

# Configuration Management of information systems in Peruvian Government organizations

Elizabeth Mendoza, Ciro Rodríguez, Doris Esenarro

**Abstract—Having a well-defined control of the change processes in the configuration management in the software development life cycle, before and after being put into production environment, implies an effort of development personnel and an additional cost in the maintenance system. The objective of this paper is to establish the guidelines to regulate the activities and tasks during the process of development and maintenance of software-based systems in order to control the changes, integrity and traceability of its configuration, for this purpose it is taken as a reference the peruvian technical standards NTP-ISO/IEC 12207: 2016 for Software and systems engineering, NTP-ISO/IEC 27001: 2014 for Information security management systems and the methodology MÉTRICA version 3 for the systematization of life cycle of the software activities. The proposal defines the roles and responsibilities, the activities of each thread and the use of control templates, the validation of the was achieved through the analysis of three software systems with results that show that there is a better organization in the development, maintenance, control of the versions of the elements and the percentage of error in the configuration.**

**Keywords:** Software Configuration Management, information system, maintenance, change control, NTP-ISO / IEC 27001:2014, NTP-ISO / IEC 12207: 2016

## I. INTRODUCTION

Many public organizations in Perú do not have a well-defined process to control software changes in their information systems, before and after putting them into production. The lack of a process of management of the configuration of the software systems, has as a consequence the instability and insecurity of the product and its components, which implies a double effort on the part of the development personnel and an additional cost in the maintenance of the system, during the software development process and the implementation of procedures, methodologies and guides problems have been found that need to be corrected or minimized, this is where the process of managing the software configuration of the systems plays a very important role , considering that it is one of the key processes for the proper functioning of the information systems of organizations that perform software engineering, since it allows a better organization of software development and maintenance during the life cycle of the software process.

According to [1] “The Software Configuration Management Process establishes and maintains the integrity of the support elements of a process or project and make them available to interested parties”. In [2] it is explained

that the purpose of this process area is to establish and maintain the integrity of work products using the identification, control, status and audits of the configuration. Pressman in [3] shows the breakdown of the knowledge area Software configuration management of SWEBOK V3 with the knowledge areas characterizing the practice of software engineering.

In [4], the METRIC V3 methodology offers organizations a tool for the systematization of activities that support the software life cycle where “configuration management is to maintain the integrity of the products obtained during the development of the systems of information, ensuring that there are no uncontrolled changes in the development of the system with the correct version, therefore, among the software configuration elements, there is not only executable code and source, but also data models, process models, specifications of requirements, tests ”.

According to [5], Annex A.9.4.5 on the Control of access to the source code of the program, it is explained that access to the source code of the program must be restricted and strictly controlled, since it can be vulnerable if it is not adequately protected, compromising systems and quickly destroying the value of the business.

## II.METHOLOGY

According to [6] Software Engineering (IS) is the discipline or area of computer science that offers methods and techniques for the development and maintenance of quality software In spite of all efforts made, in the successive stages of development and management activities of software projects, problems occur as: lack of reliability, need for permanent maintenance, etc. Dynamics of software development processes require a constant update of techniques and technologies.

According to [7], the control of the documents generated from the process of implementing an Information System helps to manage, declare and organize the latest versions, giving legibility in the documents during the implementation life cycle. As in [8], is also important consider the cryptographic key management guide to define and implement appropriate key management procedures, using algorithms that adequately protect confidential information and planning in advance possible changes and the availability of computer techniques through a general approach.

It is also important to consider the methodologies as in [9] for the planning and implementation of an integral IT architecture that combines software with high-level servers that can host systems capable of providing support and continuity of IT services in critical areas of the

**Revised Manuscript Received on 14 September, 2019.**

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# CONFIGURATION MANAGEMENT OF INFORMATION SYSTEMS IN PERUVIAN GOVERNMENT ORGANIZATIONS

organization as well as the optimization of the resources necessary for its administration which influence configuration and change management

According to [10], the generation of efficient and quality software products without sacrificing time or costs is the goal that software developers seek to achieve, for this it is necessary that the actors involved in the process can have all the information related to the project and that the version control systems support the software development process, facilitating the management of version control of the source code files generated by the developers and providing the tools to merge and generate a new version of a project, without causing loss of data or file locks, as well as recover previously generated files, which can be used to correct system errors.

In [11], the emergence of Global Software Development GSD has created difficulties for the practice of Software Configuration Management (SCM), the author has proposed tools to reduce such difficulties, to do this has specifically identified the environment, contributing to: Synthesize SCM tools in GSD and identify the current trend of SCM tools in the software development environment.

