents and filling the CMDB with data.* (Section 3.3.2). In building a CMDB for the case company, all of these steps in each stage of CMDB project should be thoroughly addressed.

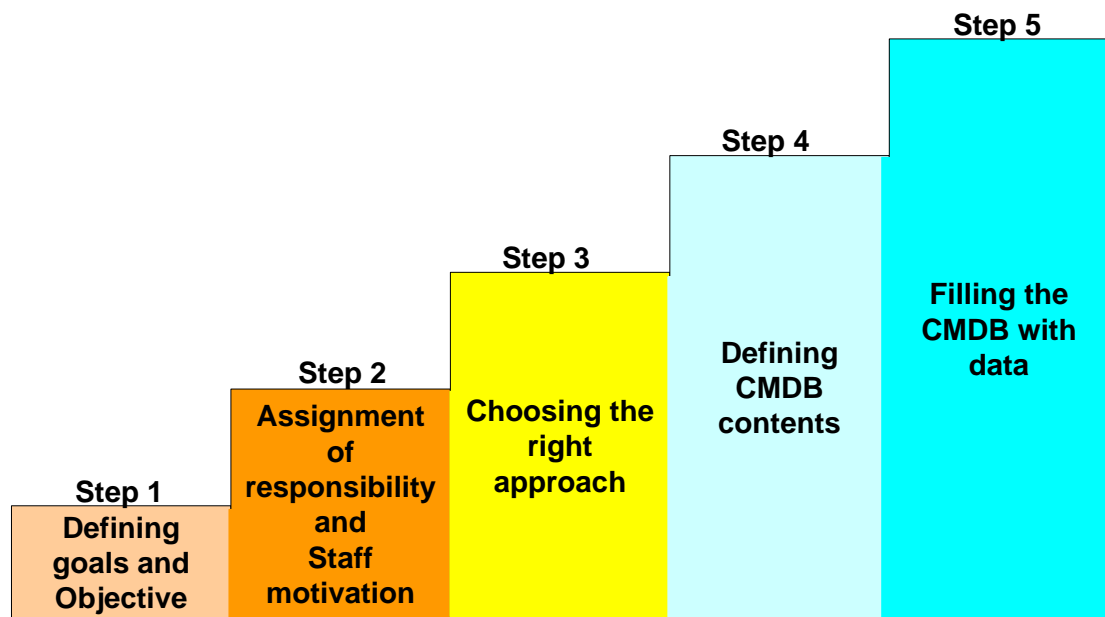


Figure 12. Building a CMDB in five steps.

Figure 12 exemplifies five stages for successful CMDB implementation. First, *defining the objective and goals* of CMDB is crucial at the early stage of implementation process. At this stage, the scope, goals and purpose of building a CMDB should be well stated and justifiable. This study recommends that the objective should be defined from a business perspective by making sure the CMDB project aligns with business goals. Objective defined from the business perspective will likely attract funding for any

IT project. This study also recommends that the expected benefits and reasons for CMDB at early stage of implementation should be stated.

Second, as detailed in Section 3.3.2, *assignment of responsibility and staff motivation* ensure that all ICT staff members are involved and are part of the CMDB project and implementation. For a successful CMDB project, staff involvement is critical; this involvement enables changes to be made possible. CMDB project brings numerous changes and additional responsibilities to the organization and to members of the staff. Therefore, staff members must be motivated and helped to see the main reasons for building a CMDB.

Third, a *right approach* ensures that the relevant configuration items are captured and CI levels are well defined (see pages 25-27). Since the case company had already outsourced its data center, including basic IT support such as helpdesk, systems support, systems administration, platform and capacity management, and the workstation support, this study recommends the following actions regarding CI and its levels, based on the proven ITIL practices: a) only capture CI elements that have greater impact on the quality of service delivery; b) use auto-discovery software to help scan all the relevant items since manual method of scanning is error prone; c) details of workstations attributes such as type of processor, model, serial number, size of memory are not necessary to be stored in the CMDB; and d) since local CMDB already exist in the form of Excel spreadsheets and other databases, each member of ICT staff should be asked to identify the data they have, how the data is being maintained and its usefulness to the organization and vendors, and various support partners should be contacted to produce the relevant documentation. This way, the relevant data would be captured and subsequently stored in the CMDB. Overall, this stage is very important to ensure the CMDB stores the required data for performing support services.

Fourth, *CMDB contents* such as systems relationships, systems connectivity should be well defined at this stage. Relationship such as CI to CI relationship, CI to ITSM processes needs to be defined as well. The depth of CIs information, CIs levels and as well as CI attributes should be determined so as to establish the true definition of all infrastructure components.

