CMMI®-Based Professional Certifications: The Competency Lifecycle Framework

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Acknowledgments

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Abstract

This report describes how a competency lifecycle framework can be used as the basis for the Software Engineering Institute's Capability Maturity Model® Integration (CMMI®)-based professional certifications, in such areas as leading appraisals and instructing CMMI courses. The competency lifecycle framework (CLF) provides a systematic approach to defining the abilities, skills, and knowledge an individual needs in order to successfully perform in a CMMI-based professional role. The overall CLF structure defines competency clusters appropriate for a wide variety of certifications. This report also outlines a supporting mechanism, the individual competency record (ICR), as a basis for tracking and administering certifications in terms of the demonstrated competency growth of candidates.

The expected benefits of using the CLF and ICR are discussed. This report also addresses plans for next steps and opportunities for future work.

This document is intended for anyone who would like to understand the concepts underlying CMMI-based professional certifications. This includes those responsible for developing the tools, documents, and training courses that lead to certifications. In addition, this document might also be of interest to anyone seeking or holding a CMMI-based authorization or certification, or anyone who would like to know how such certification programs are defined.

1 Introduction

The SEI has used formal qualification and authorization methods for its model-based process improvement licensing programs since the 1980s. This approach provides a measure of assurance that professionals using SEI developed products and services have the essential skills and domain-specific knowledge needed to be effective in these roles.

As the CMMI Product Suite has grown and matured, the SEI has chosen to complement this evolution in the models by moving toward the professional certification of individuals. Such certification depends on the development of clear and detailed definitions of the skills and knowledge certified individuals are expected to possess, and how the acquisition and development of such skills and knowledge will be supported and verified.

In order to practice in a formal CMMI-based role, an individual needs both permission to use the SEI's intellectual property and the ability to use that property effectively. Permission is managed through the SEI's licensing program, which is not addressed in this report. Only individuals nominated by a duly licensed organization will be considered as candidates for certification and each certified individual must maintain a formal relationship with one or more licensed organizations. This report focuses on the certification process itself and proposes a path individuals can follow to obtain, demonstrate, and develop the competencies needed to carry out the roles for which they are being certified.

Using the certification of SCAMPI[SM] A Lead Appraisers as the primary example, a detailed description of the competencies needed for the role, and the opportunities for the competencies to be learned, demonstrated, and further developed, are described. However, the overall structure is intended to eventually apply to a much wider range of certifications. These are expected to include, but not be limited to, certifications for instructors of the Introduction to CMMI course and the Intermediate Concepts of CMMI course, certifications for team leads for SCAMPI B and C, and certifications for PSP engineers and TSP launch coaches. Certifications might also be developed in the future for SCAMPI A, B, and C observers and for instructors and observers for the Introduction to CMMI course.

All of these certifications serve a similar purpose: to ensure that the people who are leading or managing key CMMI-based activities, whether for their own home organizations or for client organizations, are appropriately qualified to do so. The SEI oversees the quality of the services that are performed in its name, both by establishing qualification requirements for certified individuals and by reviewing the feedback and artifacts resulting from the performance of licensed activities.

A number of these certifications are expected to share common elements, or to serve as precursors to other certifications. In order to ensure that all CMMI-based certifications are consistent with each other, and to fully exploit the opportunities for commonality and sharing, a common structure has been developed to

- make explicit the clusters of competencies needed for various professional certifications
- identify how these competencies are to be acquired (with or without training provided by the SEI)
- clarify how these competencies might be demonstrated by candidates and objectively observed
- outline how certified professionals can further develop their competencies, aiming toward continuous improvement and the demonstration of competencies at an exemplary level

This common structure is referred to as a competency lifecycle framework (CLF).

This report describes the general sequence of events common to all SEI CMMI-based certifications. It then explains how this common structure will help the SEI to systematically define and administer CMMI-based certification processes in a clear and consistent manner. A related common structure, the individual competency record (ICR), is also described, and its anticipated uses identified. The expected benefits of using the CLF and ICR structures are discussed.

A generic CLF structure applicable to all CMMI-based certifications is then presented. Of course, for each certification, the generic CLF structure will need to be tailored and made more explicit, addressing the unique aspects of that certification. However, by basing each specific, tailored instance on a single, comprehensive and generic structure, commonality and consistency among different certifications can be fostered and encouraged.