## III. MATERIALS AND METHODS

On the materials and methods, the following were taken into account:

### Research Techniques and Instruments:

Direct observation: monitoring of the main development activities in the process of the Configuration Management of the information systems was carried out, in order to detect the current state.

### Data Analysis:

Logical techniques of content or qualitative analysis, to obtain conclusions.

### Unstructured Interviews:

A series of interviews were conducted with personnel who develop and implement software, in order to obtain detailed information on this activity.

### Referential Review:

Standards NTP-ISO/IEC 12207:2016, NTP-ISO/IEC 27001:2014; Metric V3.

### Instruments:

- NTP-ISO / IEC 12207: 2016.
- Metric V3.
- NTP-ISO / IEC 27001:2014
- Bizagi Modeler tool.
- Computer requirements.
- Meeting Minutes.
- Development methodology.
- MS Office package.
- Laptop with internet access.
- Office resources.

### Proposed model:

The configuration management model of the information systems, aims to establish and maintain the integrity of the products and services developed, as well as the control of changes throughout the software life cycle. The elements are: the information of an element and software products, its version, status, trace of its evolution, technical

documentation related to the analysis, design, construction, implementation and acceptance of the information system.

Figure 1, shows the processes and activities of the management of the configuration of the computer systems: Roles and responsibilities of configuration management, this phase describes identifying the roles and responsibilities of the entire management process in which they are: IT Manager, Project Leader, Configuration Management Leader, Software Configuration Management Specialist, Technical Documentation Management Specialist, Database Configuration Management Specialist, Quality Assurance Leader, Quality Assurance Specialist, Data Center Supervisor. Of the computer systems and of the technical documentation: In this phase the process of change requests and production sources is indicated.

Related to computer systems and the technical documentation: In this phase the process of change requests and production sources is indicated. Upon the change requests, the development area receives the change request, evaluates and assigns the developer for its attention, the developer must record the changes made for each item and / or software products, technical documentation in a control log of changes, as shown in Figure 1.

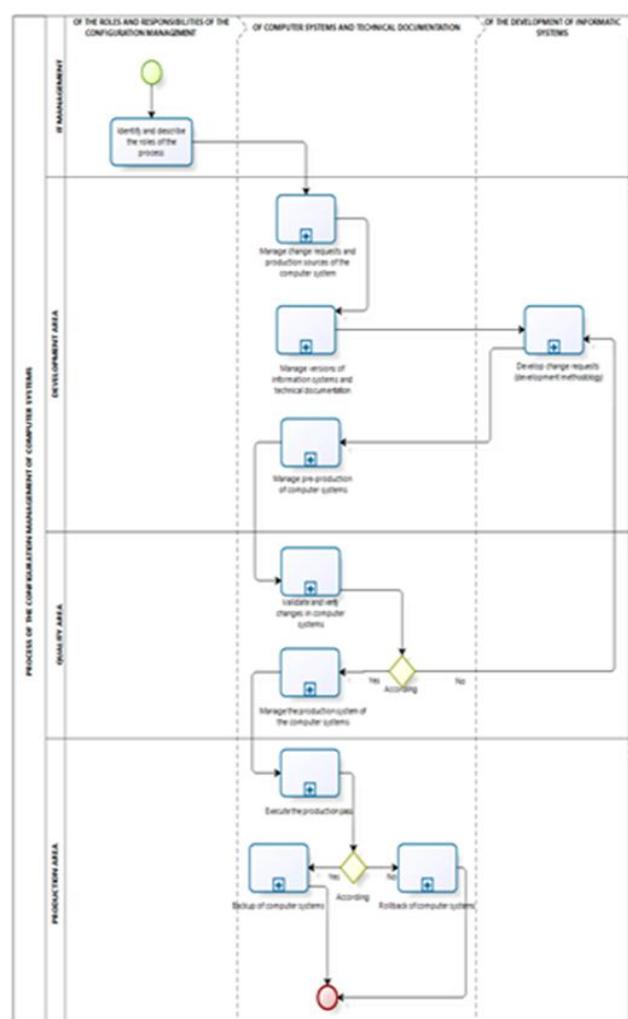


Figure 1. Process of the Management of the Configuration of the Computer Systems



In Figure 2., changes made to information systems are recorded as; the system, sub system, module, sub module, type of device, date of request, version, description of the change, information system affected, responsible for the change, date of update and the location of the change.

Annotations are made in the binnacle of change control.