Finally, the last stage ensures *CMDB is filled with relevant data* required for business. As earlier mentioned, such filling should be done automatically for better accuracy. When all these recommendations are considered, there is a high possibility to conduct a successful CMDB project and achieve the set goals.

In addition to the above five-step framework, this study recommends other essential additions to consider during the CMDB implementation, which include: *training program; service catalog; choosing the right CMDB tools, and presentation of a good business case.*

First, to ensure that investment is not wasted, CMDB users are expected to acquire CMDB knowledge through formal or informal *training*. This is necessary to ensure that all aspects of a CMDB are well understood by every member of ICT staff. The case company is, therefore, advised to ensure the ICT members are trained and have adequate knowledge of CMDB. In addition, this study recommends that every member involving in CMDB project should familiarize themselves with ITIL literature.

Second, service catalogue

Before implementation of a CMDB begins, expert usually recommends that the implementation of the service catalogue should be done first. Service catalogue defines all the services offered to the customers both from the business and IT perspectives. Gandar (2006: 2) argues that implementation needs to begin from the perspective of a front office (service catalogue) for IT, where business customer needs drive the definition and delivery of IT services rather than from the perspective of the back office (CMDB) of systems, assets, and resources, currently and historically managed by IT. The researcher of this Thesis supports this argument and recommends that services offered to the customers should be defined first in the context of the business rather than in the context of the technology. Hence, introduction of a new technology can only be justified if the organization is able to identify its benefits to the organization. As earlier recommended in this section, the objectives of building a CMDB should be defined from the business perspectives, detailing its benefits to the customers and other users' community.

Gandar (2006: 2) presents four key propositions to justify the implementation of a service catalogue either before or in parallel with the CMDB deployment:

1. "Unless business needs drive the definition of services and delivery of those services, there will continue to be a disconnection between IT and its internal customers." This is because service defined from existing infrastructure assets and configuration items will take the same 'IT-centric view' rather than business-centric view. Expert recommends that data model for a CMDB needs to be drawn from a service catalogue. This will help IT to articulate what it does for its customers. Hence, service catalogue forces IT to review, define, and present what it provides from a customer's perspective, and not from an infrastructure view (Gandar 2006: 2).
2. "The benefits of the service catalogue will come much earlier in the adoption cycle than those for the CMDB, especially when considering the long time to completion of most CMDB projects." (Gandar 2006: 2)
3. A service catalogue ensures more customer-centric IT service management (Gandar 2006: 2).
4. Service catalogue accelerates a CMDB deployment and improve efficiency of IT operations. It also helps define and captures the information required to populate the CMDB. (Gandar 2006: 3).

To further support the above facts, some of the case company's informants mentioned that (see page 53) the service catalogue helps to better understand the services offered to the customers and those offered by the vendors. In addition, Table 10 shows the differences between a service catalogue and the CMDB.

| | Service Catalogue | CMDB |
|-------------------|--|---|
| Focus | Services | IT systems/assets/configuration items |
| Starting Point | Service definition | Auto-discovery |
| Financial Aspects | Service-based pricing models | Asset-based cost models |
| Data Aspects | Source of record for the services that IT offers | Source of record for IT systems and assets |
| Primary Functions | Services are published, agreed, managed, requested, tracked, | Configuration items are inventories, tracked, updated, and rec- |

| | and reported | orded |
|--------------------|--|--|
| Key ITIL Processes | Business relationship management, service level management, and financial management | Configuration management, change management |
| Reporting Aspects | Reporting to the business on what services IT can/does deliver | Reporting for IT on resources and system usage |
| Terminology | Business language | Technical language |
| Usage | Used by Relationship Managers, Service Delivery Managers, Users, and Customers | Used by Change Manager, Configuration Managers, and Operations Teams |

Table 10. The service catalogue and the CMDB (Gandar 2006: 6).

As seen in the Table 10, integrating the service catalogue with the CMDB is essential so that each compliments the other. From the Table 10, it can be deduced that both the service catalogue and CMDB are fundamental elements of the ITSM model. However, the researcher of this thesis perceives that CMDB works better when it is being implemented along with or after a service catalogue. This way, IT service delivery can be easily aligned with customer expectations.

Third, *CMDB tool* needs to be carefully chosen. The CMDB features described in Section 3.3.1 are vital when choosing the right CMDB. These four key features are: *federation; reconciliation; synchronization, and mapping and visualization*. All these four features enable creation of a dimensional database, something that few vendors deliver or even talk about. Figure 13 outlines the key features of a true CMDB.

