# Harmonizing maturity levels from CMMI-DEV and ISO/IEC 15504

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## SUMMARY

**ISO has recently published Part 7 of the ISO/IEC 15504 standard, with the aim of determining the extent to which an organization consistently implements processes that contribute to achievement of its business goals. This new Part 7 of ISO/IEC 15504 has addressed issues related to the assessment of organizational maturity, as the CMMI-DEV model also does. Recently, growing interest has been shown towards the need to harmonize different improvement models or standards, thereby presenting an integrated vision about them. All this being so and in an effort to offer information on how the maturity levels described in these two models are related, we have carried out the harmonization of these two models. It is based, firstly, on a mapping between processes of ISO 12207:08 and process areas of CMMI-DEV, and in second place, on a matching between processes of ISO 12207:08 and ISO 15504-5. For this work, we have taken into account the latest versions of the models, and defined a suitable process to carry out the mapping in a systematic way. We established differences and similarities between the maturity levels (and their processes) described in these models, our goal being to support organizations which are interested in tackling organizational maturity. Copyright © 2009 John Wiley & Sons, Ltd.**

KEY WORDS: harmonizing improvement technologies; mapping; matching; maturity levels; CMMI-DEV; ISO/IEC 15504-7; SPI

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## 1. INTRODUCTION

Emphasis on process provides the main justification for many standardization initiatives, as well as for the efforts to measure organizational maturity (Derniame *et al.* 1999), like the CMMI-DEV v1.2 (hereafter CMMI-DEV) (SEI 2006) and CMMI-ACQ (SEI 2007) of the Software Engineering Institute and recently the ISO/IEC 15504-7 (hereafter ISO 15504-7) (ISO 2008a) of the International Organization for Standardization. The recently issued Part 7 of ISO/IEC 15504 defines a framework for determining organizational maturity. It includes the possibility of assessing the organizations in ISO/IEC 15 504 by maturity levels (in the same way as the CMMI model does). This assessment allows us to rate the maturity of the organization, based on the process capability. Organizational maturity is seen as:

- The extent to which an organization consistently implements processes within a defined scope that contributes to achievement of its business goals (current or projected) (according to ISO 15504-7). In the ISO 15504-7 standard, the overall organizational maturity is established based upon assessed profiles of process capability.
- The extent to which an organization has explicitly and consistently deployed software processes that are documented, managed, measured, controlled and continuously improved (according to CMMI-DEV). In CMMI models the organizational maturity is established based on the staged representation and measured by maturity levels.

Regarding the maturity levels, in both ISO 15504-7 and CMMI, each maturity level provides a set of processes or process areas that characterize different organizational behaviours. A maturity level consists of specific (or base) and generic practices related to a predefined set of processes or process areas that improve the overall performance of the organization. For CMMI the specific and generic practices are described in the process areas presented in the same model. Nevertheless, for ISO/IEC 15504 the generic practices are described in the process attributes presented in Part 2 (ISO 2004) [and extended in Part 5 (ISO 2006)] of this standard, and the base practices are described in the processes presented in ISO/IEC 12207 (ISO 2008b) [or in ISO/IEC 15504-5 (ISO 2006)].

It is important to highlight that organizational maturity involves both process capability and process sets associated with each of the maturity levels:

- The *process capability* is enhanced by the achievement of generic practices of the process attributes (of ISO/IEC 15504-2) or generic goals (of CMMI) which are transverse to any process or process area.
- The *maturity levels* propose a predefined set of processes or process areas in order to offer a systematic and structured way to approach process improvement for an organization.

With this new organizational maturity model on stage and given the present need to harmonize different improvement technologies (SEI 2008) to support organizations which are interested in assessing organizational maturity, it is important to have information on how the maturity levels described by both ISO 15504-7 and CMMI-DEV are related. According to SEI (2008), mapping is one of the most widely used specific strategies for the harmonization of models. In this sense, from the viewpoint of the *process capability* in Rout and Tuffley (2007), a current and detailed mapping between generic practices of the process attributes of ISO/IEC 15504-2 and generic goals of CMMI is shown. Nevertheless, from the viewpoint of the *maturity levels* there is no work that brings into concordance the process areas described in the maturity levels of CMMI-DEV and the processes

described in the maturity levels of ISO 15504-7. For this reason, in this article we harmonize these two models from the viewpoint of the relationship of the sets of processes described in the different maturity levels of ISO/IEC 15504-7 and CMMI-DEV v1.2. The objective is to determine the degree of coverage of the maturity levels of CMMI-DEV, using the maturity levels proposed in Appendix A of ISO 15504-7.

Since the harmonization of these maturity levels involves processes and process areas and as there is no mapping of processes of the last version of ISO/IEC 12207 and the process areas of CMMI-DEV, we initially carried out a mapping between process areas of CMMI-DEV and processes of ISO/IEC 12207:2008 (hereafter, ISO 12207:08) (ISO 2008b) (process reference model proposed by ISO/IEC 15504). Because the processes of each maturity level listed in Appendix A of ISO 15504-7 are identified through their names and acronyms from ISO 15504-5 and we wished to use the previous mapping, we also established a matching of the processes described by ISO 15504-5 and ISO 12207:2008. In this article we present this mapping in detail, along with the matching established. Using this mapping and this matching, we determined the relationship of the first three maturity levels of ISO 15504-7 to those described in CMMI-DEV.

The article is structured as follows. Section 2 presents related works, and then the mapping between ISO 12207:08 and CMMI-DEV is described in detail (Section 3). Section 4 presents a matching of the processes of ISO 15504-5 and ISO 12207:2008. The relationship between maturity levels of ISO 15504-7 and CMMI-DEV is shown in Section 5. Our conclusions are set out in Section 6.

## 2.  RELATED WORKS

Regarding the relationship between maturity levels proposed by ISO 15504-7 and CMMI, there are few relevant pieces of work. This is due to the fact that the ISO 15504-7 standard was published only recently (in November 2008). However, the literature presents some works that involve relationships, comparisons and mapping between different versions of CMM(I) and SPICE (ISO/IEC 15504); among these we find:

- An analysis of compatibility between SPICE (ISO/IEC 15504:1998) and CMM is given in Rout (1998).
- An analysis of the conceptual relationship between Software CMM and ISO/IEC 15504:1998 and a discussion of similarities and differences between them is described in Paulk (1999).
- In Lepasaar *et al.* (2002), a description of and comparison between the general structure of ISO/IEC TR 15504 and the continuous representation of CMMI are presented.
- An analysis and comparison of ISO/IEC 15504:2004 and CMMI v1.1 for software process assessment is set out in Wangenheim and Thiry (2005).
- In Rout and Tuffley (2007), the harmonization of CMMI v1.1 and ISO/IEC TR 15504-2:2002 is presented.

From the analysis of the works presented above we have found that: (i) the work that deals with the standards ISO/IEC 15504-2:2004 involves ISO/IEC 12207:2002 directly and (ii) in none of these studies, the latest versions of these models are involved. Moreover, with the exception of the work presented in Rout and Tuffley (2007), the process entities included in the relationship, comparisons or mappings are at a high level of abstraction.

