Configuration Management and ICT: A Case Study of Improving Quality of Processes by System Virtualization

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Abstract: *In today's highly competitive time of globalization, the successful company should deliver and support products and services at a time convenient for the customer. These demands put tremendous pressure on engineering function to improve the product quality while reducing lead times. Sometimes demands are recognized as need to develop different versions of the same products or service for different market segments. Moreover, this situation goes to be more complex: more companies need to create a special configuration for individual clients. Such requirements assume a strong configuration management that enables rapid development of new products and services with established rules, but pliable enough for the version options, choices of options, alternatives or replaceable components. This paper is addressed to propose qualitative advices of product data management and it contains the analysis of one successful solved practice issue.*

Keywords: *Configuration management, Product data management, Product lifecycle management,Improving quality of processes, A Case study*

1. INTRODUCTION

With the development of ICT, business organizations are transforming into complex, open and variable continually. In such conditions, their components are introduced and / or upgraded in real time, which significantly affects their mutual compatibility and configuration of the entire system. This represents the pressing need to closely monitor changes in system components or their configuration. The product lifecycle management (PLM) is born on these requirements, which considers a systematic concept for the integrated management of all product related information and processes through the entire lifecycle. [1]

Originally, PLM has made existence in jobs that require a high level of security and control. Examples of such technical and scientific areas which began use successfully PLM solutions are aviation, manufacturing of medical devices, production of ICT equipment, military industry, etc.. These industries originated the discipline of configuration management (CM), which has evolved with the development of new technologies and ICT. [2]

Configuration management is a set of current action or set of actions over time with objective to manage products and / or services characteristics. [3]

As we know, the term configuration has a wide range of use and when the ICT sector is considered, configuration refers to

all parts of a computer system: hardware, software, application packages, bespoke software, operating system(s), in-house developed and maintained software, on-screen help files and documentation in manuals, working practices, communication interfaces, LANs, WANs and all peripherals. [4]

This paper's case study considers a change in one type of bank service that involves a change in hardware and software configuration.

In the most cases, business organizations main processes are very much dependable of ICT solutions. Today's IT operations are a collection of integrated computing networks that possess mind-boggling complexity and sophistication. Even the simplest environment, supporting only a few business applications, requires attention to configurations to keep applications and hardware running smoothly. One major function of CM system is to maintain data integrity and to provide accurate data when required

2. CONFIGURATION MANAGEMENT RESEARCH AND DEPLOYMENT

Many researchers were investigating problems and solving them in this area. It shows continuous nature because organizations exists in real time and dynamcic changes in business are inevitable.

The paper of Masashi Iizuka [5] describes the configuration management models that were developed by Fujitsu. With the business environment changes, ICT has been moving in the open – source direction and it's technology area has become broader and significantly complicated. This paper defines what requirements are needed in configuration management and proposes model for overcoming various issues such as reducing costs, improving relationship with customer, operate in stable state with high – quality information technology, etc.

Bae and group of authors [6] proposed a new method of document version management for workflow management systems (WfMSs). A WfMS is considered an essential element for automation of complex business processes involving many companies, particularly for those in an e-business environment. A core element of such business processes is the documents that flow through the processes.

Gruhn [7] presented a configuration management concept for software projects using Lyee methodology. First, he presented an introduction in configuration management. Then, the structure of Lyee programs is defined by sets and their dependencies. From this structure, the actual configuration management concept is deduced and discussed by rendering the structure for an existing configuration management.

CM standards show a lack of precision in terms of handling the issue of integrating heterogeneous, autonomous, and distributed information, especially for virtual enterprises. Cloi and Bae [8] proposed an architecture for active product configuration management in industrial virtual enterprises based on WWW, CORBA, and rule management. The architecture represents qualitative solution for active configuration management that efficiently controls engineering activities involving communication among diverse companies with heterogeneous, autonomous, and distributed data sources. This solution also includes the core functions and objects for configuration management extracted from various configuration management standards. A prototype system based on the architecture is presented in the paper to demonstrate the feasibility of the proposed architecture.

