Process Maturity Frameworks. Towards a Generic Model

Simon Alexandre and Naji Habra

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Chapter 1

Introduction

1.1 Scope

This technical report presents the methodology used to produce a *Generic Model* of available maturity frameworks such as CMM, SPICE,... Detailed results produced by the different methodology steps could be found in this report.

1.2 Methodology presentation

The proposed methodology contains 7 steps that are described in the following chapters of the report. The 7 steps are:

- Model selection

- Syntactic rewriting

- Semantic enrichment

- Investigating and definition correspondences

- key concepts identification and schema integration

- Relationship definition

- Schema transformation

This methodology has been inspired by [4].

Chapter 2

Model selection

2.1 Introduction

This chapter presents the models selection criteria.

2.2 Selection method

Five models have been selected and modeled in this study: SW-CMM 1.1, Trillium 3.0, ISO/IEC15504-1998 (SPICE), Bootstrap 3.0 and CMMI for software engineering (Staged and Continuous representations) regarding the four following criteria:

1. **Widespread use** *of the model*: this criterion takes into account the use of the model in organizations all over the world. For example, SW-CMM and ISO/IEC 15504 are models widely used among organizations.

2. **Reputation** *of the model*: criterion that examines if a model is known among organization. For example, SW-CMM 1.1 is much more renown than Trillium 3.0.

3. **Specialization** *in a specific domain*: criterion that considers if a model has been developed for a specific domain. For example, Trillium has been specifically designed by and for telecommunication organizations.

4. **Documentation**: this criterion takes into account the quantity and quality of information (model itself, technical reports, papersĚ) available for a given model.

Other selection criteria for selecting and classifying SPI frameworks have been proposed in several studies presented in [3]. The goal of the grid proposed by [3] is to provide selection criteria to choose a given maturity framework for a software process improvement approach. However our goal is different: to select several representative frameworks for the modeling. So selection criteria have been adapted to this goal.

The application of these criteria to the five models is summarized in Table 2.1. When a symbol (✓) appears, it means that the criterion is largely fulfilled. The main objective of this reading grid is not to provide a strict and rigorous

model classification but to emphasize existing differences between those models from the four criteria viewpoint. The characteristics of a one model must be read in relation to others models. For example, Trillium 3.0 and Bootstrap 3.0 are not completely unknown but are less renown than CMM, ISO/IEC15504 and CMMI. So, in that particular case, the "reputation" criterion is not checked.

	CMM 1.1	Trillium 3.0	Iso/Iec 15504	Bootstrap 3.0	CMMI 1.1
Widespread use	✓		✓		✓
Reputation	✓		✓		✓
Specialization		✓			
Documentation	✓	✓	✓		✓

Table 2.1: Selection criteria. Reading Grid.

In the reading grid, Bootstrap 3.0 does not meet the proposed criteria but has been kept in order to apply the modeling methodology to a model for which fewer information were available.

Chapter 3

Syntactic rewriting

3.1 Introduction

Schema of the different selected models have to be expressed in a common notation language. This language should be expressive enough to preserve models information.

3.2 UML Class Diagram

According to the version 1.5 of the OMG-UML specifications [1], a Class Diagram is a *graph of Classifier elements connected by their various static relationships*. A class diagram is a collection of static declarative model elements, such as classes, interfaces, and their relationships, connected as a graph to each other and to their contents. Class diagram is a widely used modeling tool, opened to more people thanks to its success. This permits to underline the structure of a given model. All available class diagram components were not used in this modeling, and only *Class, Attribute, Binary Association, Multiplicity, Generalization* and *Aggregation* have been used.

3.3 Class Diagram of the selected maturity models

All the diagram can be found in [2].

Chapter 4

Semantic enrichment

4.1 Introduction

Schema produced by the previous step can present some semantic lack. So, in the current step, these elements will be identified and defined in a more detailed way. In this step, all attributes of selected concepts should be identified and defined.

4.2 Encountered problems

TBD

Chapter 5

Investigating and definition correspondences

5.1 Introduction

During this step correspondence between concepts will be checked at data and schema levels.

5.2 Data and schema level verification

5.2.1 Data level

Correspondences between instances of classes presents in selected models have to be identified. These correspondences are established through comparisons of instance semantic. Two instances have the same semantic if they describe the same real world element.