BITACERA DE CAMBIO DE SISTEMAS INFORMÁTICOS							
Item	Code	System	Subsystem	Module	Sub module	Code Prod Fonts	Type of Artifact
1							
2							
Detalle de los Cambios Realizados en los Sistemas Informáticos							
Req Request Date	Version	Change Applicant	Description of the Changes Made	Information systems Affected	Responsible change	Update date	Location

**Figure 2. Change control log of computer systems.**

When requesting sources, the IT project leader or authorized persons in their absence will be the only ones who can request production sources. The software configuration specialist and the technical documentation specialist will provide the requested sources, also record the item's output in the version control register.

VERSION CONTROL BITACORA DE SISTEMAS INFORMÁTICOS							
Item	Code	System	Sub system	Module	Sub module	Code Prod Fonts	Type of Artifact
1							
2							
ENTRY				EXIT			
Delivery Date Prod Sources	Version	Location	Date Update Sources Prod	Version	Location		

**Figure 3. Version control log of computer systems.**

Figure 3 shows the control record of system versions, subsystem, module, submodule, type of artifact; at the entrance: the version, location; and on the way out: the product update date, version and location.

<b>Origin of the Requirement:</b> <input type="checkbox"/> Request for Requirement No. <i>(.... Indicate the requirement number...)</i> <input type="checkbox"/> Incidence No. <i>(.... Indicate the incidence number...)</i>	<b>Programming language:</b> <i>(.... Indicate the type of Programming Language...)</i> <b>Reason for Request:</b> <i>(.... Indicate the reason...)</i> <b>Folder where the source will be copied:</b> <i>(.... Indicate the correct route where the source (x) will be copied...)</i> <b>Reason for Request:</b> <i>(.... Indicate the reason for the source request...)</i>
<b>System / Module:</b> <i>(.... Indicate the system name and module name...)</i>	
<b>Sources:</b> <b>Name:</b> <i>(.... Indicate the name (s) of the source (s)...)</i> <b>Kind:</b> <input type="checkbox"/> Source code <input type="checkbox"/> EAR <input type="checkbox"/> WAR <input type="checkbox"/> Other, specify: <i>(.... Indicate the type of source...)</i>	<b>BD objects:</b> <b>Name:</b> _____ <b>Scheme:</b> _____ <b>Username:</b> _____  <b>Kind:</b> <input type="checkbox"/> Package <input type="checkbox"/> Functions <input type="checkbox"/> Procedures <input type="checkbox"/> Bookstores
<b>Actions to be carried out:</b> <i>(.... Indicate the considerations and actions to follow for the attention...)</i>	

**Figure 4.Request for sources.**

Figure 4 shows the origin request, according to [6], where the control A.9.4.5 "The access control to the source code of the programs must be restricted", therefore, must be requested through a document or email indicating: the origin of the requirement, system / module, name of the source, type of source, programming language, name of the database, scheme and the place where the information was requested will be copied.

**Origin of the Requirement:**

- Request for Requirement No. (*.... Indicate the requirement number...*)  
 Incidence No. (*.... Indicate the incidence number...)*

**System / Module:** (*.... Indicate the system name and module name...*)

**Reason for Request:** (*.... Indicate the reason for the request...*)

**Document Version:** (*.... Indicate the updated version...*)

**Type of technical documentation:**

- System Analysis  
 System design  
 Doc. Spec. Technique  
 User manual  
 Installation and Configuration Manual  
 Operations manual  
 Assistance Manual  
 Help Desk

**Folder where the technical documentation will be copied:**

*(.... Indicate the correct route where the documentation will be copied...)*

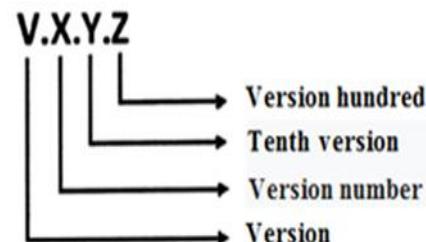
**Actions to be carried out:**

*(.... Indicate the considerations and actions to follow for the attention...)*

**Figure 5. Request for technical documentation**

The document in Figure 5, as in the previous one, shows that the technical information is requested through a document or email: origin of the requirement, system / module, the version of the document and the location where the information will be copied.

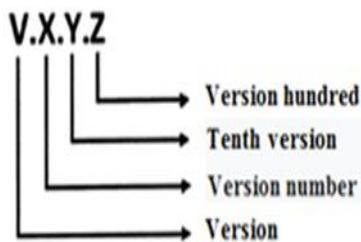
On the management of versions Figure 6 shows development to pre-production: little significant change: increase by one hundredth of the version if you do not pass the pre-production test. No change: the tenth remains the same. Significant change: increase 1 in version number.



