



## FAMILIES Consortium-Wide Deliverable 2.1: Family Maturity Framework (FMF)

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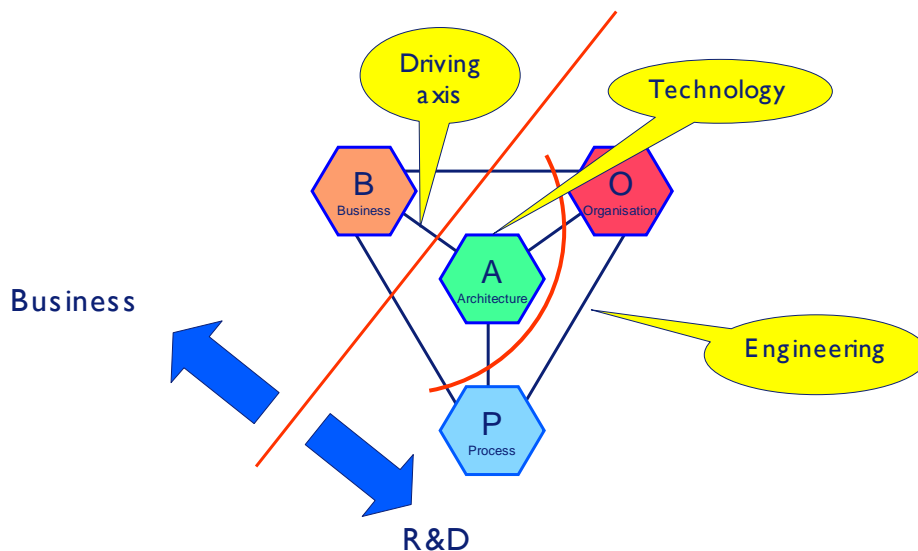
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## 1. INTRODUCTION

The Family Maturity Framework (FMF) provides the Process dimension into the Family Evaluation Framework (FEF), a key result of the ITEA/FAMILIES project. Other FEF dimensions (Business, Architecture, Organisation) were covered by other Work Packages (WPs) of the FAMILIES. As a whole FEF (and FMF as a part of it) is a consolidation of a large amount of work in all WPs in FAMILIES and in the previous ITEA projects ESAPS and CAFÉ.



**Figure 1. Family Evaluation Framework (FEF)**

FMF is based on the idea of creating a new (tentative) scope “System Family Engineering” (SFE) into the existing CMMI<sup>®</sup> appraisal model, as maintained by the Software Engineering Institute (SEI) of Carnegie Mellon University. The new scope is tentatively called CMMI<sup>®</sup> for System Family Engineering (CMMI<sup>®</sup>-SFE)

This document describes

- CMMI<sup>®</sup>-SFE requirements
- CMMI<sup>®</sup>-SFE training material
- CMMI<sup>®</sup>-SFE trial scheme
- CMMI<sup>®</sup>-SFE trials at
  - Nokia
  - Siemens
- CMMI<sup>®</sup>-SFE trials summary

The actual CMMI<sup>®</sup>-SFE model (with its editorial process) is presented in the CWD of Task 2.2 of FAMILIES WP2.

After the FAMILIES projects ESI will perform adequate negotiations with the SEI about utilisation of the results of this work, and ESI will also facilitate the corresponding utilisation on behalf of the members of the FAMILIES Consortium.

## 2. CMMI<sup>®</sup>-SFE OVERVIEW

### 2.1 REQUIREMENTS

The CMMI<sup>®</sup>-SFE (hereinafter “CMMI<sup>®</sup>-SFE”) requirements have been agreed on as follows.

(R1) **CMMI<sup>®</sup>-SFE model may cover the full CMMI<sup>®</sup>-SE/SW/IPPD/SS v 1.1, Staged representation (hereinafter “CMMI<sup>®</sup>”), but it shall cover at least CMMI<sup>®</sup>-SE/SW.**

(R2) **CMMI<sup>®</sup>-SFE model may cover all CMMI<sup>®</sup> Maturity Levels (ML) 1-5, but it shall cover at least Levels 2 and 3 (ML2, ML3).**

(R3) **CMMI<sup>®</sup>-SFE model shall be as consistent as possible with FAMILIES glossary.**

Additional concepts and terms shall be defined in the CMMI<sup>®</sup>-SFE

(R4) **CMMI<sup>®</sup>-SFE model shall not affect structural elements of CMMI<sup>®</sup> architecture.**

It shall include neither additional process areas nor specific goals to those stated in the CMMI<sup>®</sup>.

(R5) **CMMI<sup>®</sup>-SFE model shall not include additional specific or generic practices to those stated in the CMMI<sup>®</sup>.**

Amplifications are the only instruments used in CMMI<sup>®</sup>-SFE.

(R6) **CMMI<sup>®</sup>-SFE model shall address a new tentative CMMI<sup>®</sup> discipline: SFE and its sub-activities: Domain engineering (DE) and Application Engineering (AE).**

- DE is responsible for defining and providing the infrastructure required for development of a common reuse infrastructure for a given domain. This must include procedures of use of the infrastructure, methodologies, components (from reusable assets to architectures) and guidelines.
- AE is responsible for the development of applications within a given domain making use of available resources and infrastructure.
- SFE: When addressing a SFE approach in which both DE and AE roles are evaluated, the major issue that has to be considered is the synchronization between these two roles.

