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Experience applying the model Integration of Capability Maturity Models Level 2 (CMMI-DEV 2) in the SME Miracle Business Network SA de CV

Experiencia aplicando el modelo Integración de modelos de madurez de capacidades nivel 2 (CMMI- DEV 2) en la Pyme Miracle Business Network S.A. de C.V

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Abstract

The use of models to improve the quality of software in the information technology sector in terms of innovation and specialization has become a requirement for small, medium and large enterprises around the world. In Mexico, the Ministry of Economy, respond to calls to several programs. It has invited this sector to facilitate the development and competitiveness of Mexican companies and the attraction of foreign investments. The objective of this work is to describe the experience to implement CMMI-DEV2 model. The SME Miracle Business Network SA de CV, located in the state of Tlaxcala, make a remembrance of what is CMMI origin, evolution, levels; with emphasis on development level 2 that was used to show some artifacts used, highlighting the importance of teamwork in the project called acquisition of property and infrastructure of the microenterprise.

Software, SMS, Development

Resumen

El uso de modelos para mejorar la calidad del software en el sector de las tecnologías de la información en términos de innovación y especialización se ha convertido en una exigencia para las pequeñas, medianas y grandes empresas de todo el mundo. En México, la Secretaría de Economía, responde a las convocatorias de varios programas. Ha convocado a este sector para facilitar el desarrollo y la competitividad de las empresas mexicanas y la atracción de inversiones extranjeras. El objetivo de este trabajo es describir la experiencia de implementación del modelo CMMI-DEV2. La PYME Miracle Business Network SA de CV, ubicada en el estado de Tlaxcala, hace una remembranza de lo que es el origen de CMMI, la evolución, los niveles; con énfasis en el nivel de desarrollo 2 que se utilizó para mostrar algunos artefactos utilizados, destacando la importancia del trabajo en equipo en el proyecto denominado adquisición de bienes e infraestructura de la microempresa.

Software, SMS, Desarrollo

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Introduction

CMMI is the successor to CMM, the goal of the CMMI project was to improve the usability of maturity models from software engineering and other disciplines by integrating different models into a single framework.

CMM was developed from 1987 to 1997. In 1987 Watts Humphrey published the first ideas of the CMM framework in IEEE Software magazine. In 1989 he published his book titled Managing the software Process. In 1991, the technical report was published describing the process areas of version 1.0 of the CMM (Key Practices of Capability Maturity Model for Software Engineering v1.0-CMU-SEI/91.TR-25). In 1993 it the model is updated and version v1.2 of the CMM is published in the technical report (Key practices of capability Maturity Model for Software Engineering v1.1-CMU-SEI/93-TR-and the year 2000 version 1.0 emerged, in 2002 version 1.1 and in 2006 version 1.2 was released. And in 2010 version 1.3 came out. To build the CMMI, a first set of models were used as sources, such as SW-CMM version 2, EIA/IS 731, IPD-CMM. (Piattini Velthuis Mario, Garzas Parra Javier, 2010)

CMMI allows you to approach continuous improvement and software evaluations using 2 representations, the staged representation and the continuous representation, each of the representations provides a path to implement software process improvement with the aim of achieving business objectives, both representations provide the same content but organized in different ways; there are two different representations by inheritance of the model they use previously:

If you are familiar with the CMM Software then the staged representation is used, while if you come from the System Engineering Capability Model (SECM) the continuous representation is used.

The CMMI DEV 2 model is a set of products (suite) that support the improvement of the system, this set is made up of the set of reference CMMI models, the SCAMPI evaluation methods (Standard CMMI Apraisal Method for Improvement processes) and the courses of training.

CMMI models identify the process areas present in an industrial approach to software or systems development. The goal is to help organizations improve their ability to deliver products to their customers, they can be used to improve the entire organization, a division, or an organizational unit.