With respect to the first mapping between ISO 12207:08 and CMMI-DEV, we followed a well-defined process for that purpose, which we also used for other mappings that we have carried out [e.g. ISO 12207:08 to CMMI-ACQ (Pino *et al.* 2009), ISO 9001 to CMMI-DEV and ISO 27000 and ISO 20000]. We might add that the entities involved in this mapping are: (i) activities and tasks for ISO 12207:08 and (ii) specific practices for CMMI-DEV. These process entities are of low level abstraction in the description of the processes or process areas. A mapping at this abstraction level provides information about the activities and tasks outlined in ISO 12207:08 that support specific CMMI-DEV practices. Furthermore, an analysis at this abstraction level can give directions about how a model previously implemented in the organization (ISO 12207:08) can meet part of the requirements for establishing a new model (CMMI-DEV). This could reduce the effort and costs associated with the implementation of a new model, with reference to a model already used in the organization.

The most significant contribution of this article is the harmonization of ISO 15504-7 and CMMI-DEV, by establishing a relationship between maturity levels described in these two models. This connection is based on: (i) a complete, thorough and unambiguous mapping between ISO 12207:08 and CMMI-DEV and (ii) a matching between the processes described by ISO 15504-5 and ISO 12207:2008. Figure 1 shows a structure of the work performed.

## 3.   MAPPING ISO/IEC 12207:2008 AND CMMI-DEV V1.2

After conducting a high-level analysis of the different related pieces of work mentioned in the previous section, we have observed that process areas of CMMI-DEV are closely related to the processes described in ISO/IEC 15504-5 (hereafter ISO 15504-5) (ISO 2006) and ISO 12207:08 (process dimension) (see Table I). On the other hand, generic goals and practices of CMMI-DEV are closely related to the process attributes described in the ISO/IEC 15504-2 (ISO 2004) (capability dimension). Based on this analysis and given that the maturity levels involve process areas and processes, the mapping between ISO 12207:08 and CMMI-DEV must be carried out at the level of process dimension.

### 3.1.   Process for mapping

The process carried out to perform the mapping between ISO 12207:08 and CMMI-DEV is described in the following lines. The purpose of this process is to provide a guideline for performing a step-by-step mapping of different models, aiming to guarantee the reliability of results obtained. In order to organize and manage the people and activities involved in the comparison, this process defines two roles: the performers and the reviewers of the mapping, along with five tasks:

- *Analyzing the models:* This activity involves the tasks: (i) acquiring knowledge about the models to compare and (ii) analyzing the structure of these models.
- *Designing the mapping:* This activity involves the tasks: (i) fixing the process entities to be com pared, based on the research needs; (ii) defining the comparison scale; (iii) fixing the directionality of the comparison and (iv) defining a template comparison.
- *Carrying out the mapping:* This activity involves the tasks: (i) carrying out a comparative analysis based on the descriptions of the process entities under study (by performers), (ii)
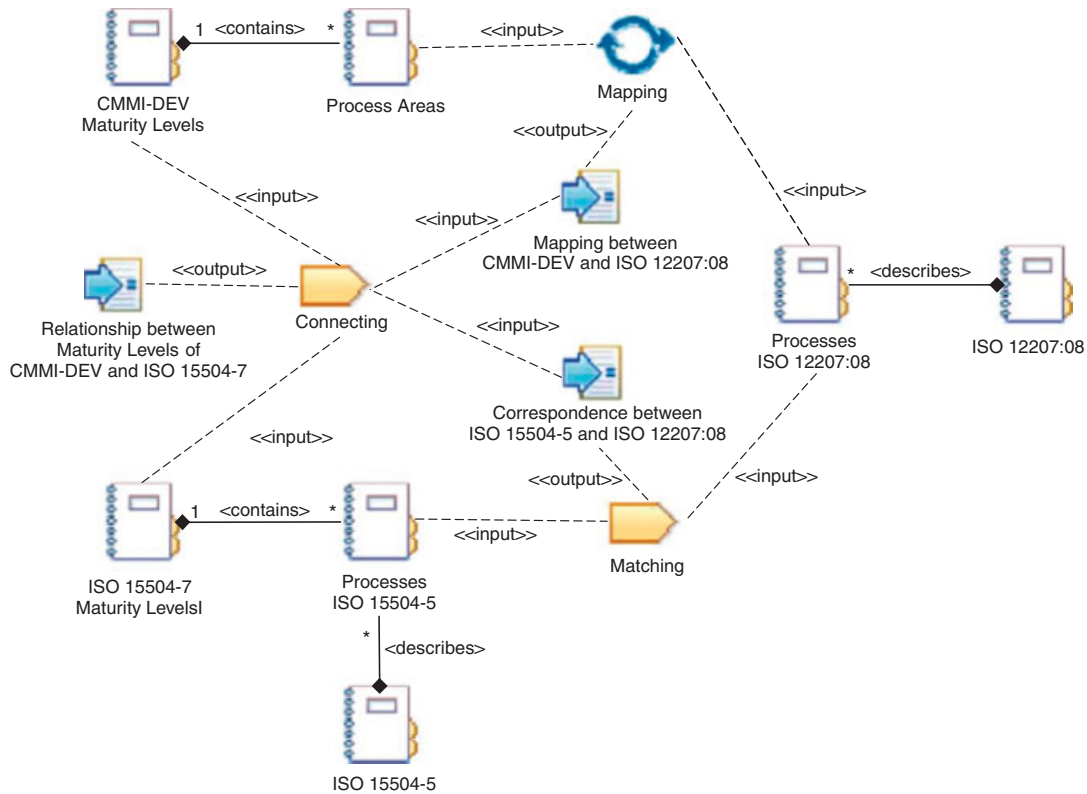
Figure 1. Work performed in order to find the relationship between maturity levels.

Table I. Matching CMMI-DEV and ISO 15 504 Part 2,5,7 and ISO 12 207:08.

| | | CMMI-DEV | | |
| --- | --- | --- | --- | --- |
| | | Generic Goals/Generic Practices | Process Areas | Maturity levels |
| **ISO 15 504-2** | **Process Attribute** | *Institutionalization of the capability of the process (Capability dimension)* | | |
| **ISO 15 504-5** | **Process** | | Performance of the process (Process dimension) | |
| **ISO 12 207:8** | | | | |
| **ISO 15 504-7** | **Maturity Levels** | | | Organizational maturity |

resolving the discrepancies of the outcomes of the performers (by reviewers) and (iii) verifying and validating these results (by reviewers).

- *Presenting the outcomes of the mapping*
- *Analyzing the results of the mapping*

Figure 2. Activity diagram of the process for mapping.

Figure 2 shows the activity diagram of the process for mapping different models, which uses SPEM 2.0 notation and includes roles, activities and work products.

We followed the guidelines for the activities described previously and executed them to perform the mapping of ISO 12207:08 and CMMI-DEV. Furthermore, the roles were assigned (two people as performers of the mapping and two reviewers). In the next sub-sections we describe these activities.