(R7) **Specific ways of organizing activities/projects shall not be dictated in amplifications.**

See CMMI<sup>®</sup> A-Specification v1.6 requirement 4.4.3: “...the content of the models shall be analyzed to assure they do not define the specifics of particular implementations”.

(R8) **CMMI<sup>®</sup>-SFE model shall address Variability Management (VM) issues at ML2 and at ML3 with specific amplifications for Requirement Management (REQM), Project Planning (PP), Requirement Development (RD) and Technical Solutions (TS) Process Areas (PAs).**

Amplification should be defined in a way that Variability Management is performed informally at ML2, while formally performed at ML3 and above.

(R9) **Synchronization between DE and AE activities is addressed within SFE discipline at:**

- ML2.
  - At PAs: PP and Project Monitoring and Control (PMC);
  - At generic practice GP2.1 Establish an Organizational Policy
  - At generic practice GP2.7 Identify and Involve Relevant Stakeholders
- ML3
  - At specific points in selected PAs;
  - At generic practice GP3.1 Establish a Defined Process
  - At generic practice GP 2.6 (DI 1) Manage Configurations
  - At generic practice GP3.2 Collect Improvement Information.

(R10) **Amplifications have to be focused and short. An indicative length is 6 to 7 lines.**

## 2.2 HIGH LEVEL DESCRIPTION

This section intends to provide an informal and high-level view of the characteristics of the CMMI®-SFE model with specific emphasis on each ML.

In principle the CMMI®-SFE model should address a new discipline SFE and its sub-activities: AE and DE. The proposed model is structured in a way that if an organization is interested in appraising DE activities only, the focus can be adjusted consequently (this is also valid for AE). When an organization is interested in appraising both AE and DE activities, the appraiser should focus on SFE and how AE and DE activities are performed with respect to it and between them.

### 2.2.1 Maturity Level 2 (ML 2)

At CMMI® ML2 projects act as the main actors in the organizational movie. This means that each project is responsible for defining its own procedures, and so, different projects may use different procedures. Policies are the organization main instrument (at this level) to try to guarantee integrated results from different projects or groups in the organization.

In pure ML2 organizations the focus is on keeping management issues under control (while engineering issues will be central from ML3 onwards). This is why at this level the Process Areas (PAs) are mainly focused on keeping projects under control:

- Projects via PP and PMC,
- Work products (WPs) via Configuration Management (CM),
- Requirements via REQM
- Suppliers via Supplier Agreement Management (SAM)

At CMMI®-SFE ML2 there is a need for synchronization of DE and AE activities. When both are in the same project, synchronization is guaranteed by the mechanisms the CMMI® provides. However, when this is not the case and DE and AE activities are in different projects synchronization is reinforced in a number of ways:

- Organization policies (PP and CM). A PP policy asks for the identification of commonalities through the cooperation of AE and DE. A CM policy asks for a synchronized configuration between DE and AE.
- DE considers AE a stakeholder and vice versa. This is reflected in certain generic practices in all PAs and specifically in REQM, PP and PMC specific practices.

### 2.2.2 Maturity Level 3 (ML3)

At CMMI® ML3 management issues are under adequate control, and the focus is more on:

- Shifting the focus from projects to the organization by centralizing Organizational Training (OT) and process assets such as Organizational Process Focus (OPF) and Organizational Process Definition (OPD) and by guaranteeing Integrated Project Management (IPM)
- Engineering issues such as Requirement Development, Technical Solution, Product Integration, Verification and Validation (RD, TS, PI, VER and VA respectively). It is easier to do a good engineering work, once management issues are under control.

In CMMI®-SFE ML3 the Organization's Set of Standard Processes (OSSP) includes not only traditional process assets, but also DE specific assets (reusable components, architectures, etc). This happens because OPD scope has been extended and is also in charge of creating these DE specific assets. However OPD cannot create these assets by itself. It needs a software life cycle for that. This is the reason while engineering processes include DE amplifications, i.e. to support OPD in the development and maintenance of DE assets.

The DE assets in the OSSP are maintained by OPD with the feedback provided by all PAs in *GP3.2 Collect Improvement Information*.

Variability analysis is not isolated in one single PA. Both OPD and RD (using DE) support variability analysis, while variability resolution is done at RD (using SFE discipline)

IPM is traditionally in charge of instantiating the OSSP for a specific project and now in CMMI<sup>®</sup>-SFE, IPM scope has been extended to instantiate the specific DE assets that each project needs.

### 2.2.3 Maturity Level 4 (ML4)

At CMMI<sup>®</sup>-SFE ML4 the process is quantifiable and predictable since it is measured and operates within measurable limits. This allows an organization identifying how process and product quality are performing within the limits established. The major benefit of this level of capability is that since the process is stable and measured, it is possible to identify and address any exceptional variation in the process.

At CMMI<sup>®</sup>-SFE ML4 special attention has to be paid to the continuous interaction among DE and AE, which directly impacts both in the establishment of the quality and process performance attributes as well as the management of the performance objectives.

The major source of risk that can be identified when addressing SFE arises when the process performance objectives of DE and AE are mutually dependent. This requires a dedicated effort for controlling these dependencies. Examples of process performance objectives when addressing DE are issues such as, percentage of exploited variability, relative number of products in the family.

Another issue that must be handled is the resolution of conflicts, when addressing SFE, the conflicts identified between the quality and performance objectives have to be monitored carefully. The kinds of conflicts that can be identified are, among others: when a related AE and DE project influences the current project performance or there is an inadequate synchronization of DE and AE projects.