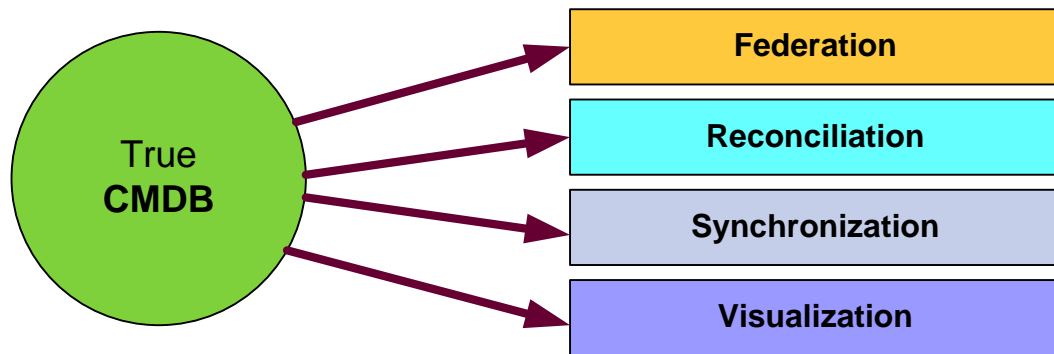


Figure 13. Features of A True CMDB.

The case company is thus advised to look for all these features in any CMDB tool they choose to buy. The detailed descriptions of the above features are explained below.

Feature 1. Federation

A federated CMDB is a combination of multiple management data repositories, at least one of which federates the others into an aggregate view of management data (BMC et al. 2007: 8). The federated CMDB ensures that the data from multiple sources are integrated into a flawless and consistent CMDB. The CMDB that has the capability to federate the data minimizes the time and effort required to integrate various data sources into a single CMDB. The federated CMDB architecture allows IT organizations to create and configure a CMDB from management data repository (MDR). Federation is not as simple as auto-discovering CIs or their relationships; it also must include an understanding of which data store is definitive, as well as which data reside in the CMDB store and which reside in the original data store. The CMDB must provide the means to store some data attributes locally and use this as the context to glue the federated data attributes into a cohesive configuration model or dimension (Marquis 2007: 55).

Feature 2. Reconciliation

Reconciliation ensures there are no duplicates and maintains the correct nomenclature for any given CI. In a small firm, reconciliation is usually performed in the brain and expertise of the lead technician. In large organization, reconciliation cannot be done in someone's head. Therefore, the need for a sophisticated reconciliation engine increases as the number of federated data sources increases (Marquis 2007: 56).

Feature 3. Synchronization

Synchronization allows IT users in various ITIL-defined roles such as change manager, incident manager, service level manager, service desk agent, service level manager, change advisor, and other roles to see and assess the risks of a change. Synchronization helps keep federated CMDB under proper management control. When a CMDB system detects a CI change in a federated data source, it compares the change to its list of approved changes and synchronizes itself, if there is approval on changes or raises an alert if there is no approval for changes (Marquis 2007: 56).

Feature 4. Mapping and Visualization

True CMDB should be able to display its logical CI configurations visibly for its human users without confusion. Some systems use file metaphor, terminology or graphical representation to display their data. Data visibility is paramount in a true CMDB to prevent confusion (Marquis 2007: 56).

Thus, a true CMDB system must have connection to the definitive source (federation), detect the change (reconciliation), determine the validity of the change (synchronization), store the old configuration, and make and display a new dimensional model for the new configuration (mapping and visualization). Marquis (2007: 3) argues that CMDB products from most vendors today usually offer at least one of these four key features. While “no vendor today offers all of them in a mature form, all claims that they will soon.” Therefore, in building CMDB, organization needs to be wise on the choice of CMDB products.

Next, *business case* gives the key reasons for opting for a project. This study recommends that the business case to be presented to management should provide details of the current organizational challenges, along with the perceived risks that configuration management will solve. In addition, the expected benefits and how CMDB project will support a specific business needs need to be discussed with management. A good business case details how organization will benefit from the project such as cost-saving benefits or improved customer satisfaction.