## 3.2.  Analyzing the models

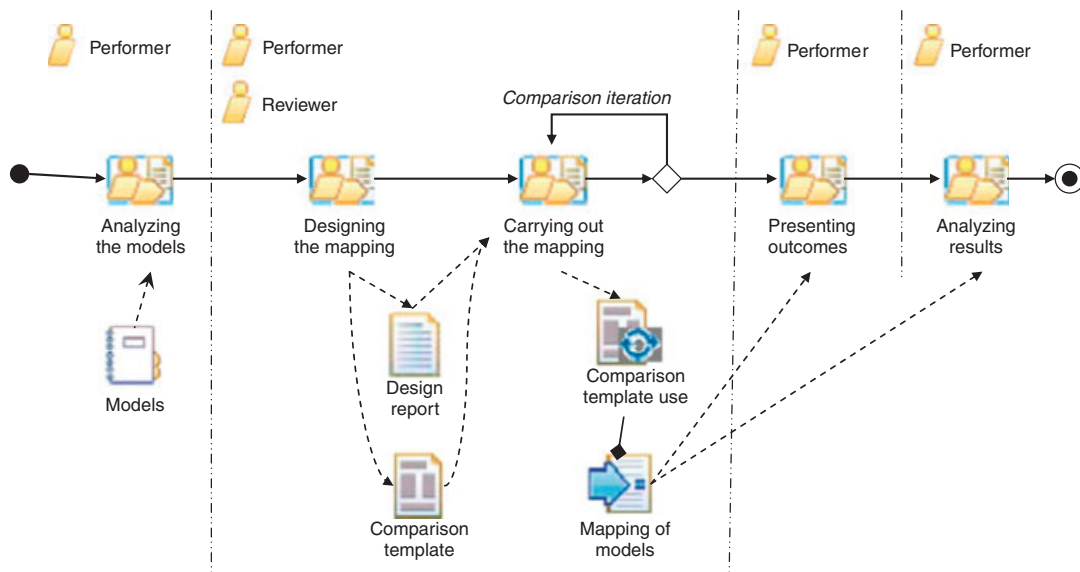According to SEI (2006), the purpose of CMMI-DEV is to help organizations improve their development and maintenance processes for both products and services. CMMI-DEV is a collection of best practices that is generated from the CMMI framework, which is the basic structure that organizes CMMI components and combines them into CMMI constellations and models. Regarding the CMMI-DEV's structure, it contains two main sections in its description: (i) generic goals and practices and (ii) process areas. Each process area is defined in terms of the process entities: purpose, specific goals (required component) and specific practices (expected component). A required component describes what an organization must achieve to satisfy a process area; an expected component describes what an organization may implement to achieve a required component.

On the other hand, according to ISO (2008b) the purpose of the ISO 12207:08 standard (Systems and software engineering - Software life cycle processes) is to provide a defined set of processes to facilitate communication between and among acquirers, suppliers and other stakeholders in the life cycle of a software product. With respect to the ISO 12207:08 structure, the processes are grouped into process groups and each process is described in terms of the process entities: purpose, outcomes, activities and tasks. The purpose and outcomes are a statement of the goals of the performance of each process. The list of activities and tasks is performed to achieve the outcomes.

### 3.3.   Designing the mapping

This mapping should support a comparative analysis from the viewpoint of the relationship of process set described in the different maturity levels of ISO 15504-7 and CMMI-DEV. The organizational maturity model defined in Appendix A of ISO 15504-7 is based on ISO/IEC 12207 as process reference model. The processes described in each maturity level, however, are identified by the acronyms and names of the processes presented in ISO 15504-5 (ISO 2006). It is important to highlight that some activities of various processes of the new ISO 12207:08 can be replaced by some processes of ISO 15504-5. For instance, the processes of ISO 15504-5: PIM.1 Process establishment, PIM.2 Process assessment and PIM.3 Process improvement can replace, respectively, activities 6.2.1.3.1 Process establishment, 6.2.1.3.2 Process assessment and 6.2.1.3.3 Process improvement of the Life Cycle Model Management Process of ISO 12207:08. Taking into account this requirement in our research, the mapping should be done at the level of: (i) the entity specific practices for CMMI-DEV and (ii) the entities activity and task for ISO 12207:08. To determine whether an activity or task supports, or has any connection with a specific practice, a comparative analysis of the descriptions of these process entities must be performed. The results of the mapping of these process entities are rolled up to the level of processes of ISO 12207:08 and process areas of CMMI-DEV and these results are expressed through a degree of relationship. The degree of relationship indicates the extent to which a process of ISO 12207:08 supports, or has any connection with, a process area of CMMI-DEV. This expresses a one-to-one relationship.

In order to express the degree of relationship between an ISO 12207:08 process and a CMMI-DEV process area, we have defined a discrete scale (scale of comparison) which has major correlation to the scale defined in ISO/IEC 15504-2. We have added an element in our scale, in order to indicate that two process entities are unrelated. Each of the elements of the scale has been associated with a set of numeric values which are described in terms of percentage. This scale is made up of the following elements: strongly related (86% to 100%), largely related (51% to 85%), partially related (16% to 50%), weakly related (1% to 15%) and non-related (0%). The numeric values can be found by dividing the number of specific practices (from a process area of CMMI-DEV) that are related to activities (from a process of ISO 12207:08) by the total number of specific practices defined in that process area. For this work, it is important to highlight that this numeric value is only indicative of the extent to which a process area of CMMI-DEV is addressed by means of the processes of ISO 12207:08. The degree of relationship is hence expressed only through the discrete scale.

When a mapping involves process entities of low-level abstraction, it is relevant to define the direction of the mapping. With an early detailed comparison between a process and a process area, an analysis of the degrees of relationship in this comparison was conducted. From this analysis, we conclude that the degree of relationship depends on the direction of the comparison (Pino *et al.* 2009). The direction of this mapping is from ISO 12207:08 to CMMI-DEV. In this sense, the goal is to understand the treatment of the CMMI's specific practices by means of the activities and tasks described in ISO 12207:08. A template for recording the information generated from the comparison and mapping of process entities was defined.

### 3.4.   Carrying out the mapping

We have carried out the mapping by means of an iterative and incremental procedure in order to identify which specific practices of CMMI-DEV are supported, addressed or related to the activities

Table II. Detailed mapping between Measurement Process (ISO 12207:08) and Measurement and Analysis (CMMI-DEV).

| Process Area | MEASUREMENT AND ANALYSIS (MA) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Specific practices | SP 1.1 Establish Measurement Objectives | SP 1.2 Specify Measures | SP 1.3 Specify Data Collection and Storage Procedures | SP 1.4 Specify Analysis Procedures | SP 2.1 Obtain Measurement Data | SP 2.2 Analyze Measurement Data | SP 2.3 Store Data and Results | SP 2.4 Communicate Results |
| Degree of relationship | S (Strong) | | | | | | | |
| **6.3.7 Measurement Process** | | | | | | | | |
| 6.3.7.3.1 Measurement planning. | Task 6.3.7.3.1.1 Task 6.3.7.3.1.2 | Task 6.3.7.3.1.3 | Task 6.3.7.3.1.4 | Task 6.3.7.3.1.4 Task 6.3.7.3.1.5 | | | | |
| 6.3.7.3.2 Measurement performance. | | | | | Task 6.3.7.3.2.1 Task 6.3.7.3.2.2 | Task 6.3.7.3.2.3 | | Task 6.3.7.3.2.4 |
| 6.3.7.3.3 Measurement evaluation. | | | | | | Task 6.3.7.3.3.1 | | |
| **S (7 Specific Practices of 8)** | | | | | | | | |

and tasks described in the processes of ISO 12207:08. This procedure is iterative, because the execution of the mapping is carried out completely on one CMMI-DEV process area first and then on the others in turn. It is also incremental in the sense that the comparison template (which is the product) grows and evolves with each iteration until it becomes the definitive one. This iterative and incremental approach has allowed managing the complexity entailed in a mapping in which entities of low-level abstraction are involved.