5.2.2 Schema level

If the data level verification is positive, generalization (class level) can be done. There are three type of correspondence between concepts:

equivalence

inclusion

intersection

5.3 Analysis grid

This section presents all the analysis grid obtained from selected models.
[Grid Description: TBD]

5.3.1 Class comparisons

5.3.2 Relationship comparisons

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE	PROCESS	Identifier	SUP2	Name	Configuration Management Process	Purpose	The purpose of the Configuration Management process is to establish and maintain the integrity of all the work products of a process or project.		
CMM	KEY PROCESS AREA			Name	Software Configuration Management	Description	The purpose of Requirements Management is to establish a common understanding between the customer and the software project of the customer's requirements that will be addressed by the software project.	Description	
CMMI-Staged	PROCESS AREA			Name	Configuration Management	Purpose	The purpose of Configuration Management is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.	Introductory Notes	The Configuration Management process area involves the following: • Identifying the configuration of selected work products that compose the baselines at given points in time • Controlling changes to configuration items
CMMI-Continu	PROCESS AREA			Name	Configuration Management	Purpose	The purpose of Configuration Management is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.	Introductory Notes	The Configuration Management process area involves the following: • Identifying the configuration of selected work products that compose the baselines at given points in time • Controlling changes to configuration items
TRILLIUM	ROADMAP	Number	6.5	Name	Configuration Management				
BOOTSTRAP	PROCESS	Number	SUP2	Name	Configuration Management				

figure 5.1: Process

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example	Attr 05	Example
SPICE	BASE PRACTICE	Id	SUP.2.BP1	Name	Develop configuration management strategy	Description	Determine configuration management strategy, including configuration management activities and schedule for performing these activities.				
CMM	KEY PRACTICE	Number	activity 2	Name	A SCM plan is prepared for each software project according to a documented procedure.						
CMMI-Staged	SPECIFIC PRACTICE (GENERIC PRACTICE)	Number	SP 1.2	Name	Establish a Configuration Management System	Description	A configuration management system includes the storage media, the procedures, and the tools for accessing the configuration system. A change management system includes the storage media, the procedures, and tools for recording and accessing change requests.	Summary	Establish and maintain a configuration management and change management system for controlling work products.		
CMMI-Continu	SPECIFIC PRACTICE (GENERIC PRACTICE)	Number	SP 1.2-1	Name	Establish a Configuration Management System	Description	A configuration management system includes the storage media, the procedures, and the tools for accessing the configuration system. A change management system includes the storage media, the procedures, and tools for recording and accessing change requests.	Summary	Establish and maintain a configuration management and change management system for controlling work products.		
TRILLIUM	PRACTICE	Id	6.5.2.7	Name	A documented and approved CM plan is used as the basis for performing the CM activities					Reference	[SEI SCM Activity 2] [ISO 9001 4.5.3, 4.8] [ISO 9000-3 6.1.1, 6.1.2, 6.1.3.1, 6.1.3.2] [Bellcore TR-NWT-000179 4.1.3-5] [Trillium]
BOOTSTRAP	PRACTICE			Name							

figure 5.2: Practice

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE									
CMM	GOAL	Number	1	Name	Software configuration management activities are planned				
CMMI-Staged	SPECIFIC GOAL GENERIC GOAL	Number	SG1	Name	Establish Baselines	Summary	Baselines of identified work products are established	Description (SG)	Specific practices to establish baselines are covered by this specific goal. The specific practices under the Track and Control Changes specific goal serve to maintain the baselines.(...)
CMMI-Continu	SPECIFIC GOAL GENERIC GOAL	Number	SG1	Name	Establish Baselines	Summary	Baselines of identified work products are established	Description (SG)	Specific practices to establish baselines are covered by this specific goal. The specific practices under the Track and Control Changes specific goal serve to maintain the baselines.(...)
TRILLIUM									
BOOTSTRAP									

figure 5.3: Goal

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE	WORK PRODUCT	Id	52	Work product class	2.2	Work product type	Requirement specification	Work product characteristic	Each requirement is identified - Each requirement is unique (...)
CMM									
CMMI-Staged									
CMMI-Continu									
TRILLIUM									
BOOTSTRAP									

figure 5.4: Input

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
		Id		**Work product class**		**Work product type**		**Work product characteristic**	
SPICE	**WORK PRODUCT**		91		1.4		Configuration management plan		Defines or references the procedures to control changes to configuration items (...)
CMM									
CMMI-Staged	**TYPICAL WORK PRODUCT**					**Name**	Configuration management system access control procedures		
CMMI-Continu	**TYPICAL WORK PRODUCT**					**Name**	Configuration management system access control procedures		
TRILLIUM									
BOOTSTRAP									

