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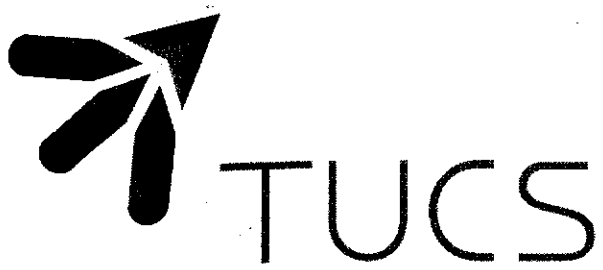

Terry Rout | Ivan Porres | Risto Nevalainen
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Software Process Improvement and Capability Determination

9th International Conference

SPICE 2009

Turku, Finland, June 2009

Proceedings

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TUCS General Publication
No 54, May 2009

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Editors:

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PREFACE

The SPICE Project was formed in 1993 to support the development of an international standard for software process assessment. The work of the project has led eventually to the finalisation of ISO/IEC 15504 – Process Assessment, and its complete publication represented a climax for the work of the project. As part of its charter to provide ongoing publicity and transition support for the emerging standard, the Project organised a number of SPICE Workshops and Seminars, with invited speakers drawn from project participants.

These have now evolved to a sustaining set of international conferences with broad participation from academics and industry with a common interest in model-based process improvement. This is the ninth in the series of Conferences organised by the SPICE Users Group to increase knowledge and understanding of the International Standard, and of the technique of process assessment.

The papers provided in these proceedings fall into two classes. A series of short reports and industry experience reports were submitted. Extended abstracts and in some instances, full papers of these submissions are included in these Proceedings. The technical research papers were selected for presentation following peer review by members of the program committee. The conference program also includes four keynote presentations, some invited papers, a workshop session and a number of tutorials.

We wish to thank the members of the Steering Committee, and in particular Timo Varkoi, the co-chair (Tutorials), and the other members of the local Organising Committee, who carried the load of most of the local liaison and organisation. Our thanks are also due to the sponsors of the event, without whom the conference would not have been possible. We also thank the members of the Program Committee. Finally, our thanks go to all those contributors whose involvement has resulted in a high quality contribution to the state of knowledge.

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SPICE 2009

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Relationship between maturity levels of ISO/IEC 15504-7 and CMMI-DEV v1.2

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Abstract

With the objective of determining the extent to which an organization consistently implements processes that contribute to achievement of its business goals, the ISO has recently published Part 7 of the ISO/IEC 15504 standard. This allows organizations to be assessed by maturity levels like the CMMI-DEV model. In this paper we present the relationship between the CMMI-DEV and ISO/IEC 15504-7 models with the aim of identifying the degree of coverage of the CMMI-DEV maturity levels in relation to the ISO/IEC 15504-7. This relationship is based on a comparison that we have carried out between the process areas of CMMI-DEV and the processes described by the latest version of ISO/IEC 12207:2008.

1. Introduction

Emphasis on process provides the main justification for many standardisation initiatives, as well as for the efforts to measure organizational maturity [1], like the CMMI-DEV v1.2 (hereinafter CMMI-DEV) [2] and CMMI–ACQ [3] of the Software Engineering Institute (SEI) and recently the ISO/IEC 15504-7 (hereinafter ISO 15504-7) [4] of the International Organization for Standardization (ISO). 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 15504 by maturity levels (in the same way as the CMMI model does). This assessment allows us to give a rating to the maturity of the organization, based on the process capability. Organizational maturity is intended as: (according to [2]) the extent to which an organization has explicitly and consistently deployed software processes that are documented, managed, measured, controlled, and continuously improved; and (according to [4]) the extent to which an organization consistently implements processes within a defined scope that contributes to achievement of its business goals (current or projected).

In ISO 15504-7 the overall organizational maturity is established, based upon assessed profiles of process capability, and in CMMI the organizational maturity is established, based on the staged representation and measured by 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 [5] (and extended in Part 5 [6]) of this standard, and the base practices are described in the processes presented in ISO/IEC 12207.

With this new organizational maturity model on stage, it is important to have information on how the maturity models described by ISO 15504-7 and CMMI-DEV are related. In this sense, the 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. In [7] a current and detailed mapping between these two process entities of ISO 15504 and CMMI is shown.

- 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. In this paper we present a comparative analysis 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 what the degree of coverage of the maturity levels of CMMI-DEV is, using the maturity levels proposed in Annex A of ISO 15504-7.