In each iteration, we performed a comparative analysis of the descriptions of the specific practices of a process area of CMMI-DEV versus the activities and task of all ISO 12207:08 processes. The comparative analysis of the entities related to the process chosen is limited to establishing whether a task or activity of ISO 12207:08 addresses in some way (or not) some aspects of a specific CMMI-DEV practice. In other words, the comparative analysis establishes whether there is a relationship between these process entities, but it does not deal in depth with the extent to which a task or activity satisfies a specific practice.

At the end of each iteration, the performers carried out a peer review of the results obtained from the mapping of process area of CMMI-DEV under comparison. After that, the reviewers resolved any discrepancies between the performers and validated the results of the mapping. Performing these review activities has enabled us to reach a consensus on these results, thus increasing the reliability of results obtained in the mapping. For instance, Table II shows a detailed comparison between activities and tasks of the Measurement Process from ISO/IEC 12207 and the Measurement and Analysis process area from CMMI-DEV.

## 3.5.    Presenting the outcomes of the mapping

Based on the activities performed in the mapping described in the previous sub-sections, an overview of the degree of relationship of each CMMI process area with the ISO 12007's processes is presented in Table III. A view of this comparison is presented in detail in Pino (2009).

Table III. Overview of the comparison between ISO/IEC 12207:2008 and CMMI-DEV.

**Direction of the mapping:** From ISO 12207:08 to CMMI-DEV
**Process entities for the mapping:**
• For ISO 12207:08: Activities and tasks of the standard's processes.
• For CMMI-DEV: Specific practices of the process areas.
**Research question:**
• What ISO 12207's activities and tasks can offer support to specific practices of CMMI?
• What ISO 12207's activities and tasks are strongly related with the support to CMMI's specific practices?
**Mapping goal:** To determine which activities and tasks of ISO 12207:08 have a close relationship to some specific practice of CMMI-DEV. The goal is know which is the degree of relationship to the specific practices of CMMI-DEV based on the activities and tasks described in ISO 12207:08.
**Scale of comparison:**
• **S** - **S**trongly related (86% to 100%)
• **L** - **L**argely related (51% to 85%)
• **P** - **P**artially related (16% to 50%)
• **W** - **W**eakly related (1% to 15%)
• - Non-related (0%)

CMMI column acronyms: CAR = Causal Analysis and Resolution; CM = Configuration Management; DAR = Decision Analysis and Resolution; MA = Measurement and Analysis; OID = Organizational Innovation and Deployment; OPF = Organizational Process Focus; OPP = Organizational Process Performance; OT = Organizational Training; PMC = Project Monitoring and Control; PP = Project Planning; PPQA = Process and Product Quality Assurance; QPM = Quantitative Project Management; REQM = Requirements Management; RSKM = Risk Management; IPM+IPPD = Integrated Project Management +IPPD; OPD+IPPD = Organizational Process Definition +IPPD; PI = Product Integration; RD = Requirements Development; SAM = Supplier Agreement Management; TS = Technical Solution; VAL = Validation; VER = Verification.

| ISO/IEC 12207:2008 process | CAR | CM | DAR | MA | OID | OPF | OPP | OT | PMC | PP | PPQA | QPM | REQM | RSKM | IPM+IPPD | OPD+IPPD | PI | RD | SAM | TS | VAL | VER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **System context process** | | | | | | | | | | | | | | | | | | | | | | |
| *Agreement processes (2 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 6.1.1 Acquisition process | | | | | | | | | | | | | | | | | | | S | | | |
| 6.1.2 Supply process | | | | | | | | | | | | | | | | | | | | | W | |
| *Organizational Project-Enabling Processes (5 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 6.2.1 Life Cycle Model Management Process | L | | | W | P | | | | | | | | | | W | P | | | | | | |
| 6.2.2 Infrastructure Management Process | | | | | | | | | W | | | | | | | | | | | | | |
| 6.2.3 Project Portfolio Management Process | | | | | | | | | P | | | | | | W | | | | | | | |
| 6.2.4 Human Resource Management Process | | | | | | | | S | W | | | | | | P | W | | | | | | |
| 6.2.5 Quality Management Process | | | | | | | | | | | P | | | | | | | | | | | |
| *Project processes (7 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 6.3.1 Project Planning Process | | | | | | | | | | L | P | | | | W | | | | | | | |
| 6.3.2 Project Assessment and Control Process | L | | | | | | | | L | P | | | | | W | W | | | | | | |
| 6.3.3 Decision Management Process | | | P | | | | | | | | | | | | | | | | | | | |
| 6.3.4 Risk Management Process | | | | | | | | | W | W | | | | S | | | | | | | | |
| 6.3.5 Configuration Management Process | | S | | | | | | | | | | | | | | | | | | | | |
| 6.3.6 Information Management Process | | | | | | | | | W | | | | | | | | | | | | | |
| 6.3.7 Measurement Process | | | | S | | | | | | | | | | | | | | | | | | |
| *Technical processes (11 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 6.4.1 Stakeholder Requirements Definition Process | | | | | | | | | | | | | P | | | | | P | | | | |
| 6.4.2 System Requirements Analysis Process | | | | | | | | | | | | | L | | | | | P | | | | |
| 6.4.3 System Architectural Design Process | | | | | | | | | | | | | P | | | | | P | | | | |
| 6.4.4 Implementation Process | | | | | | | | | | | | | | | | | | | | | | |
| 6.4.5 System Integration Process | | | | | | | | | | | | | | | | | P | | | | | |
| 6.4.6 System Qualification Testing Process | | | | | | | | | | | | | | | | | P | | | | | |
| 6.4.7 Software Installation Process | | | | | | | | | | | | | | | | | | | | | | |
| 6.4.8 Software Acceptance Support Process | | | | | | | | | | | | | | | | | | | | | | |
| 6.4.9 Software Operation Process | | | | | | | | | | | | | | | | | | | | | | |
| 6.4.10 Software Maintenance Process | | | | | | | | | | | | | | | | | | | | | | |
| 6.4.11 Software Disposal Process | | | | | | | | | | | | | | | | | | | | | | |
| **Software specific process** | | | | | | | | | | | | | | | | | | | | | | |
| *Software Implementation Processes (7 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 7.1.1 Software Implementation Process | | P | | | | | | | | | | | | | | | | | | | | |
| 7.1.2 Software Requirements Analysis Process | | | | | | | | | | | | | L | | | | | P | | | | |
| 7.1.3 Software Architectural Design Process | | | | | | | | | | | | | | | | | | P | | P | | |
| 7.1.4 Software Detailed Design Process | | | | | | | | | | | | | | | | | | | | P | | |
| 7.1.5 Software Construction Process | | | | | | | | | | | | | | | | | | | W | P | | |
| 7.1.6 Software Integration Process | | | | | | | | | | | | | | | | | P | | | | | |
| 7.1.7 Software Qualification Testing Process | | | | | | | | | | | | | | | | | P | | | | | |
| *Software Support Processes (8 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 7.2.1 Software Documentation Management Process | | | | | | | | | | | | | | | | | | P | | | | |
| 7.2.2 Software Configuration Management Process | | S | | | | | | | | | | | | | | | | | | | | |
| 7.2.3 Software Quality Assurance Process | | | | | | | | | | | S | | | | | | | | | | | |
| 7.2.4 Software Verification Process | | | | | | | | | | | | | | | | | | | | | | P |
| 7.2.5 Software Validation Process | | | | | | | | | | | | | | | | | | | | | L | |
| 7.2.6 Software Review Process | W | | | | | | | | P | | S | | | | | | | | W | | | P |
| 7.2.7 Software Audit Process | | | | | | | | | | | | | | | | | | | | | | |
| 7.2.8 Software Problem Resolution Process | L | | | | | | | | | | | | | | | | | | | | | |
| *Software reuse processes (3 processes)* | | | | | | | | | | | | | | | | | | | | | | |
| 7.3.1 Domain Engineering Process | | | | | | | | | | | | | | | | | | | | | | |
| 7.3.2 Reuse Asset Management Process | | | | | | | | | | | | | | | | W | | | | | | |
| 7.3.3 Reuse Program Management Process | | | | | | | | | | | | | | | | | | | | | | |