### 2.2.4 Maturity Level 5 (ML5)

At CMMI<sup>®</sup>-SFE ML5 the organizational processes are continuously improved based on quantitative understanding of the causes for variation inherent in processes.

CMMI<sup>®</sup>-SFE -SFE does not introduce any major aspect addressed at ML5, since the amplifications defined in the previous levels already guarantee a more efficient execution of the CMMI<sup>®</sup>-SFE level 5. Future use of the SFE discipline outside the scope of the FAMILIES project may help identifying whether this level requires any amplification or not. In any case we consider this will not be the case.

### 3. CMMI<sup>®</sup>-SFE TRAINING MATERIAL

#### 3.1 OVERVIEW

This section addresses more in detail the scope of most CMMI<sup>®</sup>-SFE Process Areas that have been amplified in order to highlight the major impact of SFE in CMMI<sup>®</sup>-SFE.

The requirements for the creation of CMMI<sup>®</sup>-SFE (see section 2.1) have been formulated taking into account not only SFE specific needs but also a number of aspects that shall make the final model as usable as possible. Furthermore, some requirements were formulated with the double intention of not overturning the original CMMI<sup>®</sup> and of making the CMMI<sup>®</sup>-SFE as similar as possible to other CMMI<sup>®</sup> existing extensions.

Finally, the CMMI<sup>®</sup>-SFE adds more than 70 amplifications to classical CMMI<sup>®</sup> (including examples). They can be basically divided into three general groups that can characterize the SFE discipline within the CMMI<sup>®</sup>-SFE: project management, engineering and process management related PAs. For keeping the scope focused we provide a general description of the most representative PAs of each group.

#### 3.2 MATURITY LEVEL 2: DETAILED EXPLANATION

##### 3.2.1 Requirements Management (REQM) [1]

SFE-specific topics in the REQM Process Area are:

- management of dependencies between requirements, other artifacts, and work products that are developed in different projects (DE and AE projects) but depend on each other;
- management of dependencies between variants and variation points (note that variability is inherent in different artifacts).

To consider for REQM with respect to SFE:

- if system family requirements are managed in one project and application requirements are managed in other projects, a mechanism is needed to provide each other with feed-back
- traceability must exist across project boundaries in SFE to manage changes in AE and DE;
- new traceability link types are necessary due to variability in artifacts
- Some aspects of requirements management for SFE concern multi-project management. Thus, requirements management for SFE contains level 3 elements.

##### 3.2.2 Project Planning (PP) [1]

SFE-specific topics in the PP Process Area are:

- We have projects in DE and AE that are dependent on each other
- In both cases the projects are interrelated, milestones are dependent, synchronization is necessary, and joint risk management is necessary.

To consider for PP with respect to SFE:

- Estimates of planning parameters must consider synchronization between related processes.
- Estimates of project planning parameters must consider reuse and platform.
- The project plans must consider the relations of projects, dependencies between milestones of different projects, and synchronization points between projects.

Many specific parts of project planning for SFE concern multi-project management, so project planning for SFE contains considerable level 3 elements.

### 3.2.3 Project Monitoring and Control (PMC)

SFE-specific topics in the PMC Process Area are:

- We have projects in DE and AE that are dependent on each other.

To consider for PMC with respect to SFE:

- These dependencies shall be monitored and appropriate actions taken, if necessary.
- Dependent milestones shall be monitored and reviewed.
- Work products being output of one project and input of another shall be monitored.
- Commitments to providing and reusing assets shall be monitored.
- Problems with the above topics create risks that shall be identified and monitored.

The major parts of project monitoring and control for SFE concern multi-project management, so project monitoring and control for SFE is closer to level 3 than to level 2.

### 3.2.4 Configuration Management (CM)

SFE-specific topics in the CM Process Area are:

- configuration of DE and AE work products may be managed separately;
- DE and AE work products depend on each other and so do the configuration items and baselines that comprise those work products;
- synchronization between DE and AE configuration management activities is an essential prerequisite to get the full reuse benefits.

To consider for CM with respect to SFE:

- separate baselines should be established for DE and AE work products;
- baselines and configuration items for DE work products shall be considered as a basis for the corresponding AE work products;
- the reuse-specific dependencies between DE and AE work products and the respective configuration management entities (e.g. configuration items, baselines and change re-quests) shall be monitored and appropriate actions taken, if necessary;
- configuration management has to cope with the (higher) concurrency and multiplicity of engineering activities in SFE;
- if the system family is not managed as a whole under configuration management (e.g. DE and AE work products are managed separately), the linkage and exchange of configuration information has to be addressed;
- the work products should be organized in a way that facilitates an efficient and effective management of variability.

Some aspects of configuration management for SFE concern multi-project management, so configuration management for SFE is between level 2 and level 3.

## 3.3 MATURITY LEVEL 3: DETAILED EXPLANATION

### 3.3.1 Requirements Development (RD) [1]

SFE-specific topics in the RD Process Area are:

- domain scoping has to be conducted;
- proactive development of requirements; more requirements sources must be considered;
- commonality and variability analysis has to be conducted;

- variability in requirements is introduced and documented explicitly;

To consider for RD with respect to SFE:

- requirements sources have to cover a whole market segment;
- farsighted identification of common and variable requirements of all stakeholder groups for the whole lifetime of the system family;
- variability of the system family has to be communicated to customers in order to reuse as many system family artifacts as possible;
- application requirements are partly derived from system family requirements and partly developed from scratch.