This idea is directly analogous to the maturity level 3/capability level 3 concepts embodied in the CMMI models themselves, in which a standard set of organizational processes are tailored and customized to meet the need of individual development projects, allowing enhanced commonality and consistency among the processes used by different projects.

In order to clarify the intended use of these generic structures, a sample CLF template is provided in Appendix A, and an example ICR is provided in Appendix B. The development lifecycle leading to the certification and subsequent maturation of SCAMPI A Lead Appraisers is used in the examples. The objective is to present this tailored instance in enough detail to guide the following:

- revisiting, and possibly updating, the existing prerequisites that have been established for SCAMPI A Lead Appraiser Training
- detailed prerequisite review of candidates for SCAMPI A Lead Appraiser Training

- planned revision of the existing SCAMPI A Lead Appraiser Training (including helping candidates acquire competencies and allowing candidates to demonstrate competencies)
- planned revision of the existing Intermediate Concepts of CMMI course to ensure that the expected prerequisite competencies are appropriately addressed
- designation of essential components of a SCAMPI A Lead Appraiser ICR
- planned updating of SCAMPI A observation support materials
- establishment of consistent remediation guidelines for candidates who do not meet certification requirements
- possible maturation pathways beyond the initial certification

Finally, this report addresses the benefits of this approach, as well as opportunities for future work, including the following:

- further development of CLF and ICR instances for other CMMI-based certifications
- use of both examples included in this report
- additional instances to guide the development of materials to support other SEI certifications

2 The Certification Process Context

This section describes the generic certification process that all CMMI-based certifications follow, highlighting key aspects that are significant in the rest of this report. Then, the roles of the competency lifecycle framework and the individual competency record in this generic process are outlined. The details of these two mechanisms are described in subsequent sections.

2.1 The Generic Sequence of Events for Certifications

All of the CMMI-based certifications created will follow a common pattern. This pattern consists of the following steps:

1. **Prerequisite training and experience**—Before an individual can be considered a candidate for certification, that person must accumulate specified prerequisite training, competency in the profession's body of knowledge, and relevant practical experience. The purpose of these prerequisites is to ensure a basic level of both knowledge and relevant skill so that certification-related training has at least a minimum basis on which to build.
2. **Principal qualifying event (PQE)**—For each certification, there is one principal event that every certified person must complete successfully (even though there might be other prerequisite events). Typically, it is a specific training course. The training course also provides opportunities, through class exercises, homework, and examinations, to observe trainees and determine their level of understanding and skill. For example, SCAMPI Lead Appraiser Training (SLAT) is the PQE for SCAMPI A Lead Appraisers.
3. **Performance demonstration (PD)**—For each certification, there is a requirement that the trained candidate demonstrate the skills and abilities required of the role. This demonstration might take the form of passing a written examination, submitting examples of required types of products, or of actually performing the role in the presence of a qualified observer. For example, Introduction to CMMI trainers must teach a session of the course in the presence of a qualified observer, who rates the candidate against defined criteria, provides feedback to the candidate, and makes a recommendation to the SEI by means of a completed observation report. Typically, the PD is the last stage of the certification process.
4. **Maintaining certification**—Certifications have specific required activities that must be performed in order for them to be periodically renewed. At a minimum, some amount of experience in the certified role is required during the renewal period. In some cases, additional training might be required, especially when the materials associated with the ac-

tivity are updated. When the certification period nears expiration, a certified person's record is reviewed to see if the requirements for renewal have been fulfilled. Certification renewal includes a review of the individual's ICR data against the required elements. Notification of status is then given.

Interest in a candidate's activities and performance does not end with certification. The SEI expects to receive artifacts from each activity conducted under certification (e.g., the feedback form from Introduction to CMMI courses, and appraisal artifacts and feedback forms from SCAMPI appraisal sponsors and team members). These artifacts are reviewed to ensure that the expectations of the certification are still being satisfied.