In addition, *metrics and measurement* need to be implemented for measuring the performance and success of CMDB. The configuration management process should be monitored, reported, and improved upon. It is recommended that the organization identifies metrics that will justify the objectives of the projects. ITIL recommends the following key performance indicators for CMDB project (ITIL Service Transition 2007: 95): percentage improvement in maintenance scheduling over the life of an asset (not too much, not too late); degree of alignment between provided maintenance and business support; assets identified as the cause of service failures; improved speed for incident management to identify faulty CIs and restore service; impact of incidents and errors affecting particular CI types, e.g. from particular suppliers or development groups, for use in improving the IT services; fewer errors caused by people working with out-of-date information; increased quality and accuracy of asset and configuration information; ratio of used licenses against paid-for licenses (should be closed to 100); percentage reduction in business impact of outages and incidents caused by poor asset and configuration management; reduction in the use of unauthorized hardware and software, non-standard and variant builds that increase complexity, support costs and risk to the business services; changes that were not completed successfully or caused error because of poor impact assessment, incorrect data in the CMS, poor version control and value of IT components detected in use.

In summary, this section first introduced a five step framework for building a CMDB in the case company. The framework is recommended based on the current state and the need of the case company. Second, the key features of CMDB to look for in any CMDB tool the case company chooses to buy have been offered in this section. Third, the fundamental principles to put into considerations before CMDB deployment and other essential additions to the proposed framework are also offered in this section. The fundamental principles recommended are derived from the suggestions of the interviewees during the interview sessions and the recommendations of business/IT experts.

6.2 Validation of the Proposal with the Case Company

As reported in Section 2.5, a validation meeting was organized with the incident manager and quality assurance manager of the case company. The outcome of the thesis was evaluated in order to ensure the proposed solutions match the expectations of the

case company. After the evaluation, there were suggestions about other ITIL processes that need to be implemented along with configuration management in the case company. It was specifically stated that configuration management process cannot effectively function without effective change management process. Based on this, it was agreed that change management should be implemented and should also form part of the proposal for the case company.

Finally, the attendees were pleased with the outcome draft presented and expressed their satisfaction that the implementation of ITIL configuration management will solve the current challenges of configuration management in the case company.

6.3 Modifications

During the validation meeting, it was decided that the outcome drafts match the needs of the case company as earlier stated. Although there were still other modifications to the first outcome draft, these modifications were suggested during the validation meeting and brainstorming session. The main changes were seen in the configuration items and the configuration items level. It was suggested that the configuration items provided by the various interviewees should be well defined in order to reveal the right level of configuration items. Appendix D show some of the changes added to the initial proposal. On the whole, the proposal was approved of and validated by the case company. The next section discusses and concludes the Thesis.

7 Discussion and Conclusions

This section covers a summary of the Thesis.

The main purpose of this study was to answer the following research questions: what are the current practices of configuration management? How to build an ITIL compliant configuration management process, including a CMDB? To answer these questions, a case study was conducted. The current practices of configuration management in the case company were investigated and analyzed through brainstorming and series of interviews held in the case company. The current practices analyzed in Section 5 provide useful information for ICT managers of the case company in terms of area that deserve most attention when implementing a pragmatic ITIL compliant configuration management.

After the case study research and thorough review of existing literature, an ITIL compliant configuration management was then proposed. In addition, a five step framework for building a CMDB has been proposed in this study. Additionally, the key capabilities to look for in any CMDB tool have also been offered in this study as detailed in Section 3, Section 4 and Section 6.

However, this study has achieved four main contributions. First, the analysis of the current practice of configuration management in the case company has been reported in this work. Second, the detailed overview of the current best practices of ITIL configuration management has been provided. Third, this study has successfully identified a gap between the current practice of configuration management of the case company and the best practices of ITIL configuration management. Fourth, feasible solutions for building an efficient ITIL compliant configuration management database has been proposed for the case company.

Furthermore, this Thesis has successfully presented the benefits of ITIL complaint configuration management in the form of CMDB and configuration management process. Some of the main benefits are as follows: with a CMDB organizations can know what their assets worth, CMDB eliminates unnecessary time and money spent on seeking information about the IT infrastructures, offers impact analysis information on process-

es and business, provides a true source of information for all IT infrastructure, provides a comprehensive view of the IT infrastructure, it serves as a platform for information integration between capacity service and application service, ensures accuracy of changed items, eliminates scattered documentation and enhances resource and process optimization. All of these help an organization to effectively align IT services with business goals and objective.

Conclusively, based on the result from this study, an organization needs to install a CMDB as well as configuration management process in order to succeed in any ITIL processes or IT Service Management. However, the proposed CMDB solution and a well-defined configuration management process can be used to prepare a ground for a pragmatic CMDB to be set in place in the case company or any similar organization.