### 3.3.2 Technical Solution (TS)

In SFE, technical solution activities can be split in two sub-processes. The first covers the design, development and, implementation of system family components (during DE). The latter covers the design, development and, implementation of application components (during AE). Design, development and, implementation should be communicated in an effective way between DE and AE.

Design, development and, implementation of application components must be derived from the system family assets, wherever it is possible.

To consider for TS with respect to SFE:

- Alternative solutions and selection criteria for inclusion within Domain from Application.
- Research of operational concepts and scenarios for System Family in both Domain and Application.
- Application at hand components design has to be defined and configured from SFE assets, wherever it is possible
- SFE must communicate the interface criteria to DE and AE.
- SFE must establish evaluation criteria and policies for DE and AE in order to decide when to buy, build or reuse a component
- SFE must coordinate the integration of implemented Domain components within Application and the enriching of Domain with specific code implemented by Application

### 3.3.3 Product Integration (PI)

Agreed processes exist and tools are used to synchronize (possibly intermediate level) deliverables from DE to AE. This entails

- The roadmapping of future products and product enhancements
- The definition of the project deliverables (intended use, level of quality)
- The timing of the product transfers
- The actual transfer protocol of deliverables
- The integration support from DE to AE
- The feedback about problems found between AE and DE during integration
- Management of product problem solutions between the DE and AE organization
- Management of (user and technical) product documentation between DE and AE

The issues above can be dynamic, as in many cases it will be found that development at DE and AE side takes some form of incremental development, with a possibly high frequency of small product synchronizations.

Further more architectural issues influence this process. That is clarity and simplicity and ownership of interfaces must be established between the DE and AE organizations. This is relatively straightforward for independent devices, but far more difficult for infrastructures (e.g. operating systems, and basic computer services).

### 3.3.4 Verification (VER) [2]

During Verification (VER) it is not enough to communicate the results between AE and DE. Naturally the DE environment is interested in problems that AE encounter, for several reasons:

- The number of defects found by the AE in relation to those found by the DE test organization in a DE work product is a useful input to analyse the quality of the testing process at the DE side. This can be used to set measurable goals, where various goals can be set for the different severity of problems.
- The number of defects found by AE that are due to incorrectly operating the DE work product says something about the usability of and the supporting processes of the DE
- The total number of defects found says something about the inherent quality of the development process

To consider for VER with respect to SFE:

- A cross AE-DE analysis team shall analyse problems that require combined DE AE effort
- The AE organization shall supply the DE organization with problem statistics for analysis of the DE process affectivity, and setting goals.

### 3.3.5 Validation (VAL) [2]

SFE-specific topics in the VAL Process Area are:

- Product validation is used to demonstrate the fitness of a product for intended use, in defined circumstances. This is done against product requirements.
- For a DE+AE organization this means that validation is done at various levels.
- The first level is at the DE level, where a product may actually have to go through a number of validation 'cycles' due to the fact that different AE's may have different intended usages, or different environments for the DE product.
- The other level is at the AE side.
- As several law regulations can be interpreted as meaning that validation is by definition only done at AE side, this interpretation can have consequences for the DE validation activities. If this issue arises the best thing to do is to discuss the issue with specialists in the area of law.
- However, purely from the Business interest point of view it is advantageous to perform DE product validation as this gives an impartial and objective insight in the achieved quality at the DE side. This enables the DE to give a balanced overview to the AE of what they can expect, in terms of realized functionality and quality of this.

### 3.3.6 Organizational Process Focus (OPF) [1]

SFE-specific topics in the OPF Process Area are:

- We have different processes (DE and AE) that constitute SFE and have to be synchronized and improved. To consider for organizational process focus in CMMI®-SFE:
- The process needs shall encompass the perspective of the whole system family (in contrast to individual systems).
- The business objectives shall encompass the perspective of the whole system family and the markets for all systems in the family (in contrast to individual systems and markets).

- Improving the cooperation between DE and AE processes and platform usage is an ongoing requirement for OPF.

### 3.3.7 Organizational Process Definition (OPD) [1]

SFE-specific topics in the OPD Process Area are:

- We have different processes (DE and AE) that constitute SFE and have to be synchronized and improved.

To consider for OPD with respect to SFE:

- DE and AE shall be established as separate processes of SFE.
- Their dependencies shall be expressed.
- The specific roles (e.g. product manager vs. product family manager, platform manager, etc.) shall be identified.
- Process attributes like methods and procedures shall encompass variability management, commonality and variability analysis, etc.
- Dependencies and interrelations of the life-cycle models shall be identified.

### 3.3.8 Organizational Training (OT) [1]

SFE-specific topics in the OT Process Area are:

- The organization focuses now on a whole system family, not just on individual products.
- The platform is now a central object of the organization.
- The dependency between platform and systems of the family must be trained.

To consider for OT with respect to SFE:

- The focus shift shall be a central subject of OT.
- The platform and its usage shall be a central subject of OT.
- The training shall support and enforce cooperation between projects and groups.

## 3.4 MATURITY LEVEL 4: DETAILED EXPLANATION

### 3.4.1 Quantitative Project Management (QPM) [1]

SFE-specific topics in the OPM Process Area are:

- The organization has to establish and manage multiple related projects, not just a single one
- Metrics and statistics have to consider that there are multiple related projects and take these into account for all kinds of measurements, statistics, and evaluations of those.