There might be circumstances under which a particular candidate is determined to require remediation, either prior to their performance demonstration (typically as a result of concerns that arise during the PQE) or as a result of their PD (in cases where immediate certification is not recommended). Additional activities might be required in situations where, after certification, a person's submitted artifacts or reports from the field suggest performance problems. Remediation could be an alternative to more severe sanctions, which could include suspension or revocation of the certification.

2.2 Promoting Consistency and Coverage: CLFs and ICRs

Certification processes must ensure that each individual undertaking a particular certification is treated consistently and fairly. For related certifications, overlapping topics and issues must be addressed consistently. Finally, certification processes must assure that all required skills and abilities have been addressed adequately during the process, particularly in terms of the performance demonstration. The mechanisms described in this report, namely the competency lifecycle framework and the individual competency record, are intended to promote the achievement of these goals.

The CLF approach proposed for designing and administering CMMI-based certification processes involves the following steps:

1. Define key competencies required for basic satisfactory performance by an individual acting in a certified role.
2. Determine which competencies are to be acquired, whether formally or informally, through prerequisite training and experience, and to what extent and how acquisition of these competencies will be observed, confirmed, or measured.
3. Determine which competencies are to be primarily acquired, and at least partially observed and confirmed, during the PQE.
4. Determine which competencies are to be primarily observed and confirmed during the PD.

5. Determine which competencies will be monitored as part of the overall process of maintaining and renewing certifications.
6. Define approaches by which competencies might be developed to an exemplary level and achievement of such exemplary levels might be observed and, if needed, confirmed.

The mechanisms that support this basic approach include the following:

- a matrix, referred to as a competency lifecycle framework, which describes in detail the specific competencies required for a particular CMMI-based certification as well as how and when each one will be acquired, observed, and matured
- an individual competency record, retained centrally by the CMMI Initiative at the SEI, where a person's progress through all the steps of any CMMI-based certification will be recorded and stored
- rigorous enforcement of experience prerequisites, training prerequisites, and all performance demonstration requirements, throughout all CMMI-based certification programs

3 The Competency Lifecycle Framework

The SEI intends to create a series of certification programs for CMMI-based professional roles, such as TSP Launch Coach, SCAMPI A Lead Appraiser, and Introduction to CMMI course instructor. Certification of an individual for a particular professional role indicates that the person possesses, and has satisfactorily demonstrated to at least a minimum required degree, the competencies needed to perform that role in an effective manner. At this level, the idea of competency is very similar to the term "workforce competency" as used in the People Capability Maturity Model (CMM), which is defined as the "knowledge, skills, and process abilities that an individual should develop to perform a particular type of work" [Curtis 02].

These role competencies are unique to each specific CMMI-based professional role, but they can be grouped into "competency clusters," that is, groups of related specific competencies. The competency lifecycle framework is based on the key insight that there is a set of competency clusters that will be common to all of the expected CMMI-based certifications, just as there is a common pattern of activities leading to certification for each role. This section elaborates on these ideas, and presents the basic structure of the common competency lifecycle framework.

3.1 Defining Competency and Competency Clusters

According to the People CMM, a competency is "an underlying characteristic of an individual that is causally related to effective or superior performance, as determined by measurable, objective criteria, in a job or situation" [Curtis 02]. Clearly, the effective performance of the complex tasks required of any of the CMMI-based professional roles will involve multiple competencies of different types. The term "competency cluster" is also used to refer to a set of key competencies that are similar in nature to each other, and that together enable the individual to perform characteristic tasks for a particular role.

Each of the roles involves multiple types of functions, and therefore will involve multiple competency clusters. However, it might not be the case that all clusters are required for every role.

3.2 Structure of the Competency Lifecycle Framework

The competency lifecycle framework is a matrix that identifies the specific competencies required for a particular CMMI-based professional role and specifies the points in the certification process lifecycle at which the competencies are to be initially acquired, informally or

formally demonstrated, and eventually matured to an exemplary level. The row headings for the matrix are the names of the competency clusters that are common to all CMMI-based certifications, with specific instances relevant to a particular professional role identified. The column headings cover the main events in the certification lifecycle for a particular professional role, and are organized into three major groups: prior to the principal qualifying event (PQE), during the PQE, and after the PQE. (In the expanded example in Appendix A, these three groups are expanded into three tables.)