7.1 Managerial Implications

In spite of the fact that a lot has been said on ITIL as the best practice framework for ITSM, some organizations still do not have the knowledge of where to begin or which processes to change. Based on these facts and the needs of the case company, this study recommends the following to be considered by the managers in an ITIL compliant configuration management project.

1. The first recommended action is to arrange for staff training and find a way of motivating the staff through communication and awareness. According to Enterprise Management Associate consulting and research, no CMDB succeeds without attention to training, communication, process and culture (Enterprise Management Associate 2008: 5).
2. Managers need to formulate clear goals and objectives for implementing an ITIL compliant configuration management. Section 5.2 details the objectives stated by some interviewees in the case company. The already stated objectives can be used for writing a good business case.
3. Manager should consider the credibility and experience of the external vendor to be used for ITIL configuration management implementations. Experienced vendor with a good success records usually learns from past mistake and ensures the mistake does not come up again in the future project.

4. Another important recommended action for manager is to consider the employees' culture by ensuring ICT staff members share all the infrastructure information in their possession. This information is needed for the accuracy and integrity of CMDB contents.
5. Involving the right people, right from the start of the CMDB project, is also recommended.
6. Managers are advised to appoint the owner of configuration management process including a CMDB. Configuration manager ensures data are accurately kept and maintained in the CMDB. He/she ensures the continuous optimization of process and maintains and validates changed items.
7. Support is needed from management for proper procurement of credible CMDB tools.
8. Support is also needed from management for implementation of a structured change management process.
9. Managers should re-define processes for more effective IT collaboration with vendors.
10. Finally, managers need to measure the return on investment from their ITIL configuration management implementation as well as the key benefits.

7.2 Validity and Reliability in this Thesis

All the research approaches suggested by the business researchers and other established theories as detailed in Section 2.5 were rigorously followed and applied in this study. In view of the need for quality research outcome, qualitative case study methodology was used as explained in Section 2.1. All the relevant people involving in the management of ICT services in the case company were selected and interviewed without any bias. The secondary data collected were from recognized academic international articles and journals, ITIL library and community forum and the case company's internal data.

However, as previously explained, the main purpose of this Thesis was to analyze and present the current practice of configuration management in the case company and also introduce an ITIL compliant configuration management to be set in place in the case company. The outcome of this Thesis and the proposed solutions were drawn

from different data sources which include ITIL best practices framework for configuration management and the findings from the case company. The proposed solutions to the research questions had been sent to the case company for immediate implementation of pragmatic CMDB and configuration management process. The data collected can be defended and therefore valid. Additionally, the interview questions measured what they were intended to measure. The reliability of this Thesis could be increased by implementing a pragmatic CMDB in the case company as suggested in this Thesis. At the time of finalizing this Thesis, the case company has already concluded to shift from their current method of configuration management to an ITIL compliant configuration management. Finally, by using the same research approach applied in this study, the same findings can still be obtained if the research were conducted at a different point of time or by another researcher.

Finally, to ensure the quality of research, as described in Section 2.5, there are three variables that affect the validity and reliability of a qualitative research: data gathering method, credibility of the researcher and philosophical belief in the value of qualitative enquiry (Patton 1999: 1190). To take all these three requirements into consideration, this Thesis started with a kick-off meeting with the case company followed by semi-structured interviews with the key respondents in the case company. The interview questions were designed to reveal the current practice of the case company in relation to configuration management. However, the interview questions were sent to the interviewees in advance so that the interviewees had sufficient time to prepare. During the interview session, notes were taken and subsequently transcribed using content analysis as detailed in Section 2.4 and 5. Second, The Thesis is a compilation of all various sources which include several views from different people in the case company, existing knowledge and the experience of the researcher. In addition, the researcher in this Thesis is a Master's Degree holder in Electrical and Electronic Engineering with an area of specialization in Information and Communication Engineering, who has worked for more than four years in an ITIL compliant industry. Therefore, the ITIL terminologies and the technical aspect of this Thesis were not strange to the researcher. Third, in order to ensure validity and reliability of this study, the researcher has presented the outcome of the Thesis in the case company for validation before the final proposal. Thus, the data collected and the outcome of this Thesis can be defended based on the above facts.

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Appendix A. ICT Staff Interview Questions

ITIL Compliant Configuration Management Implementation

(Researcher introduces herself and presents the purpose of interview)

Objective

1. What is your view on configuration management or describe ITIL configuration management?
2. What are the mission and vision for building CMDB?
3. What are the primary objectives of building CMDB?
4. What are your roles and responsibilities in your current position?