Since this comparative analysis involves the processes and process areas described in the maturity levels, we have initially carried out a comparison between the process areas of CMMI-DEV and the processes described by the latest version of ISO/IEC 12207:2008 (hereinafter ISO 12207:08) [8] (process reference model proposed by ISO/IEC 15504). Using this comparison, we have determined what the relationship of the first three maturity levels of ISO 15504-7 is to those described in CMMI-DEV. In this article we also present a detailed comparison of the processes of ISO 12207:08 and the process areas of CMMI-DEV.

The rest of the paper is structured as follows. Section 2 presents related works, and then the comparison between ISO 12207:08 and CMMI-DEV is described. Section 4 presents the relationship between maturity levels of ISO 15504-7 and CMMI-DEV. Lastly conclusions are set out.

2. Related works

Regarding the relationship between maturity levels proposed by ISO 15504-7 and CMMI, there are few relevant pieces of work. That is due to the fact that the ISO 15504-7standard 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 [9].
- 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 [10].
- In [11] 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 [12].
- In [7] 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 are the latest versions of these models involved. Moreover, with the exception of the work presented in [7], the process entities involved in the relationship, comparisons or mappings are of high level abstraction.

With respect to the first comparison between ISO 12207:08 and CMMI-DEV we have followed a well-defined process, which we also used for other comparisons that we have carried out (ISO 12207:08 to CMMI-ACQ [13] and ISO 9001 to CMMI-DEV). We might add that the entities involved in the process of comparison and subsequent 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 comparison at this abstraction level provides information about what activities and tasks outlined in ISO 12207:08 give support to specific practices of CMMI-DEV. 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 to establish 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.

3. Comparison between ISO/IEC 12207:2008 and CMMI-DEV v1.2

After analyzing the differently related pieces of work mentioned in the previous section, we have observed that process areas of CMMI-DEV are closely related to the process reference models described in ISO/IEC 15504-5 (hereinafter ISO 15504-5) [6] and ISO 12207:08 (process dimension). 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 [5] (capability dimension). Based on this analysis, the comparison between ISO 12207:08 and CMMI-DEV (C-12207-CMMI) must be carried out at the level of process dimension.

Activities carried out to perform the comparison between these two models are described in the following. These activities are related to the process that we have defined for the comparison of models. The purpose of this process is to provide a guideline for performing a step-by-step comparison and 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 comparison, along with five tasks: (i) analyzing the models, (ii) designing the comparison, (iii) carrying out the comparison, (iv) presenting the outcomes of the comparison, and (v) analyzing the results of the comparison.

3.1. Analyzing the models

This task involves: (i) acquiring knowledge about the models to compare and (ii) analyzing the structure of these models.

According to [2], 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. As regards 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), specific practices (expected component). A required component describes what an organization must achieve to satisfy a process area, and an expected component describes what an organization may implement to achieve a required component.

On the other hand, according to [8] 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 in 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.

3.2. Designing the comparison

This task involves: (i) fixing the process entities to be compared, based on the research needs, (ii) defining the comparison scale, (iii) fixing the directionality of the comparison, and (iv) defining a template comparison.

This comparison should support comparative analysis from the viewpoint of the relationship of processes set described in the different maturity levels of ISO 15504-7 and CMMI-DEV. The organizational maturity model defined in Annex 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 [6]. 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. This comparison should thus be done at the level of: (i) the entity specific practices for CMMI-DEV and (ii) the entity activity and tasks for ISO 12207:08. The results of the comparison of these process entities were rolled up to the level of Processes of ISO 12207:08 and Process areas of CMMI-DEV.

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 covered by means of the processes of ISO 12207:08. The degree of relationship or coverage is hence expressed only through the discrete scale.

When a comparison involves process entities of low level abstraction it is relevant to define the direction of the comparison. With an early detailed comparison between a process and a process area, an analysis of the degrees of relationship in the comparison was conducted. From this analysis, we conclude that the degree of relationship depends on the direction of the comparison [13]. The direction of this comparison is from ISO 12207:08 to CMMI-DEV. In this sense, the goal is to understand the coverage 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.

3.3. Carrying out the comparison

We have carried out the comparison by means of an iterative and incremental procedure. It is iterative, because the execution (analyze and determine the relationship of the process entities of ISO 12207:08 and CMMI-DEV) of the comparison 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 template comparison (which is the product) grows and evolves with each iteration until it becomes the definitive one. Using this iterative and incremental approach has enabled management of the complexity entailed in a comparison in which entities of low level abstraction are involved.