The elements of the matrix describe the acquisition, demonstration, or maturation of relevant competencies within a cluster, during a particular event in the certification lifecycle. In a given instance, a cluster might not be addressed during a particular event, or the cluster might be incidentally addressed, or it might be a primary focus of a particular event. The matrix structure forces a conscious and explicit decision regarding when, and in what ways, all competencies relevant to a professional role are acquired, demonstrated, and matured.

The generic form of the CLF is presented in Table 1.

COMPETENCY CLUSTERS	LIFECYCLE PHASES		
NOTE: A bulleted list of detailed competency requirement(s) for the particular certification will be provided under each competency cluster heading.	**Prior to PQE** *Expectations for the basic acquisition of competencies will be identified here, primarily through:* • *prior experience and training needed to qualify as a candidate for certification* • *designated prerequisite training courses (e.g., Intro to CMMI)* • *designated prerequisite experiences (e.g., participating as an appraisal team member)* *Expectations for the basic demonstration of competencies will be identified here, primarily through the following:* • *exercises performed, examinations taken, and products prepared during designated prerequisite training courses* • *observations of performance during designated prerequisite experiences*	**During PQE** **(including any required pre-tests and/or post-tests)** *Expectations for the basic acquisition of competencies during the presentations, discussions, and exercises of the PQE will be identified here.* *Expectations for the basic demonstration of competencies (i.e., elicitation and measurement) will be identified here, primarily through the following:* • *exercises performed, either in class or as homework, including a review of any products created* • *participation in classroom discussions in a way that demonstrates competencies* • *examinations taken, whether prior to, during, or just after the PQE* *Basic demonstration opportunities should measure multiple competencies when possible.*	**Following the PQE** *Expectations for the basic demonstration of competencies (that is, elicitation and measurement) will be identified here, primarily through the following:* • *performance demonstration through formal observation of actual performance in the field, if required* • *quality reviews of products submitted after the completion of field performances* • *feedback received from people involved in field performances (e.g., sponsors, trainees, team members, participants.)* ***Expectations for further basic acquisition of competencies and for mature acquisition (i.e., growing and developing competencies to a more advanced, exemplary level) will be identified here.*** ***Opportunities and mechanisms for mature demonstration (i.e., the elicitation and measurement of advanced, exemplary level competencies) will be identified here.***
1. Achieving & Managing Agreements			
2. Decision Making and Problem Solving			
3. Project Planning and Management			
4. Interpersonal Communication and Facilitation			
5. Integration, Articulation and Expression of Information			
6. Understanding and Adapting to Organizational Contexts			
7. Model Interpretation			
8. Product or Service Tailoring, Adaptation, and Application			
9. Professionalism			

Table 1: Competency Lifecycle Framework

Nine competency clusters have been identified as fundamental to the CMMI-based professional roles. Each of these clusters (which appears as a row heading) should be supplemented with specific competency descriptions for the intended professional role.

1. **Achieving and Managing Agreements**—The ability to reach, manage, and support clear and mutually satisfactory agreements with relevant sponsors, participants, and other stakeholders. Also includes monitoring whether the agreements made are being kept, and taking appropriate corrective action when one or more parties to an agreement find that it is no longer useful or appropriate.
2. **Decision Making and Problem Solving**—The ability to identify issues and potential solutions, evaluate advantages and drawbacks of each strategy, and to choose a suitable solution using a decision-making method appropriate to the context. Also might include awareness of a variety of decision-making strategies (optimizing, satisficing, etc.) and techniques (individual choice, consultative, collaborative, consensus, etc.), and the strengths and weaknesses of each.
3. **Project Planning and Management**—The ability to treat major role-related events (e.g., appraisals, course deliveries) as projects and to plan and manage these projects appropriately, in such areas as monitoring status and progress, and assessing and mitigating risks. Also might include documenting plans, collecting status information, sharing status information with stakeholders, and taking appropriate corrective action when actual status deviates significantly from plans.
4. **Interpersonal Communication and Facilitation**—The ability to hold effective and successful discussions with individuals and groups, with balanced focus on both effective listening and effective speaking. Also might include conducting interviews, moderating group or team discussions, establishing a comfortable and encouraging atmosphere for interviews or discussions, identifying and addressing tension or discomfort, and effective strategies for conflict resolution.
5. **Integration, Articulation, and Expression of Information**—The ability to aggregate separate but related items of information, to clearly and accurately communicate, and to effectively present information, either orally or in writing. Also might include finding the right phrasing or terminology to convey key points in a given context, and abstracting essential ideas from a large amount of detailed information.
6. **Understanding and Adapting to Organizational Contexts**—The ability to identify and understand defining aspects of an organization's culture and adjust behavior to more effectively operate within that culture. Also might include identifying key questions and key observations that highlight cultural issues, making appropriate personal adjustments (suitable attire, terminology and speech patterns, etc.), and understanding the common cultural patterns typically found in specific industries or regions.
7. **Model Interpretation**—The ability to consider how various CMMI model goals and practices can be implemented in different industries and project types. Also might include mapping model terminology and concepts to corresponding local terminology and