CMMI helps to integrate improvement efforts, completing traditionally separate aspects such as management and development aspects, it helps to determine improvement goals and priorities, by having an evaluation mechanism and reference models (Piattini et al. Pg. 236)

The CMMI DEV 2 model is based on the organization's policies where the guidelines for developing software are specified. At this level, projects are required to be managed, that is, the work team follows a defined plan with activities from each of the process areas with those responsible, effort and duration of the entire project. ―IIt involves training people to carry out the processes as planned in the plan, establishing how the documents produced at each stage will be controlled (Software Engineering Institute [SIE], 2010)

Capability Level 2: Managed

A capability level 2 process is characterized as a managed process. A managed process is a realized process (capability level 1) that has the basic infrastructure in place to support the process. It is planned and executed according to policies; employ skilled staff; has adequate resources to produce controlled results; engages relevant stakeholders; is monitored, controlled and reviewed; and adherence to its process description is evaluated. [SEI] (2010). The process discipline reflected by Capability Level 2 helps ensure that existing practices are maintained during times of pressure.

In the Mexican Republic, 49 companies have achieved certification and registration at this level, this indicates that the improvement in the software quality process under this model is in force. (Yesenia Nohemí González Meneses, 2014) This article aims to describe the relevant activities of each stage of the process of the CMMI-DEV 2 model see 1.3. From the system project Acquisition of Goods, services and infrastructure, implemented in the SME Miracle Business SAde CV.

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It is structured as follows: First, the microenterprise is described, then the importance of teamwork is argued, reference is made to the software methodology used, then the five levels that the system has are cited. model, later the CMMI-DEV2 level is described; Finally a conclusion is made.

Giro de PYME Miracle Business SA de CV

Miracle Business SA de CV It is a company of professionals dedicated to providing Business Consulting using Information Technology. MBN began operations in the year 2000 through its technological partner MiracleSoft and became an independent company name in 2006.

Miracle Business Network, SA de CV was established on March 16, 2006, derived from the experience and initiative of its partners to generate employment opportunities nationwide. In 2008, the need was identified to have a methodology that would provide the required quality to projects, for greater customer satisfaction.

For this reason, the Quality Standard NMX-I-059/NYCE-2005 (MoProSoft) was implemented. It establishes the activities and responsibilities for each of the processes that make up the organization. A year later, MBN underwent evaluation by the NYCE Verification Body, and after completing the Verification process, it was Approved and Certified within LEVEL 2 of the Quality Standard.

MBN currently has the ORACLE Gold Partner distinction, and is on the way to become a Specialized Partner in the GOLDEN GATE tool, for replication of information in real time.

Teamwork

Leadership is the process of influence between leaders and followers to achieve organizational objectives through change, it is considered crucial for the success of any project, some traits of effective leaders are: domain, high energy, internal locus of control, integrity , flexibility, self-confidence, stability, intelligence, and sensitivity to others. The establishment of roles assigned to the personnel that contributes with a specific task in this type of projects are aware that they must combine attitudes, skills, knowledge, communication and control the stress generated in moments of difficulty or contingency.

Given the increasing use of teams to organize work activities in countless organizations, The role of leaders is paramount to facilitate productive behavior among team members. There is a need for leadership because teams are made up of various personalities, mental states, motives and agendas. To be an effective team leader requires a change in the mental state and behavior of those involved, in order to foster the development of team spirit, leaders must perceptively observe what happens in the team. contributions when needed, encourage a climate of dialogue, turn obstacles into opportunities, and consider themselves and others as part of the team's body of knowledge, skills, and ideas. (Lussier, 2010) There is a need for leadership because teams are made up of various personalities, states of mind, motives, and agendas.

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As most software professionals work in project teams, as a general rule, software engineering project groups should have no more than 10 members. When using small groups, communication is facilitated. Good management cannot guarantee success. however, mismanagement often results in project failure: software may be delivered late, cost more than originally estimated, or fail to meet customer expectations. (Somerville, 2011)

Material software model

It consists of the following stages:

1. Analysis and definition of requirements. The services, restrictions and goals of the system are defined based on consultations with users. They are then defined in detail and serve as a requirements specification.

2. Software system design. The system design process divides the requirements into hardware or software systems. It establishes a complete architecture of the system. Software design identifies and describes the fundamental abstractions of the software system and their relationships.

3. Iimplementation and unit testing. During this stage the design is carried out as a set of units or programs are integrated and tested as a complete system to ensure that the software requirements are met, later these tests are delivered to the client.
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4. Foperation and maintenance. The system is installed and put into operation. Maintenance involves correcting errors not discovered in earlier stages of the life cycle, improving implementations of system units, and highlighting system services once new requirements are discovered. (Somerville I. 2005)

Reference model CMMI DEV 2 ver 1.3

The basic components that this model supports are people, methods and procedures, and tools and equipment, as shown in Figure 1.