**Figure 6.Versions to pre-production development.**

In the preproduction development of the version management, if there is a significant change, it increases by one hundredth of the version or else, passes the preproduction test. No changes: the tenth remains the same and with a significant change: it increases 1 in the version number.

# CONFIGURATION MANAGEMENT OF INFORMATION SYSTEMS IN PERUVIAN GOVERNMENT ORGANIZATIONS



**Figure 7. Versions pass pre-production to production.**

The database configuration management specialist will track the versions of the objects, procedures, functions, database packages and the version record of the computer systems. The quality control specialist will control the versions of the sources, executable from the pre-production environment as in Figure 7. The configuration management specialist will control the versions of the production environment.

<u>Origin of the Requirement:</u>	
<input type="checkbox"/> Request for Requirement No. <small>(.... Indicate the requirement number...)</small>	
<input type="checkbox"/> Incidence No. <small>(.... Indicate the incidence number...)</small>	
<u>System / Module:</u> <small>(.... Indicate the system name and module name...)</small>	
<u>Version:</u> <small>(.... Indicate the updated version...)</small>	
<u>Sources:</u>	
Name: <small>(.... Indicate the name (s) of the source (s)...)</small>	<u>BD objects:</u>
Name: _____	Name: _____
Scheme: _____	Username: _____
<u>Kind:</u>	
<input type="checkbox"/> Source code <input type="checkbox"/> EAR <input type="checkbox"/> WAR <input type="checkbox"/> Other, specify: <small>(.... Indicate the type of source...)</small>	
<u>Kind:</u> <input type="checkbox"/> Package <input type="checkbox"/> Functions <input type="checkbox"/> Procedures <input type="checkbox"/> Bookstores	
<u>Programming Language:</u>	
<small>(.... Indicate the type of Programming Language...)</small>	
<u>Reason for Request:</u> <small>(.... Indicate the reason...)</small>	
<u>Impact Level:</u>	
<input type="checkbox"/> Low <input type="checkbox"/> High	
<u>Folder where the source (s) and executable (s) are located:</u>	
<small>(.... Indicate the correct path where the source (s) and executable (s)...)</small>	
<u>Actions to be carried out:</u>	
<small>(.... Indicate the considerations and actions to follow for the attention...)</small>	

**Figure 8.Preproduction request.**

In Figure 8, the pre-production pass is requested through a document or email.

When requesting a pre-production pass, the IT project leader will request the pre-production pass for elements, executables, objects, procedures, functions, packages, etc.

The quality assurance area will verify and validate the change request, if everything is agreed it will manage the production pass, if you have any observations, it will be sent to the development area for correction.

Upon the production pass, the quality assurance specialist will issue the compliance of the requirement, using a format.

In Figure 9, the certificate of conformity is shown by the quality team, giving the conformity for the production pass.

Likewise, he will coordinate with the leader of the computer project and the software configuration management specialist for the production pass, a quality assurance specialist will send all the elements for the production pass.

<b>CONFORMITY ACT OF QUALITY ASSURANCE and/or QA</b>			
OF THE FORMAT: CODE:	Reference: _____		
			DATE: <Date of Minutes>
<b>DRAFT:</b> <Project Name / System / Module / Process / Component / Service>			
<b>AFFAIR:</b> <Topic or Developed Topic>			
<b>ACTA N°:</b> <Correlative Number - Year Initials / Manager>			
<b>DOCUMENTS CHECKED:</b>			
System / Subsystem / Modules / Sub Module	CVS Documents Reference AC	CVS Documents Reference AC	
1	Doc Date	Doc Date	Doc Date
2			
<b>CONSIDERATIONS / OBSERVATIONS:</b> <small>&lt;Description of considerations / observations&gt;</small>			
<b>PARTICIPANTS:</b>			
<b>QUALITY ASSURANCE LEADER:</b>			
<b>Firm:</b> <b>Name:</b> <Person's Name> <b>ID:</b> <ID number> <b>Position / Role:</b> <Person's Position / Role>			