To consider for QPM with respect to SFE:

- Determining whether the distribution of resources to DE and AE is adequate to satisfy the project's goals.
- Especially for SFE the quality and performance objectives between DE and AE sub-processes may conflict. They shall be monitored particularly.
- The interaction of DE and AE subprocesses has to be considered particularly.
- In addition to measuring a process against its objectives, different AE processes of the same family may be measured against each other to identify improvement potential.

### 3.5 SUPPORT TOOLS

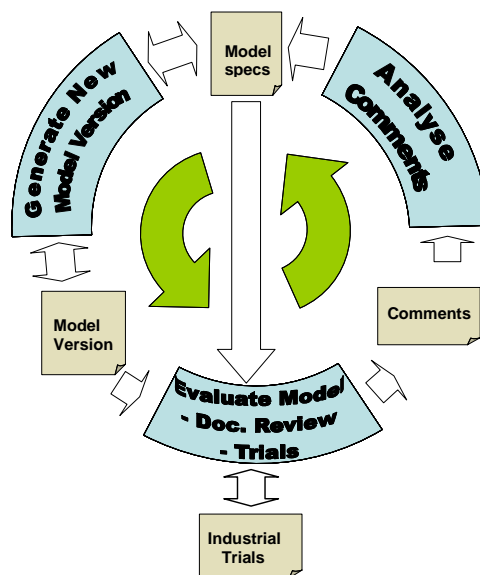
CMMI<sup>®</sup> appraisers do not always know SFE specific needs, terminology and focus. Because of that, an existing tool for CMMI<sup>®</sup>, the SAL3, has been adapted to CMMI<sup>®</sup>-SFE specific needs to support appraisers' activities when assessing CMMI<sup>®</sup> in the context of SFE.

SAL3 is a tool containing a number of questions to be made during CMMI<sup>®</sup>-SFE assessments to evaluate how an organization deals with each CMMI<sup>®</sup>-SFE process area and its goals. The questionnaires cover not only CMMI<sup>®</sup> specific aspects but also SFE amplifications. After the questionnaires are filled, it is possible to generate automatically a report containing the results of the appraisal highlighting all the aspects that need to be improved or covered to fulfil CMMI<sup>®</sup>-SFE requirements at all levels.

## 4. CMMI<sup>®</sup>-SFE TRIAL SCHEME

### 4.1 TRIAL PHASES

CMMI<sup>®</sup>-SFE has been developed following a cyclic editorial process (See Figure 2). Each CMMI<sup>®</sup> PA was assigned to a team of engineers and/or CMMI<sup>®</sup> experts that proposed possible amplifications to its Specific and Generic Goals. The intent of such amplifications was to cover SFE specific needs not addressed in CMMI<sup>®</sup> and focus existing CMMI<sup>®</sup> practices to SFE related aspects. The proposed amplifications have been reviewed by an independent team of Engineers against a list of requirements and evaluation criteria agreed among all the people involved in the creation of CMMI<sup>®</sup>-SFE. The resulting PAs have been sent back and forward among the editors and reviewers until both parts agreed in its final version. Finally, the different versions of the model were tested in real industrial case studies in Nokia and Siemens.



**Figure 2. CMMI<sup>®</sup>-SFE amplification editorial process**

The industrial trials were performed with the intention to verify the adequacy of the model validate its content in real cases of study. Because of that, after each assessment it was required the appraisers to fill a feedback form to collect their impressions. The trials performed during the creation of CMMI<sup>®</sup>-SFE provided an unbelievable added value to the whole creation process. They have been performed in parallel with the creation of CMMI<sup>®</sup>-SFE and for this reason the feedback has been used in time.

The content of the feedback form is described in the following sections, while in the last chapter of this document a brief summary of two of three appraisals and some statistics about them are presented.

### 4.2 TRIAL FEEDBACK FORM

After each trial performed during the creation of CMMI<sup>®</sup>-SFE a feedback form was filled to provide input to improve the model.

The form was divided in three groups of questions about:

- appraiser and its assessment methods
- appraised entity
- evaluation form (see the table below) and the assessors' impressions about the model

The first and the second part have been created with the intention to contextualise the appraisal with respect to organization size and domain in order to understand appraisal results from the correct point of view. They also provided useful statistical information about the performed work.

The final part, the most important one, provided the information to improve the model. In this way all appraisers' impressions about CMMI<sup>®</sup>-SFE were stored and reused to focus the scope of some PA, improve the overall model and check its consistency.

A side effect of the trials is that they highlighted a hidden weak aspect of the CMMI<sup>®</sup>-SFE model: the glossary. As a model almost entirely created by SFE experts the draft version of the model was using a glossary of terms that was not typical for people usually working with CMMI<sup>®</sup>. Because of that, many amplifications were reworded accordingly to CMMI<sup>®</sup> experts suggestions and where not possible, SFE specific terms were explained apart at the end of the document. The usability was in this way increased a lot

The following CMMI<sup>®</sup>-SFE evaluation criteria were used in CMMI<sup>®</sup>-SFE trials.