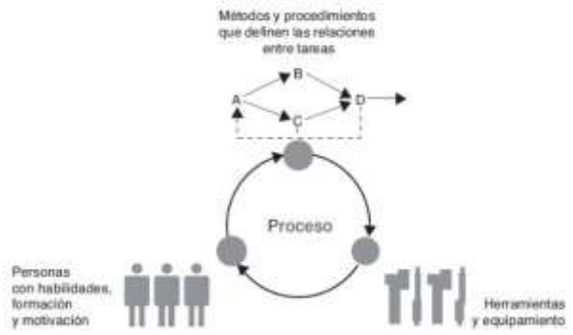

Figure 1

CMMI is a reference model that covers development and maintenance activities applied to both products and services. They are used by organizations in numerous industries including aerospace; Banks, computer construction, defense software, automobile manufacturing, and telecommunications use CMMI for development. The CMMI for Development constellation models contain practices that cover project management, process management, systems engineering, hardware engineering, software engineering, and other processes used in development and maintenance.

Thes generic goals and generic practices (GGs-GPs) are the basis for incorporating the processes implemented by a process area.

Project planning is an iterative process that begins when an initial project plan is designed during the start-up phase of the project.

At the beginning of a planning process, you have to assess the constraints that affect the project, these are delivery date, available staff, overall budget and available tools.

As shown in the following figure.

Figure 2

Required, Expected, and Informational Components

The required components describe what an organization must do to accomplish to satisfy a process area. The expected components describe what an organization can implement to achieve a required component. The required components guide those who implement improvements or perform evaluations, they also include specific and generic practices.

Informative components provide details that help organizations begin to think about how to approach the required and expected components. Figure 3

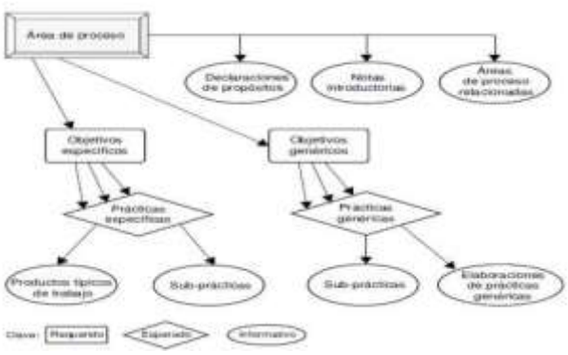

Figure 3

Process areas

A process area is a group of related practices in an area that, when implemented together, satisfy a group of objectives considered important for the improvement of this area. In this reference model there are 22 process areas. Figure no 4.

Figure 4

MCMMI DEV 2 model applied to the development of BSI (System for the acquisition of goods, services and infrastructure)

The system was developed under this model in a period from June to September 2014 with 4 modules and they are:

1. Articles Assignment letters. Loans. Maintenance.
2. Providers
3. Services
4. Login

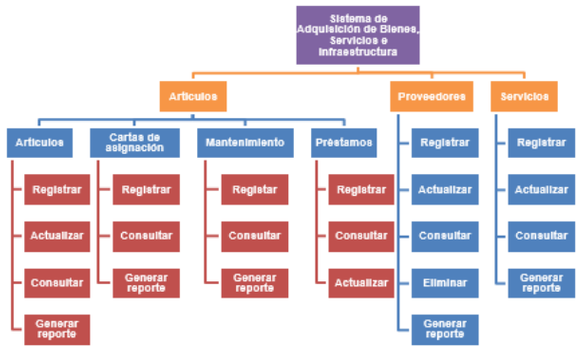

Figure 5

The work team was made up of 10 people who took on the following roles: Operations director, specific project manager, test manager, software development and maintenance manager, programmer, analyst, designer, manual manager, database administrator. data collector, reviewer, users, user interface designer, and client.

The responsibility associated with each role is briefly described below.

Specific Project Manager (APE)

Decision making, strategic planning, personnel management and software development.

Director of Operations (DO)

It maintains visibility over the allocation of resources and the results obtained by the work teams assigned to the different value-adding tasks. Participate in the approval of processes, standards and use of tools.