figure 5.5: Output

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE	NA								
CMM	MATURITY LEVEL	Name	Repeatable	Description	At the Repeatable Level, policies for managing a software project and procedures to implement those policies are established. Planning and managing new projects is based on experience with similar projects.(...)	Number	2		
CMMI-Staged	MATURITY LEVEL	Name	Managed	Description	At maturity level 2, an organization has achieved all the specific and generic goals of the maturity level 2 process areas. In other words, the projects of the organization have ensured that requirements are managed and that processes are planned, performed, measured, and controlled.(...)	Number	2		
CMMI-Continu	NA								
TRILLIUM	TRILLIUM LEVEL	Name	Repeatable and project oriented	Description	Individual project success is achieved through strong project management planning and control,with emphasis on requirements management, estimation techniques, and configuration management. (Risk - Medium)	Number	2		
BOOTSTRAP	NA								

figure 5.6: Maturity Level

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE	CAPABILITY LEVEL	Number	1	Name	Performed	Description	The purpose of the process is generally achieved. The achievement may not be rigorously planned and tracked. Individuals within (...)		
CMM	NA								
CMMI-Staged	NA								
CMMI-Continu	CAPABILITY LEVEL	Number	1	Name	Performed	Description	A capability level 1 process is characterized as a "performed process." A performed process is a process that satisfies the specific goals of the process area. It supports and enables the work needed to produce identified output work products using identified input work products.		
TRILLIUM	NA								
BOOTSTRAP	CAPABILITY LEVEL	Number	2	Name	Repeatable				

figure 5.7: Capability Area

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE	PROCESS CATEGORY	Name	Engineering process category						
CMM									
CMMI-Staged	PROCESS AREA CATEGORY	Name	Engineering						
CMMI-Continu	PROCESS AREA CATEGORY	Name	Engineering						
TRILLIUM	CAPABILITY AREA	Name	Development Practices	Number	6	Description	This Capability Area covers the following 7 Roadmaps: – Development Process, – Development Techniques, – Internal Documentation,(...)		
BOOTSTRAP	PROCESS CATEGORY	Name	Life Cycle dependent						

figure 5.8: Process Category

Model Name	Class Name	Attr 01	Example	Attr 02	Example	Attr 03	Example	Attr 04	Example
SPICE									
CMM	COMMON FEATURES	Name	Commitment to Perform	Description	Where policy statements are used, they generally refer to the project following a written, organizational policy for the practices of that key process area.				
CMMI-Staged	COMMON FEATURES	Name	Commitment to Perform	Description	groups the generic practices related to creating policies and securing sponsorship.				
CMMI-Continu									
TRILLIUM									
BOOTSTRAP									

figure 5.9: Common Feature

	Goal	Maturity Level	Key Process Area	Key Practice	Common Features
Goal			[is achieved] 1 BA		
Maturity Level			contain 0..* BA		
Key Process Area	achieve * BA	[belongs to] 1 BA		contains 1..* BA	
Key Practice			[belongs to] 1..* BA		belongs to 1 BA
Common Features				[organizes] 1..* BA	

figure 5.10: SW-CMM 1.1

SPICE-2

	Process Category	Process	Capability Level
Process Category			
Process	[belongs to] 1 BA	contains 1..* BA	
Capability Level		contains * C	

SPICE-5

	Work Product	Process	Base Practice
Work Product			
Process	[uses/produces] */* BA	is input of/is output of */* BA	
Base Practice			

figure 5.11: SPICE - ISO15504:1998

	Maturity Level	Process Area Category	Process Area	Practice	Specific Practice
Maturity Level					
Process Area Category	[belongs to] 1 BA	contain * BA			
Process Area		[belongs to] 1 BA	contains * BA	[contains] * BA	G
Practice			refers to 1..* BA		
Specific Practice				S	
Generic Practice				S	
Typical Work Product					is output of * BA
Goal					
Generic Goal					
Specific Goal					
Common Features					

figure 5.12: CMMI Staged Representation (Part 1)

	Generic Practice	Typical Work Product	Goal	Generic Goal	Specific Goal	Common Features
Maturity Level						
Process Area Category						
Process Area					[has] 1..* BA	
Practice	G					
Specific Practice		[produces] 1..* BA			achieves 1 BA	
Generic Practice				is mapped to 1 BA		belongs to 1 BA
Typical Work Product						
Goal				G	G	
Generic Goal	[has] * BA		S			
Specific Goal			S			
Common Features	[organizes] 1..* BA					

figure 5.13: CMMI Staged Representation (Part 2)