A software CM systems (SCM) can be useful to meet the higher demands of wide range business area such as: Safety

Engineering (SE), Quality Assurance (QA), Validation and Verification (V&V) and Requirements Management (RM) of the developed software tools. PLM and SCM systems together can be of great advantage in the development and maintenance of a system that emerged changing requirements frequently. In their paper, Muhammada and group of authors [9] discussed how PLM and SCM systems can be integrated together and play their role during the development and maintenance of International Thermonuclear Experimental Reactor (ITER) remote handling system.They considered the possibility to investigate such setup at DTP2 (Divertor Test Platform 2), which is the full scale mock-up facility to verify the ITER divertor remote handling and maintenance concepts.

The paper of Carnduff and Goonetillake describes enhanced database system facilities that are used to group mutually consistent component versions together into useful configurations. [9] The system includes integrity management facilities that allow evolving design constraints to be captured flexibly at individual component/object level. In order to permit evolution, integrity constraints are represented within versionable objects, so-called constraint version objects (CVOs). The evolution of configurations can be captured in the database, as configurations are also represented as versioned objects.

Mohan [10] introduced a integrating traceability and software configuration management concept. While SCM helps manage the evolution of software and its documentation, traceability helps manage knowledge about the process of the development of software. In their paper, the integration of traceability and SCM is presented with aim to help change management during the development and evolution of software artifacts. They developed a traceability model using a case study conducted in a software development organization. This model represents knowledge elements that are essential to managing changes tracked within the change management function of SCM tools. They illustrated the usefulness of the model using a change management scenario that was drawn from the case study. They also presented a qualitative study towards empirically evaluating the usefulness of their approach.

3. ISSUES IN HARDWARE AND SOFTWARE IN THE CONFIGURATION MANAGEMENT

Whe ICT sector is considered, the CM represents the management of security features and assurances through control of changes made to hardware, software, firmware, documentation, test, test fixtures, and test documentation throughout the life cycle of an IS. [11]

Configuration management involves identifying the configuration of a system at given points in time, systematically controlling changes to the configuration, and maintaining the integrity and traceability of the configuration throughout the whole lifecycle. [12] The items placed under configuration management include the software and hardware products (e.g., routers and switches) that comprise the network as well as items required to create or maintain these products (e.g., initial routing tables and switch configuration data).

There are many definitions of configuration management used in various standards and in various models which are developed during development of this area. The definitions in these standards and models are similar to a large extent.

Quality solution that can be expressed graphicly is given by Mette and Hass. [13]