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Responsible for Processes and Quality (CPC)

Keeps organizational processes and process assets up to date. Communicates changes and updated versions of processes to those involved. Facilitates training in the use of processes, formats and tools. Verifies compliance with organizational policies and processes.

Auditor (AU)

Knowledge of the different phases of project development and ability to verify the execution of processes in each of its stages.

Measurement and Analysis (MA)

Know and assess indicators associated with the development of projects that allow measuring their status.

Configuration Management (CA)

Knowledge and experience in managing version control and repository administration.

Test Manager (PR)

Knowledge and experience in planning and conducting integration and system tests. Responsible for Software Development and Maintenance (RDM). Management in project planning that consists of deploying the project/service plan, involving the actors appropriately, obtaining agreement on the plan and maintaining it, among the most important functions of this stage are the following:

1. Estimation of attributes of tasks and work products
2. Resource Determination
3. Negotiation and validation of commitments
4. Generation from plans, included andthe schedule
5. Intification and analysis of risks to mitigation plans

Measurement and Analysis (MA)

The main function is to support the teams in critical success factors, maintain visibility of the use of resources, measure and report the efficiency of the processes relevant to the organization.

Analyst (AN)

The main function is the elicitation, specification and analysis of the requirements.

Programmer (PR)

The main function is programming, in some programming language, integration and unit tests.

Designer (DI)

The main function is design of the structure of software components.

Responsible for Manuals (RM)

Knowledge of drafting techniques and experience in software development and maintenance.

Database Administrator (DBA)

Knowledge in database administration.

Client (CL)

Interpretation of the requirements specification standard.

Reviewer (RE)

Knowledge of revision techniques and experience in software development and maintenance.

User Interface Designer (DU)

Knowledge in user interface design and ergonomic criteria.

Maturity levels Maturity level 1

At maturity level 1, processes are generally ad-hoc and chaotic. The organization does not generally provide a stable environment to support the processes. Despite this chaos, maturity level 1 organizations often produce products and services that work; however, they frequently exceed their budgets and do not meet their schedules.

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Maturity level 2: Managed

At this level, the organization's projects have ensured that processes are planned and carried out according to policies; projects employ skilled personnel who have adequate resources to produce controlled results; involve relevant stakeholders; they are monitored, controlled and reviewed; and are evaluated for their adherence to their process descriptions.

Maturity level 3: Defined

Processes are well characterized and understood and are described in standards, procedures, tools and methods. The organization's set of standard processes, which is the foundation of maturity level 3, is established and improved over time. These standard processes are used to establish consistency throughout the organization. The projects establish their defined processes by adapting the set of standard processes of the organization according to the adaptation guidelines of "set of standard processes of the organization"

Maturity level 4

At this level, the organization and projects set quantitative targets for quality and process performance and use them as criteria in process management. Quantitative objectives are based on the needs of the customer, end users, organization and implementation of the process. Quality and process performance are understood in statistical terms and are managed over the life of the processes [SEI 2010].

Maturity level 5: In optimization

An organization continually improves its processes based on a quantitative understanding of the common causes of variation inherent in the processes, this level focuses on continually improving process performance through incremental and innovative process and technology improvements. Quantitative process improvement objectives for an organization are established, continually revised to reflect changing business objectives, and used as criteria for managing process improvement. The effects of deployed processes are measured and evaluated against quantitative process improvement goals. Figure 6.

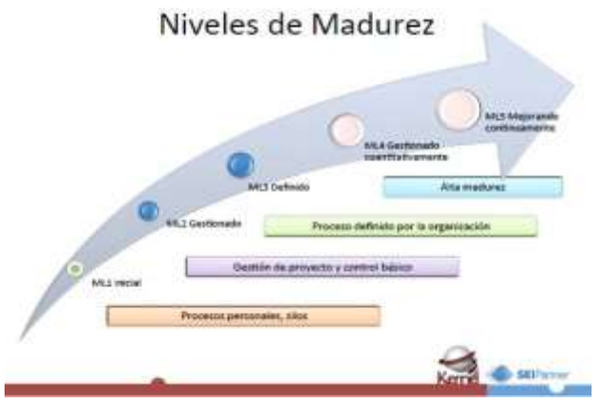

Figure 6

At level 2 there are seven process areas

1. Management from rewants (REQM)
2. Project Planning(PP) monitoring y cocontrol of project(PMC)
3. Management from acsane con Suppliers (SAM)
4. Management quantitative of the project(QPM)
5. Risk management (RSKM)
6. Configuration Management (CM) As shown in the following figure.