ID	Evaluation Criteria	YES	NO
<b>1</b>	<b>Horizontal integration</b>		
1.1	Do ML 2 amplifications provide a coherent picture of an organization applying DE/AE/SFE disciplines? <i>Example. Do you detect amplifications proposing too advance practices that should be at a higher ML?</i>	<input type="checkbox"/>	<input type="checkbox"/>
1.2	Is this picture consistent with a ML2 organization in the CMMI <sup>®</sup> - SE/SW v1.1?	<input type="checkbox"/>	<input type="checkbox"/>
1.3	Do ML3 amplifications provide a coherent picture of an organization applying DE/AE/SFE disciplines?	<input type="checkbox"/>	<input type="checkbox"/>
1.4	Is this picture consistent with a ML3 organization in the CMMI <sup>®</sup> - SE/SW v1.1?	<input type="checkbox"/>	<input type="checkbox"/>
<b>2</b>	<b>Process Areas integration.</b>		
<b>2.1</b>	<b>Amplifications adequacy</b> (For each PA amplification)		
2.1.1	Does the amplification contribute to the goals (specific and generic) of the PA? If not, consider if it can be removed or reworded	<input type="checkbox"/>	<input type="checkbox"/>
2.1.2	Does this amplification add something not provided by the model (i.e. CMMI <sup>®</sup> -SE/SW v1.1) or is it already in the model? If not, consider if it can be removed or reworded	<input type="checkbox"/>	<input type="checkbox"/>
2.1.3	Is this amplification really necessary?	<input type="checkbox"/>	<input type="checkbox"/>
2.1.4	Is this amplification in the correct PA? Is it under the correct goal (specific or generic)?	<input type="checkbox"/>	<input type="checkbox"/>
<b>2.2</b>	<b>Amplifications sufficiency</b> (For each PA amplification)		
2.2.1	Is any additional amplification needed to support the PA goals (either specific or generic)?	<input type="checkbox"/>	<input type="checkbox"/>

- |     |  |                          |                          |
|-----|--|--------------------------|--------------------------|
| 2.3 | For each PA, is any additional specific goal required to satisfy the needs of the new disciplines (DE, AE, and SFE)?                 | <input type="checkbox"/> | <input type="checkbox"/> |
| 2.4 | Is any additional PA needed to satisfy the need of the new disciplines (DE, AE, and SFE)?  | <input type="checkbox"/> | <input type="checkbox"/> |
| 2.5 | Is the amplification vocabulary consistent with CMMI <sup>®</sup> vocabulary?  | <input type="checkbox"/> | <input type="checkbox"/> |
| 2.6 | Do amplifications represent practices that are observed, documented, and judged to be effective? (A-Specification requirement 3.4.3) | <input type="checkbox"/> | <input type="checkbox"/> |

**Please indicate here your detailed comments.** When referring to a specific amplification or evaluation criterion, please indicate its associated ID.

### 4.3 TRIAL DATA CONFIDENTIALITY

During the creation of the CMMI<sup>®</sup>-SFE model the confidentiality of the data provided by the industrial partners has been jealously preserved.

The trial feedback form was introduced with the following confidentiality note: "All the data entered when filling this form will be used only for statistic purposes under the scope of the Families project. They will be kept strictly confidential and managed internally at ESI only by Piergiorgio Di Giacomo and Pedro Gutierrez."

The integrity and the validity of the confidential note have never been re-discussed after its approval. In this way it has been possible for all the involved industrial partners (even when they are competing in the same domain or market) to participate without providing confidential information to their competitors. Nevertheless, the impressions and the results coming from the appraisals have been put after their original context, reworded adequately and given to CMMI<sup>®</sup>-SFE editor for their review.

## 5. CMMI<sup>®</sup>-SFE TRIALS

In this section two different set of trials, performed in Nokia and Siemens are presented. These are not the only ones performed, but are the most important ones. Other trials addressed only some aspects of SFE or only some process area. They were important to prove that CMMI<sup>®</sup>-SFE is usable not only as a whole, but can be also applied in context where a more narrow scope is needed.

### 5.1 CMMI<sup>®</sup>-SFE TRIALS IN NOKIA

#### 5.1.1 Organisational scope

There were altogether five Nokia Product Creation (“R&D”) units involved in six separate CMMI<sup>®</sup>-SFE trials (Figure 3):

- AEU1 is an AE unit utilising internal DE units, e.g. DEU1
- DEU1 is an internal DE unit serving AE units, e.g. AEU1
- AEU2 is an AE unit utilising internal DE units, e.g. DEU2 (this unit participated in two trials)
- DEU2 is an internal DE unit serving AE units, e.g. AEU2
- AEU3 is an AE unit utilising an external DE (another company)

Four of these units are fairly large (>200 R&D persons). All of the units are multi-site, i.e. situated at several geographical locations.