	Capability Level	Process Area Category	Process Area	Practice	Specific Practice
Capability Level					[has] * BA
Process Area Category			has * BA		
Process Area		[belongs to] 1 BA		[contains] * BA	
Practice			refers to 1 BA		G
Specific Practice	is at 1 BA			S	
Generic Practice				S	
Typical Work Product					is output of 1..* BA
Goal	[belongs to] 1 BA				
Generic Goal			applies to 1 BA		
Specific Goal					is mapped to 1..* BA

figure 5.14: CMMI Continuous Representation (Part 1)

	Generic Practice	Typical Work Product	Goal	Generic Goal	Specific Goal
Capability Level					
Process Area Category					
Process Area				has 0..1 BA	
Practice	G				
Specific Practice		[produces] * BA			[has] * BA
Generic Practice				[has] 1 BA	has 1 BA
Typical Work Product					
Goal				G	G
Generic Goal	is mapped to * BA		S		
Specific Goal			S		

figure 5.15: CMMI Continuous Representation (Part 2)

	Process Category		Process		Practice		Capability Level	
		1..*	C		1..*	BA			
Process Category	contains	1..*	C	consist on	1..*	BA			
Process	[belongs]	1	BA				contains	1..*	BA	
Practice				belongs to	1	BA			
Capability Level				[characterizes]	0..*	BA		belongs	1	BA

figure 5.16: Bootstrap

	Trillium Level	Practices	Roadmaps	Capability Area
Trillium Level		[contains] 0..* BA		
Practices	belongs to 1 BA		[belongs to] 1 BA	
Roadmaps		contains 1..* BA		[belongs to] 1 BA
Capability Area			incorporates 1..* BA	

figure 5.17: Trillium

Chapter 6

Key concepts identification and schema integration: followed rules
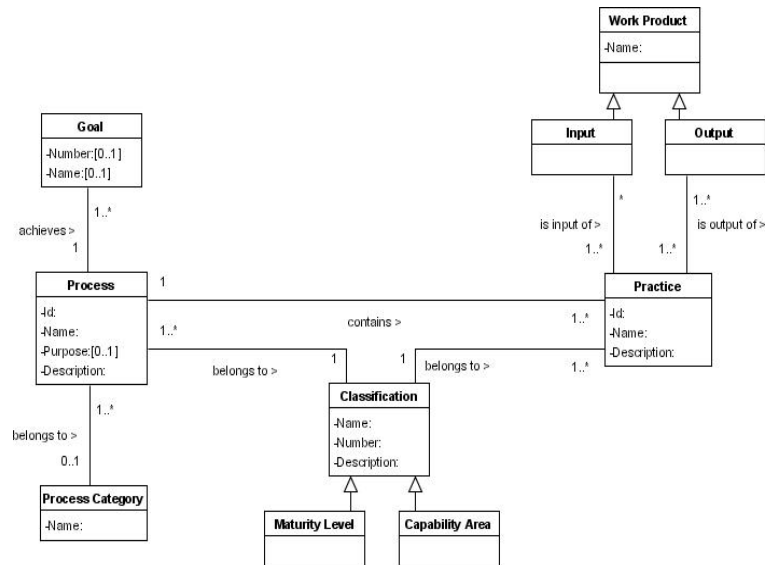
6.1 Introduction

6.2 Generic Model

figure 6.1: Generic Model Version 1.0

Chapter 7

Relationship definition

7.1 Analysis grid

	Process	Practice	Work Product	Input	Output	Goal	Category
Process		contains 1..* BA				achieve 1..* BA	[belongs to] 1 BA
Practice	[belongs to] 1..* BA			[uses] 1..* BA	[produces] 1..* BA		
Work Product				G	G		
Input		is input of 1..* BA	s				
Output		is out put of 1..* BA	s				
Goal	[is achieved] 1 BA						
Category	[contains] 1..* BA						
Common Feature		organizes 1..* BA					s
Level	[contains] 1..* BA	[contains] BA					
Maturity (level)							
Capability (level)							

figure 7.1: Relationship in the generic model. Part 1

	Category			Common Feature			Level			Maturity (level)			Capability (level)		
Process	[belongs to]	1	B.A.				[belongs to]	1	B.A.						
Practice				[belongs to]	1..	B.A.	belongs to	1	B.A.						
Work Product															
Input															
Output															
Goal					G										
Category		s													
Common Feature									s						
Level									s		G			G	
Maturity (level)															
Capability (level)															

figure 7.2: Relationship in the generic model. Part 2

Chapter 8

Schema transformation

8.1

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