Current Challenges

5. What are your current practices in relation to configuration management?
6. What are the current difficulties in your work/how do you presently function without the in-house CMDB?
7. How do you currently measure end user experience? (For example, using key performance indicator (KPI))?
8. Do you think you have enough information for IT infrastructure management?

Expectations

9. What are your expected benefits (expectation) from CMDB after its successful implementation?
10. What is your business goal to be reached once the CMDB is built? (Or how will the proposed in-house CMDB impact your everyday work?)

Implementation

11. How do you think ITIL configuration management can be implemented?
12. How much knowledge of ITIL Configuration Management do you have?
13. What configuration items (IT assets) would you wish to store in CMDB in the future?

Configuration Management Process

14. Do you document all procedures and maintenance activities done by vendor?
15. How do you update your data (automatic or manual process)?
16. Which tools do you use to record configuration information or items?
17. How do you manage the company outsourced data centre?
18. Do you have backup of all your data?
19. What kind of device do you use for the data backup?
20. How does the vendor manage your IT asset?
21. Do you have control over the business asset? The main assets in every company are its information files with valuable customer data?

Configuration Management Database Contents

22. What kind of data or documentation do you keep? (Or kindly provide the list of data/assets you currently manage or own)
23. Who maintains or manages these data?
24. What are the IT infrastructure items in your care (What type of inventory data (configuration items) do you keep)?
25. What type of application/database do you own?
26. What kind of software licence agreement is used?
27. Provide the list of integration you currently oversee

Configuration Management Database Relationships to other Processes

28. Do you have any process defined for managing changes?
29. Do you keep record of changed configuration items?
30. Where do you keep the record of changed configuration items?
31. Describe the lifecycle of incident management?
32. Can you please give examples of past incidents/problems you have encountered and how you have resolved them?
33. How do you account for incidents, problems, and changes that impact the system or application
34. Do you have enough information for the incident and problem management?
35. Do you you have enough information for the application management?
36. Do you have enough information for the service and infrastructure management?
37. Do you have enough information for vendor management?

Appendix B. Vendor Interview Questions

(Researcher introduces herself and presents the purpose of interview)

Building a Configuration Management Database

1. What is your view on configuration management or describe ITIL configuration management?
2. Do you have experience/knowledge of other companies using or who have successfully implemented CMDB?
3. Which kind of CMDB option will you recommend to build and why?
4. What kind of company is the tool best suitable for CMDB solution?
5. How much experience do you have with this tool?
6. What are the factors to consider when selecting these tools?
7. What kind of IT infrastructure items do you keep for the case company?
8. What information will users search for once CMDB is built?
9. What are your suggestions for the measurable criteria for success for the CMDB implementation?
10. Is there anything else I need to know/ is there anything more you would like to add?

Appendix C. Email Template for Interview Invitation

Hi,

We have got student Abimbola Omidiora from Helsinki Metropolia University of Applied Sciences who starts to do current state analysis for Configuration Management and CMDB in our organization. She will also collect expectations and visions from key persons for the subject. Based on the current state analysis, collected information and self study of the topic she will prepare a suggestion, how she sees Configuration Management and CMDB build and used out. Abimbola will be interviewing 7 to 8 persons from March 14 to 27.

It is agreed that Abimbola can record the interviews so that she can make notes and check details of the discussion also afterwards.

We will send the questions beforehand so that you are able to turn your mindset to the topic before the meeting.

In case the time is not suitable for you, please propose more suitable time so that we can try to arrange it.

Thank you for your co-operation in this matter.

Regards,

XXXXX

Appendix D. Listing of Configuration Items (CMDB Contents)

This appendix contains CI components that will be included in the CMDB while filling CMDB with configuration items. The details of the CI components of the case company will not be included in the appendix due to confidentiality reasons.

The following configurations items should be imported to the CMDB including their IP addresses, model, serial numbers etc. of the CIs:

1. List of integration
2. List of integration between applications
3. List of databases
4. List of servers
5. List of applications
6. Service catalogue
7. EDI links
8. List of local and network printers
9. List of switches
10. List of routers
11. List of access points
12. List of communications devices
13. List of scanners
14. List of workstations (desktop and laptops)
15. ICT service inventory
16. ICT services and processes
17. Business processes documentation
18. Support model
19. Relationship between staff and workstations
20. Relationship between workstations and servers
21. Relationship between databases, servers and clusters
22. List of racks and its relationship with the servers
23. Location of servers and other CI components