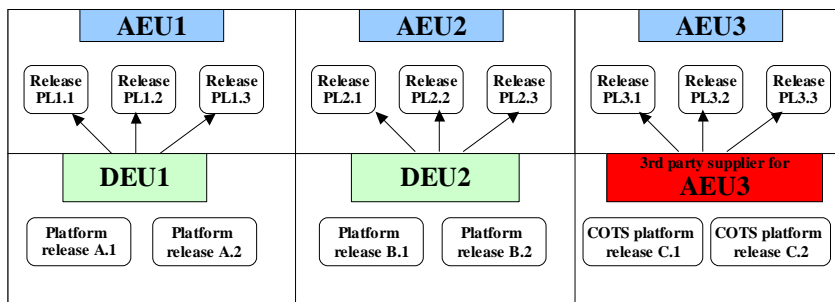


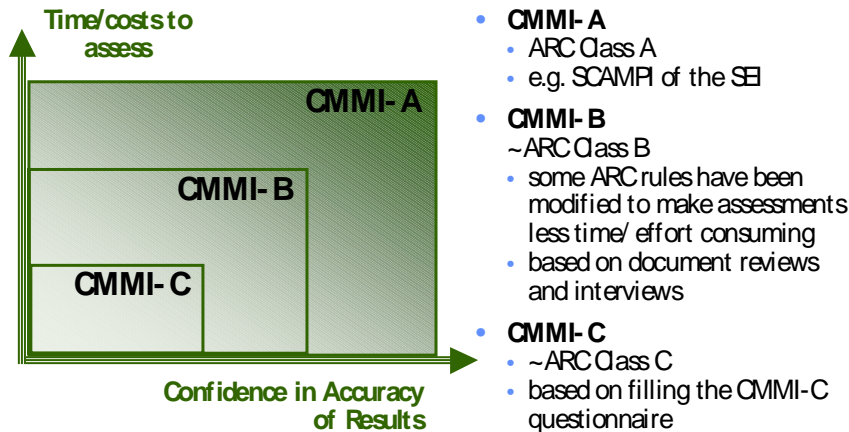
Figure 3. Units in Nokia CMMI<sup>®</sup>-SFE pilots

#### 5.1.2 CMMI<sup>®</sup> scope

Two very experienced CMMI<sup>®</sup> lead assessors led these six assessments and they commented on CMMI<sup>®</sup>-SFE after the trials in separate interviews.

Utilized Nokia-specific CMMI<sup>®</sup> methods were (Figure 4).

- CMMI<sup>®</sup>-B (largely compliant with CMMI<sup>®</sup> Class B appraisal scheme) in five assessments
- CMMI<sup>®</sup>-C (largely compliant with CMMI<sup>®</sup> Class C appraisal scheme) in one assessment



**Figure 4. Nokia-specific CMMI<sup>®</sup> assessment methods**

All CMMI<sup>®</sup>-SE/SW Process Areas at ML2 and ML3 were covered in assessments in total; in separate assessments the most typical ML/ Process Area coverage was:

- All ML 2 Process Areas, and
- A few ML3 Process Areas.

Two first assessments utilised CMMI<sup>®</sup>-SFE v01, the next two CMMI<sup>®</sup>-SFE v02, and the last two CMMI<sup>®</sup>-SFE v03. In all assessments CMMI<sup>®</sup>-SFE was used implicitly, i.e. its utilisation was neither mentioned to assessees nor visible in presenting the results.

### 5.1.3 Feedback

Detailed feedback was collected to a single document, which was sent to ESI for analysis in November 2004. The major comments from the lead assessors were:

- CMMI<sup>®</sup>-SFE is a useful CMMI<sup>®</sup> interpretation tool in assessments, where AE units, DE units or their combinations are in the organisational scope of the assessments
- Following text should be added in all ML2 and ML3 Process Areas (e.g. "SFE Introductory Notes):
  - "Synchronization in this Process Area between AE and DE is purposefully addressed."
- Following generic practices should be amplified in all ML2 and ML3 Process Areas:
  - GP2.1 Establish an Organisational Policy,
  - GP2.7 Identify and Involve Relevant Stakeholders, and
  - GP 2.6 (DI 1) Manage Configurations
- Requirements Development PA includes too many amplifications and they are too extensive
- Technical Solution PA clearly misses SFE architecting stuff, it could even be the only tentative new Goal to be added: "Develop SFE Architecture"!
- Product Integration PA does not include any amplifications at all, which is a clear weakness.
- In Verification and Validation PAs the shared testing roles between AE and DE are not properly addressed
- Risk Management PA and Decision Analysis and Resolution PA do not have any amplification to depict the shared responsibilities (a number of amplifications was propose in comments).

## 5.2 CMMI®-SFE TRIALS IN SIEMENS

### 5.2.1 Organisational scope

The organisational unit assessed is situated in Erlangen, Germany and works in the domain of medical systems, health services. The unit encompasses DE and AE activities. About 50 people (mostly developers) work in this unit.

### 5.2.2 CMMI® scope

The assessment and appraisal method used was a Siemens-specific variant of CMMI®. Siemens Process Assessment (SPA) is based on CMMI, but uses also elements of ISO 9000, Bootstrap and Siemens-specific extensions.