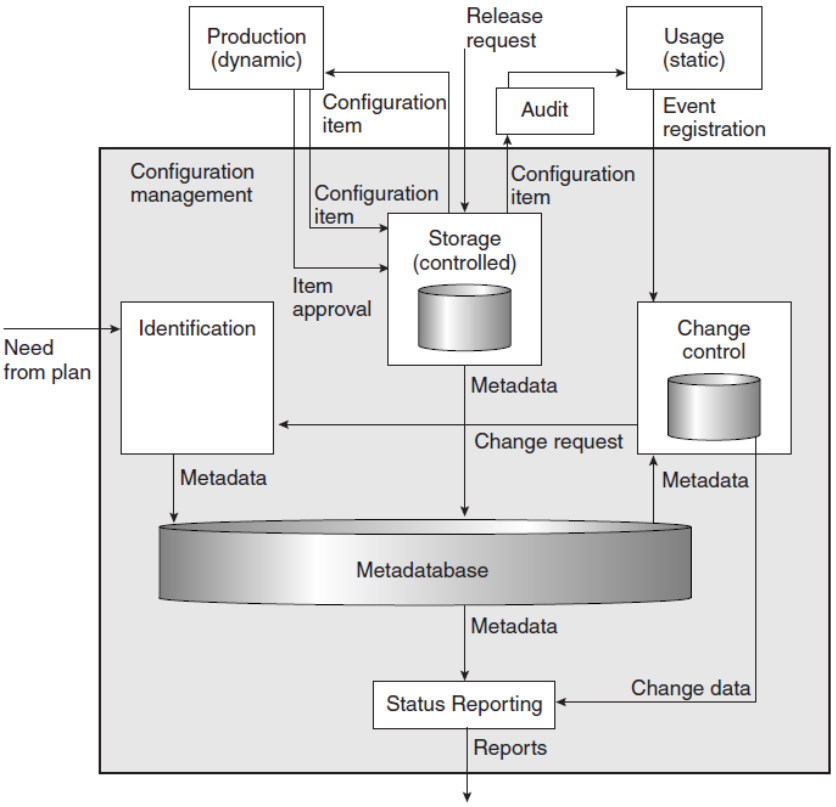

Figure 1. Overview of Configuration Management Activities

Configuration management has many interactions with processes such as development and support. Figure 1 illustrates the production and usage activity areas via their respective libraries. Over the last few decades configuration management has evolved and it includes four major parts:

- A method of identifying each configuration item,
- A control mechanism,
- Audit procedures,
- Configuration status reporting records.

All the activity areas in CM share metadata for items placed under configuration management. Metadata is a database concept that means data about the data stored in the database. So metadata in this context describes the configuration items. Metadata for a configuration item may include its name, the name of the person who produced or is responsible for the item, the production or

installation date, and references to other related configuration items.

Proper configuration management enables an organization to answer the some issues:

- Defining the process for making changes to the system,
- Define the responsibles for making changes to the system,
- Tracking the changes that were made to the system,
- Determining the time when were the changes made,

- Capturing the reasons why were the changes made.

3.1 Hardware CM

The main difference between a computer system and a computer configuration is in the way the individual components are viewed and managed. [4] A computer system is a collection of individual computer components which may be together in a network or may operate in isolation. When these items are catalogued and interrelationship between them established we are beginning to form a configuration. It is the recorded connection between the computer components and how each interacts with other members of the configuration that constitutes a configuration.

The main benefits of computer hardware configuration management are:

- Helps to minimize the impact of changes,
- Provides accurate information on configuration items,
- Improves security by controlling the versions of configuration items in use,
- Facilitates adherence to legal obligations,
- Helps in financial and expenditure planning.

3.2 Software CM

Every ICT dependable organization has information about its infrastructure, hardware and software, particularly after completing major projects or when audit and impact analyses are done. Software configuration management (SCM) has been defined as the discipline of controlling the evolution of complex software systems [14].

Nowadays, software systems usually consists many of packages and each package depends on one or more other packages for its operation. This makes system work in complex conditions because there might be situation that one software version is not compatible with another or it demands some new packages to be installed. It is clear that these conditions become very complicated and hard to document, in a large software system. [15] As the software evolves and different versions of packages are released, the problems worsen.

CM aims to provide reliable details about the IT infrastructure. When software is considered, CM data base holds the details of specific software in the infrastructure. One of the most important characteristics of software CM is how it relates these software characteristics to one another. This relationship is the very important for successful CM. If ICT organizations are to significantly improve services, a well run CM process is critical.

3.3 CM importance and Risks

CM is essential in providing knowledge of the business assets and the relationship of those assets to associated documents in business configuration. The CM process efficiently manages necessary changes, ensuring that all impacts to operation and support are addressed.

In the absence of CM, or where it is inefficient, there may be:

- Equipment failures due to incorrect part installation or replacement (eg. Energy supply failure of hardware due to inadequate instalation),
- Schedule delays and increased cost due to unanticipated changes (eg. Delays due to software update),
- Operational delays due to mismatches with support assets(eg. discrepancy of working procedures),
- Maintenance problems, down-time, and increased maintenance cost due to inconsistencies

between equipment and its maintenance instructions (eg. Delays due to printers inadequate maintenance),

- Other circumstances which decrease operational effectiveness, and add cost.