## 4. MATCHING PROCESSES OF ISO 15504-5 AND ISO 12207:2008

The processes listed in each maturity level of the organizational maturity model described in the Appendix A of ISO 15504-7 are identified through their names and acronyms from ISO 15504-5. We bare this aspect in mind and in order to use the mapping between ISO 12207:08 and CMMI-DEV described in the previous section, we carried out a matching of the processes of ISO 15504-5

(described on the first three maturity levels of ISO 15504-7) and ISO 12207:2008 (see Table IV). The goal was to establish a correspondence between the ISO 15504-5 processes and the ISO 12207:08 ones to which they are related. To perform the matching, we analyzed the descriptions of the processes and then established the correspondence.

## 5.  CONNECTING MATURITY LEVELS OF ISO/IEC 15504-7 AND CMMI-DEV V1.2

We have used the mapping ISO 12207:08 and CMMI-DEV and the matching of ISO 15504-5 and ISO 12207:2008 processes introduced above to determine the degree of coverage (from the viewpoint of the process dimension) of the maturity levels of CMMI-DEV, taking into account the first three maturity levels proposed in Appendix A of ISO 15504-7. The degree of coverage indicates the extent to which a process set of ISO 12207:08 (or ISO 15504-5) supports, addresses or has connection with a process area of CMMI-DEV; this expresses a many-to-one relationship. This coverage degree is determined only from the viewpoint of the process dimension; that is, to fix this value we considered only the specific practices from CMMI-DEV and the activities and tasks from ISO 12207:08 (we did not consider either the generic goals or the process attributes). The degree of coverage is expressed in the same scale defined for the mapping.

Table IV. Correspondence between processes of ISO/IEC 15 504-5 and ISO/IEC 12207:2008.

| Processes ISO/IEC 15 504-6 | Processes ISO/IEC 12 207:2008 |
|---|---|
| ACQ.3 Contract agreement | |
| ACQ.4 Supplier monitoring (9) | 6.1.1 Acquisition process |
| ACQ.5 Customer acceptance (10) | |
| SPL.2 Product Release (1) | 6.1.2 Supply Process |
| SPL.3 Product acceptance support | 6.4.8 Sofware Acceptaance Support Process |
| ENG.1 Requirements elicitation | 6.4.1 Stakeholder Requirements Definition Process |
| ENG.2 System requirements analysis | 6.4.2 System Requirements Analysis Process |
| ENG.3 System architectural design | 6.4.3 System Architectural Design Process |
| ENG.4 Software requirements analysis | 7.1.2 Software Requirements Analysis Process |
| ENG.5 Software design | 7.1.3 Software Architectural Design Process |
| | 7.1.4 Software Detailed Design Process |
| ENG.6 Software construction | 7.1.5 Software Construction Process |
| ENG.7 Software integration | 7.1.6 Software Integration Process |
| ENG.8 Software testing | 7.1.7 Software Qualification Testing Process |
| ENG.9 System integration | 6.4.5 System Integration Process |
| ENG.10 System testing | 6.4.6 System Qualification Testing Process |
| ENG.11 Software installation | 6.4.6 Software Installation Process |
| ENG.12 Software and system maintenance | 6.4.10 Software Maintenance Process |
| MAN.2 Organizational Management (12) | |
| MAN.3 Project management | 6.3.1 Project Planning Process |
| | 6.3.2 Project Assessment and Control Process |
| MAN.4 Quality Management | 6.2.5 Quality Management Process |
| MAN.5 Risk management | 6.3.4 Risk Management Process |
| MAN.6 Measurement | 6.3.7 Measurement Process |
| PIM.1 Process Establishment (2) | |
| PIM.2 Process Assessment (3) | 6.2.1 Life Cycle Model Management Process |

Table IV. *Continued.*

| Processes ISO/IEC 15 504-6 | Processes ISO/IEC 12 207:2008 |
| --- | --- |
| PIM.3 Process Improvement (4) | |
| RIN.1 Human Resource Management (5) | |
| Rin.2 Training (6) | 6.2.4 Human Resource Management Process |
| RIN.3 Knowledge Management (7) | |
| RIN.4 Infrastructure | 6.2.2 Infrastructure Management Process |
| REU.1 Asset Management (7) | 7.3.2 Reuse Asset Management Process |
| REU.2 Reuse Program Management | 7.3.3 Reuse Program Management Process |
| REU.3 Domain Engineering | 7.3.1 Domain Engineering Process |
| SUP.1 Qualty assurance | 7.2.3 Software Quality Assurance Process |
| SUP.2 Verification | 7.2.4 Software Verification Process |
| SUP.3 Validation | 7.2.5 Software Validation Process |
| SUP.4 Joint review | 7.2.6 Software Review Process |
| SUP.5 Audit | 7.2.7 Software Audit process |
| SUP.7 Documentation | 7.2.1 Software Documentation Management Process |
| SUP.8 Configuration management | 7.2.2 Software Configuration Management Process |
| SUP.9 Problem resolution management | 7.2.8 Software Problem Resolution Process |
| SUP.10 Change request management (11) | |

(8) The process ACQ.3 is directly related to the activity 6.1.1.3.4 of Acquisition process.
(9) The process ACQ.4 is directly related to the activity 6.1.1.3.5 of Acquisition process.
(10) The process ACQ.5 is directly related to the activity 6.1.1.3.6 of Acquisition process.
(11) According to ISO/ IEC 12 207:2008 the Software Problem Resolution Process could be used or easily adapted to manage, track and control software change requests.
(12) The process MAN.2 is not supported by any process of IS/IEC 12 207:2008 According to Annex B of ISO/IEC 12 207:2008.
(1) The process SPL.2 can replace the activity 6.1.2.3.5 of the Supply Process.
(2) The process PIM.1 can replace the activity 6.2.1.3.1 of the Life Cycle Model Management Process.
(3) The process PIM.2 can replace the activity 6.2.1.3.2 of the Life Cycle Model Management Process.
(4) The process PIM.3 can replace the activity 6.2.1.3.3 of the Life Cycle Model Management Process.
(5) The process RIN.1 can replace the activity 6.2.4.3.3 of the Human Resource Management Process.
(6) The process RIN.2 can replace the activity 6.2.4.3.2 of the Human Resource Management Process.
(7) The process RIN.3 can replace the activity 6.2.4.3.4 of the Human Resource Management Process.