**Figure 9.Certificate of Conformity of Quality Assurance and / or Quality Control.**

<b>Application for Production Systems Computer Production</b>			
Application number: _____	<b>Application date:</b> _____		
			<b>Application Time:</b> _____
<input type="checkbox"/> Request for Requirement N° _____ <input type="checkbox"/> Incidence N° _____			
<b>Origin of the Requirement:</b>		<b>System / Module:</b>	
<b>Sources:</b>		<b>Version:</b>	
Name: _____ Type: Source code: <input type="checkbox"/> EAR: <input type="checkbox"/> WAR: <input type="checkbox"/> Other: <input type="checkbox"/> Specify: _____		Type: Packages: <input type="checkbox"/> Functions: <input type="checkbox"/> Procedures: <input type="checkbox"/> Libraries: _____	
<b>BD objects:</b>		<b>Programming language:</b>	
Name: _____ Scheme: _____ Username: _____		Type: Packages: <input type="checkbox"/> Functions: <input type="checkbox"/> Procedures: <input type="checkbox"/> Data Base: _____	
<b>Reason for Request:</b> Reason for Request: _____  <b>Impact Level:</b> Low: <input type="checkbox"/> Tall: <input type="checkbox"/> <b>Requested by:</b> Position: _____ Attended by: _____ Position: _____ <b>Folder where the source (s) and executable (s) are located:</b> Production Pass Date: Time: _____			

**Figure 10. Production pass request.**

Figure 10, shows the application certificate for the production pass, which contains the necessary fields to control configuration revisions.

The leader of the software configuration management will execute the production pass if there is an error in the deployment automatically perform the rollback request as in Figure 11, otherwise the computer center supervisor will perform the backup process of the elements of the computer systems.



<b>Computer Requirement Number:</b> <small>(.... Indicate the number of the computer requirement by mail or by scm reverse....)</small>	
<b>Reason for Rollback:</b> <small>(.... Brief description of rollback....)</small>	
<b>System / Module:</b> <small>(.... Indicate the system name and module name....)</small>	
<b>Version:</b> <small>(.... Indicate the updated version....)</small>	
<b>Objetos BD:</b>	<b>Sources:</b>
Name: _____	Name: _____ <small>(.... Indicate the name (s) of the source            (s)...)</small>
Scheme: _____	
Username: _____	
<b>Kind:</b>	<b>Kind:</b>
( ) Package	( ) Source code
( ) Functions	( ) EAR
( ) Procedures	( ) WAR
( ) Bookstores	( ) Other, specify: .... <small>Indicate the type of source....)</small>
<b>Actions to be carried out:</b> (.... Indicate the considerations and actions to follow for the attention....)	

**Figure 11.R rollback request.**

#### IV. RESULTS

For the start-up of the moving process: meetings were held with the IT Management, as a result the baseline of the elements generated by the process was identified, defined and established.

Regarding the development of the process: it was carried out together with the areas involved to agree the procedures, responsible and verify that another process is not affected; generate collaborative methodologies; workflow creation; modification of the old configuration management process.

About the training: the new procedure for its application was carried out to the areas involved.

For the implementation of the start-up of the moving process: Computer requirements were performed:

- Modifications and versions of the elements are controlled.
- The states of the elements and the modifications are registered and reported.
- Ensure that the elements are complete and consistent.
- The storage, handling and delivery of the elements are controlled.
- Errors in production start-up.

**Table 1.Comparison configuration process.**

Issue	Amount before the Process	Amount after the Process
The development team does not have the latest version of the software elements.	03	0
Error in the sources	60	20
Observation in the technical documentation.	40	10
Configuration errors in the production environment.	03	01
QA	0	03
Qualityassurement.	0	03
Incidence in production.	20	05

Having completed the process of the Configuration Management of Systems, a considerable improvement computer requirement can be evidenced, minimizing the errors of the sources, technical documentation, configuration of the production environment, production incidents, higher product quality in information systems, as shown in Table I.

#### V. DISCUSSION

Standard [1] indicates that the software configuration management process establishes and maintains the integrity of the support elements of a process or project and makes them available to interested parties; for state organizations, it is applicable as long as the organization is committed, respecting the procedures efficiently, also in these organizations it is more complicated to apply [4], because it is sequential, and currently the software life cycle has a tendency To be agile, therefore the validation of the Configuration Management of a lightweight model for the development of small business software, should mention that the quality areas and the personnel that will carry out the configuration process must remain separate from the development area, not to influence.

#### VI. ACKNOWLEDGEMENTS

Acknowledgments to the research group led by Dr. Ciro Rodríguez, and engineer Anani Niño de Guzmán for her great experience in configuration management.

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## CONFIGURATION MANAGEMENT OF INFORMATION SYSTEMS IN PERUVIAN GOVERNMENT ORGANIZATIONS

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