The roles were assigned; two people as performers of the comparison and two reviewers. At the end of each iteration, the performers carried out a peer review of the results obtained from the comparison of process area of CMMI-DEV under comparison. After that, the reviewers resolved discrepancy between the performers and validated the results of the comparison. Perform these review activities has enabled us to reach a consensus on these results in order to increase the reliability of results obtained in the comparison.

3.4 Presenting the comparison outcomes

Based on the activities to perform the comparison described in the previous section, an overview of the degree of coverage of the CMMI's process areas by the ISO 12007's processes is presented in Table 1. A view of this comparison is presented in detail in [14].

4. Relationship between ISO/IEC 15504-7 and CMMI-DEV v1.2

We have used the comparison outcomes C-12207-CMMI presented in the previous section to determine the degree of coverage of the maturity levels of CMMI-DEV with reference to the first three maturity levels proposed in Annex A of ISO 15504-7. The purpose of this section is analyze the previous comparison outcomes, 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.

The processes listed in each maturity level of the organizational maturity model of ISO 15504-7 are identified through their names and acronyms from ISO 15504-5. In order to use the comparison C-12207-CMMI (see Table 1), we have established a correspondence between the processes described by ISO 15504-5 (related to the maturity levels) and ISO 12207:08 (see Table 2).

Based on this correspondence and on the comparison C-12207-CMMI (see Table 1), the degree of coverage of the maturity levels of CMMI-DEV through the maturity levels of ISO 15504-7 has been worked out. We have determined the level of coverage of each maturity level of ISO 15504-7 in detail, but, as space here is limited, in the following sub-section we present only the analysis on the process set of maturity level 1 and then give an overview of the three maturity levels. A detailed view of each maturity level is discussed in [14].

4.1 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 are: ENG.1 Requirements elicitation, ENG.2 System requirements analysis, ENG.3 System architectural design, ENG.4 Software 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 processes set of maturity level 1 of ISO 15504-7 listed above is presented in Table 3. In Table 3 it is important to underline that the 6.1.2 Supply process is not linked with Technical Solution (as in Table 1), because according to Table 2 the process SPL.2 Product release only can 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 the Table 3 we draw attention to the following points:

- Only one of the seven process areas of CMMI-DEV level 2 is addressed, in some form, by the processes of the maturity level 1 of ISO 15504-7.
- Three of the eleven process areas of CMMI-DEV level 3 are addressed, in some form, by the processes of the maturity level 1 of ISO 15504-7.

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

- 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) y Verification (VER).

Table 1. Overview of the comparison between ISO/IEC 12207:2008 and CMMI-DEV (C)

Direction of the comparison: From ISO/IEC 12207 to CMMI-ACQ
Process entities for the comparison:
- For ISO/IEC 12207: Activities and tasks of the standard's processes.
- For CMMI: specific practices.

Research question:
- What activities and tasks of ISO/IEC 12207 can offer support to specific practices of CMMI?
- What ISO/IEC 12207's activities and tasks are strongly related with the support to CMMI's specific practices?

Comparison goal: To determine which activities and tasks of ISO/IEC 12207 have a close relationship with some specific practice of CMMI. The goal is know which is the degree of fulfilment of the specific practices of CMMI based on the activities and tasks described in ISO/IEC 12207.

Scale of comparison:
- S - Strongly related (86% to 100%)
- L - Largely related (51% to 85%)
- P - Partially related (16% to 50%)
- W - Weakly related (1% to 15%)
- - Non-related (0%)