We analyzed the correspondence (see Table IV) and the outcomes of the mapping (see Table III), aiming to determine the degree of coverage of the maturity levels of CMMI-DEV through the maturity levels of ISO 15504-7. The purpose is to understand the extent to which the processes defined in the first three maturity levels of ISO 15504-7 cover the process areas and their corresponding maturity levels of CMMI-DEV. We have established the level of coverage of each maturity level of ISO 15504-7 in detail, but in the following sub-section we present only the analysis on the process set of maturity level 1 and then give a general idea of the three maturity levels. An overview of the level of coverage of the process set of maturity levels 2 and 3 is shown in Appendices A and B, respectively. Furthermore, a detailed view of each maturity level is discussed in Pino (2009).

### 5.1.   Coverage of CMMI-DEV by the maturity level 1 of ISO/IEC 15504-7

The maturity level 1 process set proposed by ISO 15504-7 is: ENG.1 Requirements elicitation, ENG.2 System requirements analysis, ENG.3 System architectural design, ENG.4 Software

Table V. Coverage of CMMI-DEV v1.2 by maturity level 1 of ISO/IEV 15504-7.

| | | | CMMI-DEV | | | |
|---|---|---|---|---|---|---|
| | | **Level** | **2** | **3** | **3** | **3** |
| | | | REQUIREMENTS MANAGEMENT | REQUIREMENTS DEVELOPMENT | TECHNICAL SOLUTION | PRODUCT INTEGRATION |
| | | **Degree of coverage** | S | L | L | L |
| Org. Maturity Model 15504-7 | | ISO/IEC 12207:2007 | | | | |
| | ENG.1 Requirements elicitation | 6.4.1 Stakeholder Requirements Definition Process | P (2 of 5) | P (4 of 10) | | |
| | ENG.2 System requirements analysis | 6.4.2 System Requirements Analysis Process | L (4 of 5) | P (2 of 10) | | |
| | ENG.3 System architectural design | 6.4.3 System Architectural Design Process | P (2 of 5) | P (2 of 10) | | |
| | ENG.4 Software requirements analysis | 7.1.2 Software Requirements Analysis Process | L (3 of 5) | P (3 of 10) | | |
| | ENG.5 Software design | 7.1.3 Software Architectural Design Process | | P (2 of 10) | P (4 of 8) | |
| | | 7.1.4 Software Detailed Design Process | | | P (4 of 8) | |
| | ENG.6 Software construction | 7.1.5 Software Construction Process | | | P (2 of 8) | W (1 of 9) |
| | ENG.7 Software integration | 7.1.6 Software Integration Process | | | | P (3 of 9) |
| | ENG.8 Software testing | 7.1.7 Software Qualification Testing Process | | | | P (2 of 9) |
| | ENG.9 System integration | 6.4.5 System Integration Process | | | | P (3 of 9) |
| | ENG.10 System testing | 6.4.6 System Qualification Testing Process | | | | P (2 of 9) |
| | ENG.11 Software installation | 6.4.7 Software Installation Process | | | | |
| | ENG.12 Software and system maintenance | 6.4.10 Software Maintenance Process | | | | |
| | SPL.2 Product Release | 6.1.2 Supply Process | | | | |

( X of Y) X=Number of specific practices addressed by the processes of ISO/IEC 12207 and Y=Total number of specific practices defined in that process area

requirements analysis, ENG.5 Software design, ENG.6 Software construction, ENG.7 Software integration, ENG.8 Software testing, ENG.9 System integration, ENG.10 System testing, ENG.11 Software installation, ENG.12 Software and system maintenance and SPL.2 Product Release.

The degree of coverage of the process areas of CMMI-DEV in relation to the process set of maturity level 1 of ISO 15504-7 listed above is presented in Table V. In this table, it is important to underline that the 6.1.2 Supply process is not linked with Technical Solution (as in Table III), because according to Table IV, the process SPL.2 Product Release can only replace the activity 6.1.2.3.5 Product/Service delivery and support of the 6.1.2 Supply process, and this activity does not address any of the specific practices of Technical Solution.

From Table V we draw attention to the fact that the processes of maturity level 1 of ISO 15504-7 are addressed in some form: (i) only one of the 7 process areas of CMMI-DEV level 2 and (ii) 3 of the 11 process areas of CMMI-DEV level 3.

The specific practices of CMMI-DEV level 2 not addressed by the processes of the maturity level 1 of ISO 15504-7 are described below:

- No specific practice of the following process areas is explicitly addressed: Configuration Management (CM), Measurement and Analysis (MA), Project Monitoring and Control (PMC), Project Planning (PP), Process and Product Quality Assurance (PPQA) and Supplier Agreement Management (SAM).
- On the other hand, all the specific practices of Requirements Management (REQM) are addressed in some form.

The specific practices of CMMI-DEV level 3 not addressed by the processes of the maturity level 1 of ISO 15504-7 are described below:

- No specific practice of the following process areas is explicitly dealt with: Decision Analysis and Resolution (DAR), Integrated Project Management+IPPD (IPM+IPPD), Organizational

Process Definition+IPPD(OPD+IPPD), Organizational Process Focus (OPF), Organizational Training (OT), Risk Management (RSKM), Validation (VAL) and Verification (VER).

- Regarding Product Integration (PI), the following specific practices are not explicitly addressed: SP 1.1 Determine integration sequence, SP 1.2 Establish the product integration environment, SP 2.1 Review interface descriptions for completeness and SP 2.2 Man age interfaces.
- Regarding Technical Solution (TS), the following specific practices are not explicitly dealt with: SP 1.1 Develop alternative solutions and selection criteria, SP 1.2 Select product component solutions and SP 2.4 Perform make, buy, or reuse analyses.
- With respect to Requirements Development (RD), the following specific practices are not explicitly addressed: SP 3.2 Establish a definition of required functionality and SP 3.4 Analyze requirements to achieve balance.

### 5.2.   Overview of the coverage of CMMI-DEV by the maturity levels 1,2 and 3 of ISO/IEC 15504-7

The degree of coverage of the process areas of CMMI-DEV by the processes set of maturity levels 1, 2 and 3 of ISO 15504-7 is presented in Table VI.

The specific practices of the process areas of CMMI-DEV levels 2 and 3 not addressed by the processes of the maturity levels 1, 2 and 3 of ISO 15504-7 are described next.

Regarding maturity level 2 of CMMI, the following specific practices (SP) are not addressed:

- SP 2.3 of Measurement and Analysis (MA).
- SP 1.2, SP 2.3, SP 2.6, SP 3.1 and SP 3.2 of Project Planning (PP).
- SP 1.1, SP 1.2 and SP 2.5 of Supplier Agreement Management (SAM).