It can be concluded that the intent of CM is to avoid cost and minimize risk. Some organizations consider the small investment in the CM process a cost-driver but they should consider the compensating benefits of CM. Ignoring or underestimating the cost, schedule and technical risk of an inadequate or delayed CM process can be very harmful in today's business.

4. THE CASE STUDY

One of the most important CM tasks is capturing, keeping and providing up-to-date information about the IT infrastructure. Our case study is developed in cooperation with Credy bank. The team with our faculty took part in the feasibility study performed for a complete change of hardware and software which results were results were used in later work to get the job completed successfully. The Credy bank management team has found out that their hardware configuration with cluster based service software cannot meet new customer demands and market trends. This was related to the increasing the security and the speed of data processing with new customer services developing which is given on the figure 2.

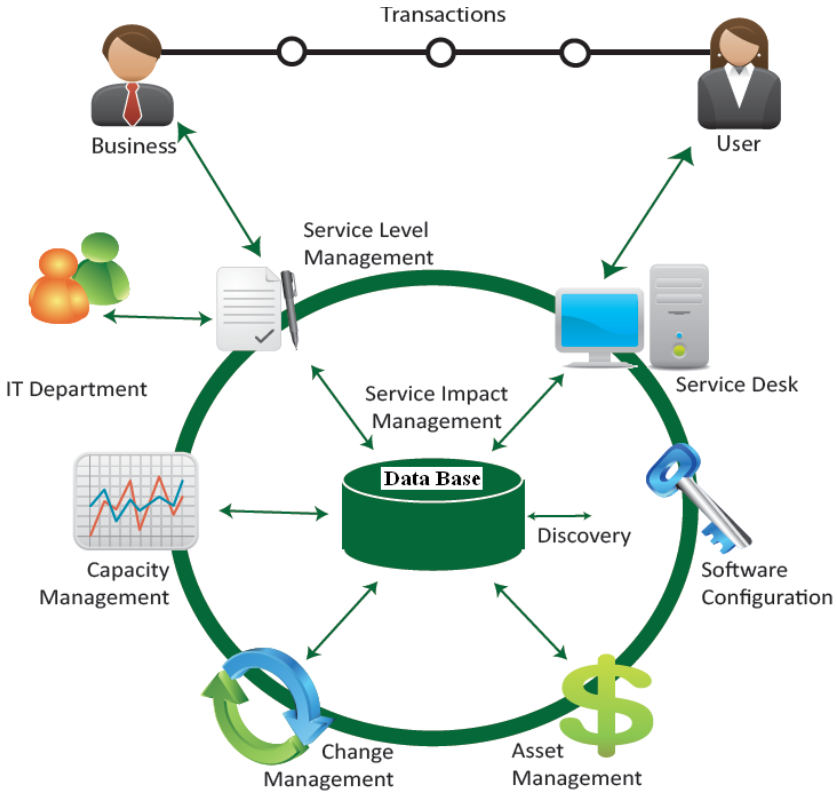

Figure 2. Overview of activities that should be covered by CM

4.1 Structure and content of a conducted configuration management plan

The whole plan for the feasibility study was made in accordance with the BS ISO 10007:2003 standard. [17]

CM plan introduction

The purpose of the configuration management plan was to provide definition of suitable equipment which can meet the demands of new business needs.

After they analyzed current situation and new business demands, Management team of Credy bank IT sector, defined new equipment requirements. Those requirements were:

- Utilization of hardware must be increased,
- Reduction of hardware from different manufacturers with different features
- Improving system scalability,
- Improving energetic efficiency (power supply, cooling system),
- Administrative processes improvement,
- Bank policy requires that each service has a it's server,
- The business continuity management requirements.

The old equipmet, which base were computers Pentium III and related IBM server, couldn't met those demands, so management team made decision to purchase sophisticate asset that could manage all the requirements.

Policies

The management team of organization made
documents related to the responsibilities and authorities of relevant interested parties. It consisted policies on the practice of configuration management and related management activities.