			CMMI-DEV v1.2																					
			Causal Analysis and Resolution (CAR)	Configuration Management (CM)	Decision Analysis and Resolution (DAR)	Measurement and Analysis (MA)	Organizational Innovation and Deployment (OID)	Organizational Process Focus (OPF)	Organizational Process Performance (OPP)	Organizational Training (OT)	Project Monitoring and Control (PMC)	Project Planning (PP)	Process and Product Quality Assurance (PPQA)	Quantitative Project Management (QPM)	Requirements Management (REQM)	Risk Management (RSKM)	Integrated Project Management +IPPD (IPM+IPPD)	Organizational Process Definition +IPPD (OPD+IPPD)	Product Integration (PI)	Requirements Development (RD)	Supplier Agreement Management (SAM)	Technical Solution (TS)	Validation (VAL)	Verification (VER)
ISO/IEC 12207:2008	System context process	Agreement processes (2 processes)	Acquisition process																		S			
			Supply process																			W		
		Organizational Project-Enabling Processes (5 processes)	Life Cycle Model Management Process	L				W	P								W	P						
			Infrastructure Management Process									W												
			Project Portfolio Management Process								P						W							
			Human Resource Management Process							S		W					P	W						
			Quality Management Process										P											
		Project processes (7 processes)	Project Planning Process								L				P		W							
			Project Assessment and Control Process	L							L	P				W	W							
			Decision Management Process		P																			
			Risk Management Process								W	W				S								
			Configuration Management Process		S																			
			Information Management Process									W												
			Measurement Process				S											W						
		Technical processes (11 processes)	Stakeholder Requirements Definition Process										P						P					
			System Requirements Analysis Process										L						P					
			System Architectural Design Process										P						P					
			Implementation Process																					
			System Integration Process																P					
			System Qualification Testing Process																P					
			Software Installation Process																					
			Software Acceptance Support Process																					
			Software Operation Process																					
			Software Maintenance Process																					
			Software Disposal Process																					
	Software specific process	Software Implementation Processes (7 processes)	Software Implementation Process		P																			
			Software Requirements Analysis Process												L				P					
			Software Architectural Design Process																P		P			
			Software Detailed Design Process																		P			
			Software Construction Process																W		P			
			Software Integration Process																P					
			Software Qualification Testing Process																P					
		Software Support Processes (8 processes)	Software Documentation Management Process																		P			
			Software Configuration Management Process		S																			
			Software Quality Assurance Process										S											
			Software Verification Process																					P
			Software Validation Process																				L	
			Software Review Process		W						P	S									W			P
			Software Audit Process																					
			Software Problem Resolution Process	L																				
		Software reuse processes (3 processes)	Domain Engineering Process																					
			Reuse Asset Management Process															W						
			Reuse Program Management Process																					

- 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 Manage Interfaces.
- As regards 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.

4.2 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 level 1, 2 and 3 of ISO 15504-7 is presented in Table 4.

The specific practices of the process areas of CMMI-DEV level 2 and 3 not addressed by the processes of the maturity level 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).

Table 2. Correspondence between processes of ISO/IEC 15504-5 and ISO/IEC 12207:2008

Processes ISO/IEC 15504-5	Processes ISO/IEC 12207:2008
ACQ.3 Contract agreement (8)	6.1.1 Acquisition process (8)
ACQ.4 Supplier monitoring (9)	
ACQ.5 Customer acceptance (10)	
SPL.2 Product Release (1)	6.1.2 Supply 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	6.4.7 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)	6.2.1 Life Cycle Model Management Process
PIM.2 Process Assessment (3)	
PIM.3 Process Improvement (4)	
RIN.1 Human Resource Management (5)	6.2.4 Human Resource Management Process
RIN.2 Training (6)	
RIN.3 Knowledge Management (7)	
RIN.4 Infrastructure	6.2.2 Infrastructure Management Process
REU.1 Asset Management	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 Quality assurance	7.2.3 Software Quality Assurance Process
SUP.2 Verification	7.2.4 Software Verification 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 12207:2008 the Software Problem Resolution Process could be used or easily adapted to manage, track and control software change requests.
(12) The process MAN.2 isn't supported by any process of ISO/IEC 12207:2008
According to Annex B of ISO/IEC 12207:2008
(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.

Table 3. Coverage of CMMI-DEV v1.2 by the maturity level 1 of ISO/IEC 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				
Level 1 Process Set	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

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 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).

Table 4. Overview of the coverage of CMMI-DEV v1.2 in relation to the maturity levels 1, 2 and 3 of ISO/IEC 15504-7

		CMMI-DEV v1.2																		
	Level	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	5	5
		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	ORGANIZATIONAL PROCESS DEFINITION + IPPD	INTEGRATED PROJECT MANAGEMENT+IPPD	ORGANIZATIONAL PROCESS FOCUS	QUANTITATIVE PROJECT MANAGEMENT	CAUSAL ANALYSIS AND RESOLUTION	ORGANIZATIONAL INNOVATION AND DEPLOYMENT
	Degree of coverage	S	S	S	S	S	L	L	S	S	S	L	L	L	P	P	P	P	S	W
	Org. Maturity Model 15504-7 Annex A																			
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.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		S											
	SUP.4 Joint review	W	P	S				W			P									
	ACQ.3 Contract agreement							W												
	ACQ.4 Supplier monitoring							P												
	ACQ.5 Customer acceptance							W												
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																			

- 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) y Validation (VAL).