As far as maturity level 3 of CMMI-DEV is concerned, the following specific practices (SP) are not dealt with:

- SP 1.2 of Verification (VER).
- SP 1.2 of Validation (VAL).
- SP 3.2 and SP 3.4 of Requirements Development (RD).
- SP 1.1, SP 1.2, SP 2.1, SP 2.3, SP 2.4 and SP 3.1 of Technical Solution (TS).
- SP 1.1, SP 1.2, SP 2.1 and SP 2.2 of Product Integration (PI).
- SP 1.3, SP 1.6, SP 2.1, SP 2.2 and SP 2.3 of Organizational Process Definition+IPPD(OPD+IPPD).
- SP 2.1, SP 2.2, SP 3.4, SP 3.2, SP 3.3 and SP 3.1 of Organizational Process Focus (OPF).
- SP 1.2, SP 1.3, SP 1.4, SP 2.1, SP 2.2, SP 2.3, SP 3.3, SP 3.4 and SP 3.5 of Integrated Project Management+IPPD(IPM+IPPD).
- All specific practices of the process areas Decision Analysis and Resolution (DAR).

Table VI shows that one process area of the maturity level 4 and two process areas of the maturity level 5 of CMMI-DEV are addressed, in some form, by the processes proposed by the maturity levels 1, 2 and 3 of ISO 15504-7. It should be noted that the process area Causal Analysis and Resolution (CAR) is dealt with intensively by several processes (PIM.2 Process assessment, PIM.3

Table VI. Overview of the coverage of CMMI-DEV v1.2 in relation to the maturity levels 1, 2 and 3 of ISO/IEC 15504-7.

| Process areas (CMMI-DEV) | Configuration Management | Project Monitoring and Control | Process and Product Quality Assurance | Requirements Management | Measurement and Analysis | Project Planning | Supplier Agreement Management | Risk Management | Organizational Training | Verification | Requirements Development | Technical Solution | Product Integration | Validation | Organizational Process Definition + IPPD | Integrated Project Management+IPPD | Organizational Process Focus | Quantitative Project Management | Causal Analysis and Resolution | Organizational Innovation and Deployment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Level** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 5 | 5 |
| **Degre of coverage** | S | S | S | S | S | L | L | S | S | S | L | L | L | L | P | P | P | P | S | W |
| **Org. Maturity Model 15504-7** | | | | | | | | | | | | | | | | | | | | |
| *Level 3 Process Set* | | | | | | | | | | | | | | | | | | | | |
| RIN.1 Human Resource Management | | | | | | | | | P | | | | | | | | | | | |
| RIN.2 Training | | | | | | | W | | L | | | | | | | | | | | |
| RIN.3 Knowledge Management | | | | | | | | | W | | | | | | W | W | | | | |
| RIN.4 Infrastructure | | | | | W | | | | | | | | | | | | | | | |
| PIM.1 Process Establishment | | | | | | | | | | | | | | | P | W | W | | | |
| PIM.2 Process Assessment | | | | | | | | | | | | | | | | | W | | P | |
| PIM.3 Process Improvement | | | | | | | | | | | | | | | | | W | | L | W |
| MAN.2 Organizational Management | | | | | | | | | | | | | | | | | | | | |
| MAN.4 Quality Management | | | | | | | | | | | | | | | | | | P | | |
| MAN.6 Measurement | | | | | S | | | | | | | | | | W | | | | | |
| SUP.5 Audit | | | | | | | | | | | | | | | | | | | | |
| REU.1 Asset Management | | | | | | | | | | | | | | | P | | | | | |
| REU.2 Reuse Program Management | | | | | | | | | | | | | | | | | | | | |
| REU.3 Domain Engineering | | | | | | | | | | | | | | | | | | | | |
| *Level 2 Process Set* | | | | | | | | | | | | | | | | | | | | |
| SUP.1 Quality assurance | | | S | | | | | | | | | | | | | | | | | |
| SUP.2 Verification | | | | | | | | | | P | | | | | | | | | | |
| SUP.3 Validation | | | | | | | | | | | | | | L | | | | | | |
| SUP.4 Joint review | W | P | S | | | | W | | | P | | | | | | | | | | |
| SUP.7 Documentation | | | | | | | | | | | | P | | | | | | | | |
| SUP.8 Configuration management | S | | | | | | | | | | | | | | | | | | | |
| SUP.9 Problem resolution management | | | | | | | | | | | | | | | | | | | | |
| SUP.10 Change request management | | | | | | | | | | | | | | | | | | | L | |
| MAN.3 Project management | | L | P | P | | L | W | | | | | | | | | W | | | L | |
| MAN.5 Risk management | | W | | | | W | | S | | | | | | | | | | | | |
| ACQ.3 Contract agreement | | | | | | | W | | | | | | | | | | | | | |
| ACQ.4 Supplier monitoring | | | | | | | P | | | | | | | | | | | | | |
| ACQ.5 Customer acceptance | | | | | | | W | | | | | | | | | | | | | |
| SPL.3 Product acceptance support | | | | | | | | | | | | | | | | | | | | |
| *Level 1 Process Set* | | | | | | | | | | | | | | | | | | | | |
| ENG.1 Requirements elicitation | | | | P | | | | | | | P | | | | | | | | | |
| ENG.2 System requirements analysis | | | | L | | | | | | | P | | | | | | | | | |
| ENG.3 System architectural design | | | | P | | | | | | | P | | | | | | | | | |
| ENG.4 Software requirements analysis | | | | L | | | | | | | P | | | | | | | | | |
| ENG.5 Software design | | | | | | | | | | | P | P | | | | | | | | |
| ENG.6 Software construction | | | | | | | | | | | | P | W | | | | | | | |
| ENG.7 Software integration | | | | | | | | | | | | | P | | | | | | | |
| ENG.8 Software testing | | | | | | | | | | | | | P | | | | | | | |
| ENG.9 System integration | | | | | | | | | | | | | P | | | | | | | |
| ENG.10 System testing | | | | | | | | | | | | | P | | | | | | | |
| ENG.11 Software installation | | | | | | | | | | | | | | | | | | | | |
| ENG.12 Software and system maintenance | | | | | | | | | | | | | | | | | | | | |
| SPL.2 Product Release | | | | | | | | | | | | | | | | | | | | |

Process improvement, SUP.9 Problem resolution management, SUP.10 Change request management and MAN.3 Project management).

## 6. CONCLUSIONS

In this article, we have presented a harmonizing of the maturity levels described in CMMI-DEV and in Appendix A of ISO 15504-7 by establishing a relationship between these levels. This relationship was based on the strategies of mapping and matching used to harmonize other improvement technologies. In this sense, we carried out two works of harmonization initially: the first one was a mapping between processes of ISO 12207:08 and process areas of CMMI-DEV, and the second one was a matching between processes of ISO 12207:08 and ISO 15504-5 (both related to the process dimension). These three works of harmonization carried out in the context of organizational maturity models and the process reference models can help an organization to: (i) understand both the differentiating and the overlapping features of these improvement models (Siviy and Kirwan 2008) and (ii) determine and understand which of these improvement models can support the organizational mission (Siviy and Kirwan 2008).