concepts, recognizing which aspects of practices are critically important in a given context and which are relatively unimportant, and understanding how local alternative practices can contribute effectively to goal satisfaction.

8. **Product or Service Tailoring, Adaptation, and Application**—The ability to understand the full range of options available in the relevant training course, appraisal method, or other licensed product or service, and to choose appropriate options for the circumstances surrounding a particular delivery of that product or service. Options or adaptations chosen should preserve the integrity and essential features of the product or service, while still accommodating any special local needs or circumstances (e.g., unconventional scheduling, participants at distant locations).
9. **Professionalism**—The ability to understand the behavioral obligations of the SEI Code of Professional Conduct, and the willingness and ability to abide by these behavioral obligations under all circumstances. Also might include managing one's own continuing professional growth and development, contributing to the knowledge base of practitioners through such means as professional papers, presentations, or shared artifacts, and acting at all times in a way that brings credit to the professional community.

Because of the complexity of any professional activity, including appraisals and teaching, many requisite activities fall into several competency cluster areas. For example, model interpretation (competency 7) is necessary to understand decisions that must be made (competency 2) and to achieve purposeful customer agreements in a professional manner (competencies 1 and 9). There is no ordinal hierarchy to these clusters; their interdependencies are most relevant to how they are acquired, demonstrated, and mastered.

As noted earlier, the competency clusters are the row headings of the CLF matrix. The column headings are based on the generic sequence of events for certifications discussed in section 2.1. Thus, there are three groups of columns:

- prior to the principal qualifying event (PQE), including both knowledge and experience gained prior to becoming a candidate for certification for a given role, and specific activities (such as courses or practical experience) that are identified as required prerequisites for the PQE
- during the PQE, including any pre-tests, in-class exercises and activities, homework assignments, and any final examination
- following the PQE, including any formal performance demonstration, as well as any review of routine products and feedback resulting from practicing the certified role

Within each group of columns, there might be specific columns concerned with different aspects of competency development, including the following:

- Basic Acquisition—This is a specification of the ways in which the basic minimum required level of a particular competency or competency cluster will be learned, such as by formal training or specific professional experience.

- Basic Demonstration—This is a specification of the mechanisms by which attainment of the basic minimum required levels of competency will be measured, or shown to have been successfully mastered. The mechanisms might include examinations, formal observations of practice, submission of products for review, completion of a required report, and so forth.
- Mature Acquisition—This is a specification of how more advanced levels of competency, beyond basic requirements, will be learned, perhaps through formal training or experience but perhaps also by mentoring or through personal development experiences not directly connected with the certified role.
- Mature Demonstration—This is a specification of how more advanced levels of competency, beyond basic requirements, will be demonstrated, and also states the mature or exemplary requirements for that competency cluster.

In general, the "Prior to PQE" columns and the "During PQE" columns will contain basic acquisition and basic demonstration entries. On the other hand, the "Following PQE" columns will contain basic demonstration entries, along with mature acquisition and mature demonstration entries.

The generic form of the CLF is presented in Table 1. Appendix A shows an example of an expanded CLF for a particular role certification, namely, the certification of SCAMPI A Lead Appraisers. Note that this example is intended to illustrate how the CLF structure would be applied to a particular certification and is not necessarily the final version of the SCAMPI A Lead Appraiser CLF. In particular, the example SCAMPI A Lead Appraiser CLF does not include any instances of either mature acquisition or mature demonstration. In the future, the SEI might seek further input from the Lead Appraiser community prior to adding mature acquisition and mature demonstration items to the CLF matrix.