Table 4 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.

5. Conclusions

According to [13], comparisons and mapping are among the most widely-used specific strategies for the harmonization of models. In this sense, in this paper we have presented two comparisons in the process dimension: the first one between ISO 12207:08 and CMMI-DEV, and the second one between ISO 15504-7 and CMMI-DEV. A correspondence between the processes of ISO 12207:08 and ISO 15504-5 has also been set out. The comparative analysis carried out in the context of the organizational maturity and the reference processes of these models can support their harmonization and integration.

We have taken into account the following considerations to carry out the first comparison between ISO 12207:08 and CMMI-DEV: (i) refer to the latest versions of the models, (ii) carry out comparison at a low level of abstraction, and (iii) guide the comparison through a well defined method. This comparison has been successfully performed and it is the base on which we have determined the relationship between maturity levels of ISO 15504-7 and CMMI-DEV.

Taking into account the processes of ISO 12207:08 and their relationship with process areas of CMMI-DEV, we can observed 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.

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 which belong to different maturity levels of CMMI.

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Improve the Test Process The SPICE4TEST approach

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Abstract

The paper presents an ISO/IEC 15504 Part 2 conformant test assessment approach. By analyzing the current approaches of ISTQB, TMMI and TPI/TMAP It ,shows that neither ISTQB, TPI® nor TMMI® fulfills the conformance requirements of ISO/IEC 15504 Part 2 and therefore can't easily used in a common and standard based approach for process improvement. Based on that intermediate result the paper outlines a first version of SPICE4TEST. ISO/IEC 15504 Part 5 was used as a starting point for the SPICE4TEST approach for the current version of the model. It describes the overall structure of SPICE4TEST the process categories, the process groups and the processes. In addition the fulfillment of the requirements of ISO/IEC 15504 Part 2 by SPICE4TEST will be shown. The paper also describes some highlights of the development process of SPICE4TEST and the used sources. Finally some crucial challenges for a test assessment approach will be presented.

1. Introduction

SQS Group is a company with approximately 1400 employees and the leading company for providing testing and quality management services since 1982. To ensure the quality of work it was necessary to deal with process models. based on decades of project experience, as well as using the knowledge form SPI-services a specific Test Process Assessment model was developed and internally used. This test process model was aligned to the requirements of ISO 15504 TR 1998. Due to the changes from ISO 15504 TR 1998 to ISO IEC 15504 it was necessary to rework the process model. A core team with experienced test- and quality manager was formed and supported by leading process assessment experts of SQS. The authors of this paper are part of this core team. After a period of evaluation of potential process or process reference models the team decided to stay with the ISO 15504 using Part 5 as starting point for deriving a specific model to assess test processes.

The standard ISO/IEC 15504 was designed for being enhanced by developing specific Process reference models (PRM) and Process assessment models (PAM). In the meantime specific models are available. The best known is the automotive SPICE® developed by the user group in coordination with the automotive domain. Additional parts are published as Technical reports and provides an exemplar system life cycle process assessment model (Part 6) and for assessing organizational maturity (Part 7).

In the test business there are 2 major assessment methods in the market: TPI/TMAP and TMM. Besides there exists different schemes for the education of test professionals like ISTQB, which is recognized as a de facto standard at least in Germany. The ISTQB education scheme implies an own process model that is used e.g. for organizing the test from a test management perspective. Because of this our team decided to judge the ISTQB approach as a topic for the evaluation and as a potential source for test processes. The first question to answer was: Is one or more of these models compliant to ISO/IEC 15504 Part 2, and if not: how should a compliant model look like?

2.2. Conformance Requirements for the Process Assessment Model (PAM)

The PAM shall declare

- the selected PRM(s)
- the selected processes taken from the PRM and the
- capability levels taken from the measurement framework.

It is also required, that the Model describes the mapping between the model and

- the Process Reference Model
- the Measurement Framework

As long as a model for assessing tests will follow these given structure the conformance to ISO/IEC 15504 Part 2 is assured. The SPICE4TEST approach is designed to fulfill these essential preconditions.