Configuration identification

A description of the product and configuration item(s) to which the plan applied:

- Four IBM servers 3950,
- IMC storage CX3 – 20 with two redundant storage processors,
- Two fibre channel switches,
- One 3kW Utility power Supply.

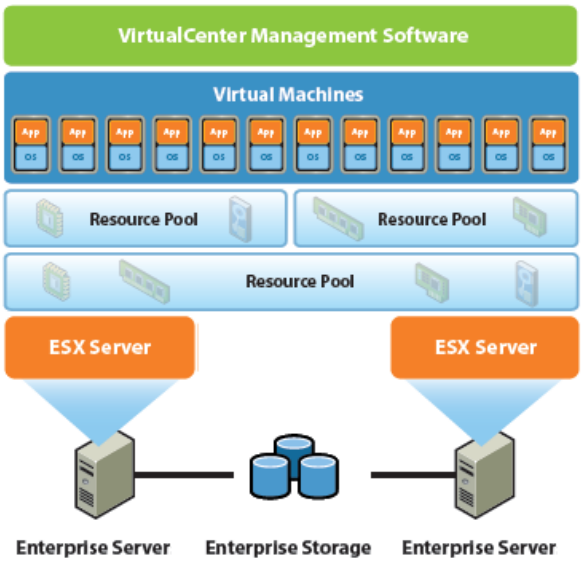

Figure 3. The look of the new computer configuration

Change control

The procedures for the control of changes prior to the establishment of a contractual configuration baseline were made in accordance with the requirements of business continuity provided by several international standards.

Configuration status accounting

The management team defined the methods for collecting, recording, processing and maintaining the data that are necessary for producing configuration status accounting records. The team made the definition of the content and format for all configuration status accounting reports

Configuration audit

The management team defined a definition of the format for audit reports and the configuration audit procedures to be used. System must operate without failure and because of that audits are perfomed in the estimated time.

Analysis of new hardware and software implementation benefits

In this case, the benefit analysis is used to assess the effects of reengineering model related to the new hardware and software implementation. On the one hand, the advantages (benefits) of the proposed model are analyzed, and on the other all of the characteristics of the old configuration are analysed in order to estimate rationality of the proposed solution. Affirmation should prove that the benefits are large enough to justify the new investment.

In order to conduct the analysis of benefits, influential factors are defined as factors in the qualitative and quantitative terms that should reflect certain changes (Table 1). To make the final unique score, measurable and immeasurable factors are introduced by importance factor weights (IF), (which is the sum of all factors and it is equal to 1) which is multiplied by a subjective rating (SR), (SR ranges from 1 to 5). Subjective assessments are defined in the case before and after the application of new hardware and software.

Factors	Value of factors (IF)	Old configuration SW i HW		New configuration SW i HW	
		SR	SR·IF	SR	SR·IF
System security	0.3	3	0.9	4	1.2
System safety	0.2	3	0.6	4	0.8
System flexibility related to changes and expansion through the new technologies	0.1	2	0.2	4	0.4
System maintenance	0.1	1	0.1	3	0.3
Requirements of Business Continuity Management	0.2	2	0.2	4	0.8
Energetic efficency of the System	0.1	2	0.2	2	0.2
Σ	**1.00**		**2.2**		**3.7**

Table 1. Ratings of new hardware and software applications benefits factors

Based on the analysis of benefits (the characteristics improvement of the new configuration compared to the old is calculated to be approximately 68%), the conclusion that the implementation of new hardware and software have been completely justified was presented. Beside that, new exploatating possibilities weren't explored yet.

5. CONCLUSION

The schedule to configuration management activities was six month. All of the old Information system entities were surveyed in the CM meta data base. The same was done with the entities of new Information systems. The all proposition is made in one step, so there were no problems related to the a listing of relevant documents and their interrelationships. Implementation was done in twelwe months. There was no delay or failure due to the parallel installation of the new information system. Maximum use of existing tools and processes has been made wherever possible to provide the integrity of the system.

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