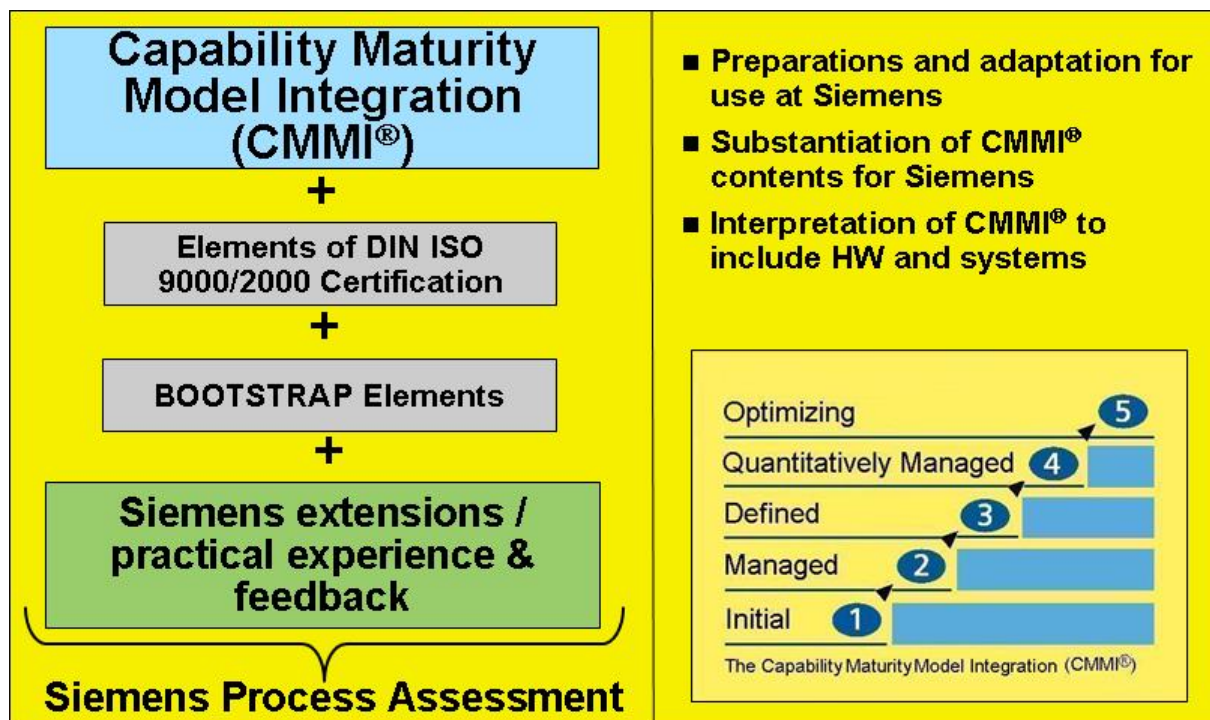


Figure 4. Siemens Process Assessment (SPA)

All CMMI®-SE/SW Process Areas at ML2 to ML5 were covered in the assessments.

### 5.2.3 Assessment organisation

The following table shows part of the assessment schedule, the roles that were interviewed and the sequence of the interviews.

Interim Profile Med HS IM, 09/2004						Assessor 1	Assessor 2	Site Coordinator	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8	Person 9	Person 10	Person 11	Person 12	Person 13	Person 14	Person 15	Person 16	Person 17	Person 18	Person 19	Person 20	Person 21	Person 22	Person 23			
Timetable and Participants						Coach	Participants																											
Topic	Date	time	from	until	Room																													
Kickoff	21.09.	0:30	09:30	10:00		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Requirements Definition	21.09.	1:30	10:00	11:30		X	X	X	X	X	X																							
Product Line Management	21.09.	1:00	11:30	12:30		X	X	X			X	X																						
Definition of Features and Architecture	21.09.	1:00	13:30	14:30		X	X	X					X	X	X	X																		
Product Integration & Test	21.09.	1:00	14:30	15:30		X	X	X										X	X															
SW-Implementation & Test	21.09.	1:00	15:30	16:30		X	X	X												X	X													
Component Reuse	21.09.	0:30	16:30	17:00		X	X	X												X	X													
Organizational Training	21.09.	0:30	17:00	17:30		X	X	X																										
Project Management	22.09.	2:00	08:30	10:30		X	X	X														X	X	X										
Quantitative Project Management	22.09.	0:30	10:30	11:00		X	X	X														X	X											
Supplier Management	22.09.	0:45	11:00	11:45		X	X	X																X	X	X								
Configuration & Change Management	22.09.	0:45	11:45	12:30		X	X	X																		X	X	X						
Quality Assurance & Peer Reviews	22.09.	1:00	13:30	14:30		X	X	X																						X	X			
Process Definition and Maintenance	22.09.	1:00	14:30	15:30		X	X	X																							X			
Organizational Process Performance	22.09.	0:30	15:30	16:00		X	X	X																							X			
Causal Analysis, Resolution and Defect Prevention	22.09.	0:30	16:00	16:30		X	X	X																							X			
Innovation and continuous quantitative Process Improvement	22.09.	0:30	16:30	17:00		X	X	X																								X		
Analysis of Documents						X		X																										
Reporting						X																												
Review								X																										
Presentation	o. 4.10	1:30	09:30	11:00		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

Figure 5. Siemens assessment schedule

### 5.2.4 Feedback

We miss a question on the adequacy of the SFE-process/ SFE-model: the process how to come to a platform, how to do scoping and requirements engineering seems to be different. It seems that most partners agree that scoping and requirements engineering is an intentional sub-process of DE; DE tries to predict the features that will be needed by the products of the system family in the (near) future; thus, DE is not just the reaction to the demands of AE; nevertheless, the process area Requirements Definition shows this picture: DE as reaction to AE.

The amplifications are not based on a common SFE reference process.

The other BAPO dimensions (Business, Architecture and Organisations) are mostly not covered. Especially scoping, product management, product line management, organisation, and institutionalisation of the SFE approach are not covered. A more detailed report about the experience of the CMMI®-SFE assessment is being prepared.

### 5.3 CMMI®-SFE TRIALS SUMMARY

As said before the appraisals were performed in parallel with the creation of the CMMI®-SFE model. This gave to the editors the time to correct the model in time, but of course also made appraisers feedback worse than expected in some cases. However, all the negative points listed in the previous sections have been corrected and the final version of CMMI®-SFE is not affected by them any more.

## 6. REFERENCES

- [1] Martin Becker, Günter Böckle, Nelufar Ulfat-Bunyadi, Stefan Voget: "Maturity Assessment for System-Family Engineering"
- [2] Erwin Engelsma: "Maturity Assessment w.r.t. System-Family Engineering for the Process Areas: Product Integration, Verification, and Validation"