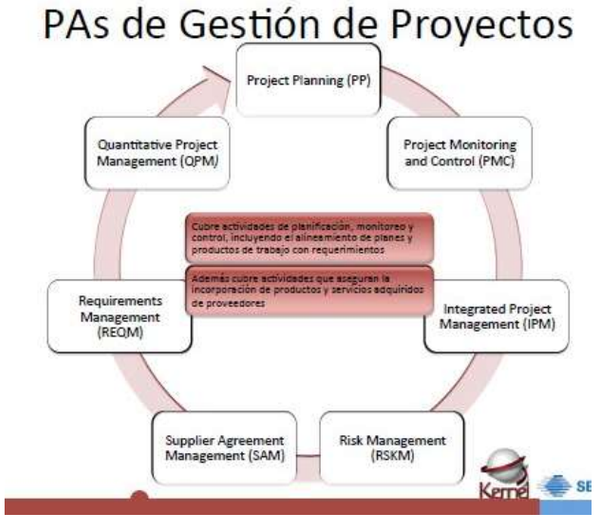

Figure 7

Relevant activities within each of the phases

Pproject planning (PP)

It resides in developing the project or service plan, involving the actors appropriately, obtaining agreement on the plan and maintaining it, within this phase the following should be covered at least:

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Estimation of attributes of tasks and work products, determination of resources, determination of resources, negotiation and validation of commitments, generation of plans, including the schedule, identification and analysis of risks to mitigation plans as shown in figure 8. It began with the estimation of time to carry out the planning of material and human resources. Table 1

Estimacion de esfuerzo del proyecto

Fase	Porcentaje	Horas
Plan de proyecto	5%	32
Especificación de requisitos	15%	95
Análisis y diseño	25%	158
Construcción	30%	190
Integración y pruebas	20%	127
Cierre	5%	32
Total	100%	634

Table 1

Specification of requirements

It consists of following the recommendations of the IEE-830 format in which it is used for the specification of customer requirements, specifying requirements (on site with the customer). Gorequirements specification verification, requirements specification correction, requirements specification validation/acceptance, develop traceability matrix, baseline requirements documents, requirements specification document delivery, also known as artifacts. Specifically, this document in a brief way, is made up of the following parts:

IEEE 830 Requirements Specification

1. Introduction. Context of the problem to solve.

2. Propposite: This section defines the role or purpose of the requirements specification in the context of the general documentation.

3. Scope: Refers to a brief description of the scope of the requirements specification; which project(s) are associated with it, and anything else that is affected or influenced by this document.

Definitions, Acronyms and Abbreviations

This section defines the definitions of all terms, acronyms, and abbreviations required to properly interpret the requirements specification. This information can be provided by reference to the organization's glossary.

Audience

This section identifies the specific intended audience for the requirements specification. For each of the participants, the levels of participation must be indicated.

References

This section has a complete list of all documents referenced anywhere in the document. Each document must be identified by title, report number (if applicable), date of publication, file that contains it, and organization that publishes it. Specify the sources from which the references were obtained. This information may be provided by reference to an appendix or other document.

1. Presentation of the product
2. System Purpose

3. Objective: This section should indicate in a general way what is intended to be achieved with the development of the system.

4. Scope: The functions that the system must perform are indicated in general terms.

Does not include: This field is used to indicate some functional or non-functional aspects that you want to highlight, they will not be included in the product. The purpose of this section is to express issues that the product will not cover.

Restrictions and assumptions: The objective of this section is to indicate any aspect that must be considered for development, which may affect compliance with the requirements, which is given from the business environment, or previously agreed upon. Fundamentally, political or legal issues in the organization's environment should be highlighted, which can affect the success of the project if they are not treated appropriately.

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List of system functionality: This section provides an overview of system functionality. It is used by the person interested in the behavior of the system, such as: clients, architects, systems analysts, business process analysts, graphical user interface designers, test analysts, test case designers, administrators, etc. You must list for each use case:

The use case number: It is a consecutive number, which is assigned as the functions of the system are identified and serves to facilitate their identification.