We have taken into account the following considerations to carry out the mapping between ISO 12207:08 and CMMI-DEV: (i) refer to the latest versions of the models, (ii) carry out the mapping at a low level of abstraction and (iii) guide the mapping through a well-defined process. Regarding the process for mapping, following this process has helped us to organize and manage the work performed for the mapping, with the aim of reducing the two types of error in the comparisons described in Yoo *et al.* (2006). Furthermore, following an iterative and incremental procedure to perform the mapping brought some advantages:

- The performing of the mapping starts with a process area to reduce the complexity and scope of each iteration.
- Each iteration of the mapping is short and provides feedback for the next iteration.
- There is an integration of the results of each iteration into the final report.
- With the design of the mapping, the iterations can be carried out both independently and in parallel.
- The complexity of each iteration is easier to manage.

Taking into account the processes of ISO 12207:08 and their relationship with process areas of CMMI-DEV, we can observe that there is a: (i) strong coverage of CM, MA, PMC, PPQA, REQM, SAM, OT, RSKM, VER and CAR; (ii) large coverage of PP, PI, RD, TS and VAL; (iii) partial coverage of DAR, IPM+IPPD, OPD+IPPD, OPF and QPM and (iv) weak coverage of OID and OPP. It is important to highlight that a strong degree of coverage (or relationship) does not mean that a process area of CMMI-DEV is satisfied. It only indicates that most of the specific practices of this process area are connected to the processes of ISO 12207:08 (or ISO 15504-5). In order to determine the degree of implementation of a specific practice from the processes of ISO 12207:08, it is necessary to conduct a detailed analysis of the degrees of coverage (or relationship) presented in this article.

There is no one-to-one relationship as far as maturity levels are concerned. In other words, the processes of a maturity level of ISO 15504-7 cover several process areas that belong to different maturity levels of CMMI.

# APPENDIX A: Coverage of CMMI-DEV v1.2 by the maturity level 2 of ISO/IEC 15504-7

| Org. Maturity Model 15504-7 / ISO/IEC 12207:2007 | Configuration Management | Process and Product Quality Assurance | Project Monitoring and Control | Supplier Agreement Management | Project Planning | Requirements Management | Risk Management | Verification | Validation | Technical Solution | Integrated Project Management+IPPD | Causal Analysis and Resolution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Level** | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 5 |
| **Degree of coverage** | S | S | S | L | L | P | S | S | L | P | W | L |
| SUP.1 Quality assurance — 7.2.3 Software Quality Assurance Process |  | S (4 of 4) |  |  |  |  |  |  |  |  |  |  |
| SUP.2 Verification — 7.2.4 Software Verification Process |  | S (4 of 4) | P (2 of 10) | W (1 of 8) |  |  |  | P (4 of 8) |  |  |  |  |
| SUP.3 Validation — 7.2.5 Software Validation Process |  |  |  |  |  |  |  |  | L (4 of 5) |  |  |  |
| SUP.4 Joint review — 7.2.6 Software Review Process | W (1 of 7) |  |  |  |  |  |  | P (3 of 8) |  |  |  |  |
| SUP.7 Documentation — 7.2.1 Software Documentation Management Process |  |  |  |  |  |  |  |  |  | P (2 of 8) |  |  |
| SUP.8 Configuration management — 7.2.2 Software Configuration Management Process | S (7 of 7) |  |  |  |  |  |  |  |  |  |  |  |
| SUP.9 Problem resolution management — 7.2.8 Software Problem Resolution Process |  |  |  |  |  |  |  |  |  |  |  |  |
| SUP.10 Change request management |  |  |  |  |  |  |  |  |  |  |  |  |
| MAN.3 Project management — 6.3.1 Project Planning Process |  |  |  |  | L (9 of 14) | P (1 of 5) |  |  |  |  | W (1 of 14) |  |
| 6.3.2 Project Assessment and Control Process |  | P (1 of 4) | L (8 of 10) |  |  |  | W (1 of 7) |  |  |  | W (1 of 14) | L (3 of 5) |
| MAN.5 Risk management — 6.3.4 Risk Management Process |  |  | W (1 of 10) |  | W (1 of 14) |  | S (7 of 7) |  |  |  | W (1 of 14) | L (4 of 5) |
| ACQ.3 Contract agreement — 6.1.1 Acquisition process |  |  |  | L (5 of 8) |  |  |  |  |  |  |  |  |
| ACQ.4 Supplier monitoring |  |  |  |  |  |  |  |  |  |  |  |  |
| ACQ.5 Customer acceptance |  |  |  |  |  |  |  |  |  |  |  |  |
| SPL.3 Product acceptance support — 6.4.8 Software Acceptance Support Process |  |  |  |  |  |  |  |  |  |  |  |  |

*Level 2 Process Set*

## Appendix B: Coverage of CMMI-DEV v1.2 by the maturity level 3 of ISO/IEC 15504-7

| Org. Maturity Model 15504-7 | ISO/IEC 12207:2007 | Degree of coverage | M&A (L2) S | PROJECT PLANNING (L2) W | ORGANIZATIONAL TRAINING (L3) S | ORG. PROCESS DEFINITION + IPPD (L3) P | ORG. PROCESS FOCUS (L3) P | INTEGRATED PROJECT MANAGEMENT + IPPD (L3) P | QUANTITATIVE PROJECT MANAGEMENT (L4) P | CAUSAL ANALYSIS AND RESOLUTION (L5) L | ORGANIZATIONAL INNOVATION AND DEPLOYMENT (L5) W |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RIN.1 Human Resource Management | 6.2.4 Human Resource Management Process | | | W (1 of 14) | S (7 of 7) | W (1 of 9) | | W (3 of 14) | | | |
| RIN.2 Training | | | | | | | | | | | |
| RIN.3 Knowledge Management | | | | | | | | | | | |
| RIN.4 Infrastructure | 6.2.2 Infrastructure Management Process | | | W (1 of 14) | | | | | | | |
| PIM.1 Process Establishment | 6.2.1 Life Cycle Model Management Process | | | | | P (2 of 9) | P (3 of 9) | W (1 of 14) | | L (4 of 5) | W (1 of 7) |
| PIM.2 Process Assessment | | | | | | | | | | | |
| PIM.3 Process Improvement | | | | | | | | | | | |
| MAN.2 Organizational Management * | | | | | | | | | | | |
| MAN.4 Quality Management | 6.2.5 Quality Management Process | | | | | W (1 of 9) | | | P (2 of 8) | | |
| MAN.6 Measurement | 6.3.7 Measurement Process | S (7 of 8) | | | | | | | | | |
| SUP.5 Audit | 7.2.7 Software Audit Process | | | | | | | | | | |
| REU.1 Asset Management | 7.3.2 Reuse Asset Management Process | | | | | W (1 of 9) | | | | | |
| REU.2 Reuse Program Management | 7.3.3 Reuse Program Management Process | | | | | | | | | | |
| REU.3 Domain Engineering | 7.3.1 Domain Engineering Process | | | | | | | | | | |

* This process has no direct support from the group life cycle process of ISO / IEC 12207:2008. We have carried out the comparison with CMMI-DEV and we did not find that there support appeared for any specific practice. This can also be observed in the comparison set out in [16].

## ACKNOWLEDGEMENTS

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