3.3 Central Role of the Principal Qualifying Event

Because the SEI needs to determine whether, and to what extent, a candidate is sufficiently qualified to be certified to conduct the selected CMMI-based activity, it will necessarily specify, design, and, typically, conduct the PQE. The PQE can take many forms, but will generally be a course, a formal practice observation, or a specified performance assignment such as a required presentation or examination. In every instance, the PQE will specify performance outcome objectives consistent with competencies defined in the competency lifecycle framework. Performance measures associated with the PQE will be determined to ensure a consistent and reliable means to assess observable, basic, and mature competencies.

Pre-PQE requirements can be viewed as enforced prerequisites to the PQE. This will help to ensure that the candidate has acquired and demonstrated the competencies necessary to successfully engage in the PQE.

Because there will be performance measures associated with the pre-PQE requirements, the PQE content (e.g., lectures and exercises) and measures (e.g., demonstration activities and

tools) can focus on new enabling abilities and capabilities, building on those demonstrated prior to the PQE. The PQE will typically include lectures, exercises, examinations, and other activities as specified in the CLF, and should directly support the acquisition and demonstration of key competencies.

Post-PQE activities provide the opportunity to acquire and demonstrate behaviors that can best be understood within a real-world context. These might also include the opportunity to accomplish competency maturation at an exemplary level, and might include evidence of satisfactory performance such as the successful implementation training, mentor-led observations, formal reporting and review, and workshop leadership.

Performance at each of these competency acquisition milestones will be compiled, annotated, and tracked in the form of an individual competency record.

4 Individual Competency Records

The structure of a competency lifecycle framework is intended to provide overall guidance for a particular type of certification. However, each individual seeking certification needs a mechanism to understand his or her current status. An individual competency record (ICR) is therefore needed for each individual who is to be certified for one or more CMMI-related activities. This record will provide a clear and useful tracking of competency development requirements and milestones achieved. The individual competency record will also be used to accumulate observations and artifacts related to an individual's progress.

The basic structure of an ICR is a matrix, similar to the CLF. In addition to the rows for each competency cluster, there is a "general comments and artifacts" row. The columns correspond to the actual events in the person's certification path. See Appendix B for an example of an ICR matrix.

For PQE prerequisites, the record would, in most cases, be limited. For example, the Introduction to CMMI course might include course descriptors, such as version, dates, instructors, and location. The record might or might not include more enabling information such as course exercise performance or instructor comments.

However, the Intermediate Concepts course might track the success of a student's in-class presentation on a Process Area, examination results, and instructor comments. Similarly, whenever someone serves as a team member on a SCAMPI appraisal team, the Lead Appraiser often develops an informed opinion about that person's performance in a variety of competency areas. In many cases, it might be an appropriate requirement for the Lead Appraiser to record predefined observations about team members, especially for those who are or who aspire to be team leads or Lead Appraisers.

After prerequisite data have been noted on an individual ICR, PQE information can be captured and tracked in some detail. In addition to these comments, additional information should be recorded by others. For example, course instructors would be expected to record observations resulting from homework assignment, in-class exercises, examinations, and other course activities.

The second set of major entries would result from the completed observation report resulting from a PD, where certification for a role requires an observation as a PD. Here, there is already a clear expectation that the observer will be recording competency-specific observations regarding the candidate and completing an observation report. Observations need to be collected and integrated with the rest of the candidate's ICR so that a picture of the individ-

ual's strengths, weaknesses, and specific competencies to perform the authorized activities emerges.