The name of the use case: It must be a representative phrase of the functionality that this use case performs, the name must not be repeated.

Priority: In this field, the use case must be categorized in relation to its importance in the context of the system that is being specified, a classification criterion could be: essential, desirable, useful.

Essential: When the use case must be included in the system since it is essential to achieve the development objective.

Useful: When the system works less efficiently if this use case is not added, that is, if the development objective is not included, it is achieved, but not optimally.

Desirable: When the use case is not essential to the system but makes it somehow more attractive to users.

Complexity: Here it is allowed to categorize the use cases according to their difficulty for development, the suggested values are: very simple, medium, complex, very complex; and they are determined based on two basic parameters, whether the use case has complicated interfaces or complicated calculations or a combination of both.

Table 3 shows a part of the general description and list of the functionality of the system, in table no. 2 shows the use case diagram, Table no.2

N°	Nombre del Caso de Uso	Prioridad	Complejidad
1	CU01_Registrar artículos	Esencial	Simple
2	CU02_Actualizar artículos	Esencial	Simple
3	CU03_Consultar artículos	Util	Simple
4	CU04_Generar reportes artículos	Util	Simple
5	CU05_Registrar carta de asignación	Esencial	Simple
6	CU06_Consultar carta de asignación	Util	Medio

Table 2

The following documents are other artifacts used in this phase.

- Use case diagrams
- List of actors
- Product perspective
- Domain model
- Detailed description of requirements
- Interface prototype
- Business rules and functions
- non-functional requirements
- Interface requirements
- Supplementary Specifications

Project Management (PP PMC)

Generates project plans, carries out monitoring and control activities including communication with the client, follows up on team activities, manages changes, checks that the activities associated with the Engineering cycle are carried out properly, verifies that activities related to product and process quality are carried out, follow up on costs, update risk status, coordinate mitigation activities, manage material and human resources, manage acquisitions for the project, follow up on training and development plans of human resources, carries out the follow-up to the data planning to verify the security and reliability of the same, as shown in figure 9.

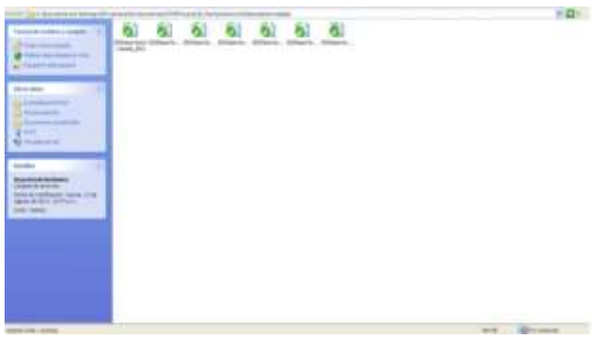

Figure 8

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Getion of requirements (RE REQM)

In this phase, the analyst executes the analysis plan, to specify the functional and non-functional requirements using representations such as prototypes, use cases or scenarios. It is also necessary to define the process for gathering requirements, control of changes, and documentation of the traceability matrix. As shown in the following figure 10.

Figure 9

Quality Assurance (PPQA)

Quality plans and audit schedules are established for each of the processes, documentation functions and test execution are also coordinated. Figures 11.

Figure 10

Configuration tion (CM)

In this stage, configuration management plans are made at the organizational level and at the project level, which manage the active work products of the process to integrate the baselines, physical audits, functional audits, change management of configuration items, and reports of condition. Figure 12.

Figure 11

Procurement Office (SAM)

In this phase, procurement plans, agreements, contracts and their follow-up are established. In the definition phase, it is necessary to review the current procurement process and document it together with the applicable formats to carry out this management, such as lists of suppliers, inventories of assets or licenses, forms for purchase requests to evaluate suppliers, periodic progress reports on supplier performance and closing of acquisitions.

Conclusion

It must be remembered that the general approach of CMMI lies in the development of organizational processes that allow improving the development of products and services. In particular, level 2 has the essence of providing the foundations to manage under processes and the bases for their standardization. The final tangible results of the project were to document the specification of requirements that contains the description of use cases as well as the non-functional and functional requirements that the project must meet, analysis and design: that it contains.

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