Even after certification, artifacts and feedback comments will continue to come from courses taught or appraisals led by the certified individual. Many of these will be general in nature, but some of them might well be competency-specific. Certainly, if any complaints are received or any quality issues result from normal quality reviews, these could be competency-linked and added to the ICR. Example applications of the ICR might include the following:

- prior to the Intermediate Concepts course—The record of which process areas the person had been responsible for on appraisal teams could be used to assign a PA that the person had not handled before.
- prior to the PQE—The instructors can be aware of any patterns of strengths or weaknesses that have appeared in prerequisite activities, as well as any patterns that emerge during the PQE itself. These patterns then become the basis for any recommendations regarding observation of the candidate, as well as any requirements for remediation, mentoring, or other appropriate actions.
- prior to the PD (when an observation is required)—Patterns of strengths or weaknesses can provide very valuable guidance for the observer, so that any known areas of weaknesses receive special attention.
- after certification—Any compliments, complaints, or quality issues that arise could be considered in the context of the previously reported patterns of competency strengths and weaknesses and an appropriate disposition determined. Also, individuals could provide details about the competency maturation and development activities that they have undertaken, and about professional contributions they have made (papers, presentations, shared tools, etc.).

A few other key points should be noted about the ICRs of candidates and certified individuals. First of all, since the records do contain personal information, they will be maintained in secure storage, with access provided on a need-to-know basis only, similar to how appraisal records are currently handled. It is also important to note that information entered in an ICR will have normally already been provided to the individual in the form of constructive feedback. Thus, it should be standard policy that individuals always have the right to see the contents of their own ICRs, and to request correction of any erroneous entries. Additionally, such requests should be promptly addressed and resulting actions documented.

5 Benefits of the Competency Lifecycle Approach

Adopting this approach to designing and administering certification processes based on CLFs and ICRs is expected to have the following benefits:

- All individuals certified by the SEI to perform CMMI-based roles will have all the basic competencies required for those roles.
- Alignment and consistency will exist between SEI model training (and any other prerequisite training) and role-specific training. This will include a clear, planned curriculum for required and optional courses.
- There will be a clear, documented basis for SEI decisions regarding the certification of individuals, including waivers from requirements or required remediation activities.
- Assessments of individual competencies will be based on strategic evaluation events tailored to increase the effectiveness of the observation. This will enhance comprehensiveness and objectivity.
- Required performance demonstrations involving observations will be better focused and more effective since they will be based on a candidate's ICR, with identified patterns of candidate strengths and weaknesses.
- Members of the CMMI-based professional community will have documented guidelines for professional growth and development toward exemplary-level competencies.
- Examinations (especially those that are part of a PQE) will be focused on explicit individual competencies to be demonstrated, and appropriate remedial activities based on identified shortcomings will be provided.

In addition, there is the opportunity to refine the identified set of competency clusters. As experience is gained in using the CLF and ICR mechanisms to support different types of certifications, the structures can be updated and modified. Also, as the experience of the CMMI-based professional community with developing and demonstrating mature and exemplary levels of competency grows, this experience can be captured and incorporated into the mature acquisition and mature demonstration entries in the CLFs for different certified roles.

6 Next Steps and Areas for Future Work

The competency lifecycle framework needs to be explicated and tested in several contexts. Of particular interest are the major competency clusters. It is currently assumed that these nine areas comprise all significant requisite behavior *categories*, requiring only customization for any specific principal qualifying event.

In the curriculum for CMMI certifications, the Intermediate Concepts of CMMI course serves as a prerequisite for SCAMPI Lead Appraiser Training, SCAMPI B and C Team Leader Training, and CMMI Instructor Training. The CLF will be used to identify the prerequisite competencies that are necessary for SCAMPI Lead Appraisers, SCAMPI B and C team leads, and candidate instructors for the Introduction to CMMI course, so that the Intermediate course can address the development of requisite competencies and provide opportunities for these competencies to be explicitly demonstrated. The CLF will help to identify appropriate remediation when the competency evaluation indicates that a candidate's development is less than expected.

The CLF will similarly guide the design of the SCAMPI B and C Team Leader Training and the redesign of the SCAMPI Lead Appraiser Training (SLAT) course and associated evaluation criteria. The evaluation criteria will include expectations for successful completion of the course, and each student in the course will be evaluated on specific competencies. These evaluations will be used to determine if students have successfully completed the course or if they require remediation, and also to assist in the mentoring that takes place during the observation process.

Qualified Observing SCAMPI Lead Appraisers perform two primary functions during observations: mentoring candidates so they understand what it takes to be successful SCAMPI Lead Appraisers and evaluating the performance of candidates during observations to determine if they have the necessary competencies to become SCAMPI Lead Appraisers. As previously mentioned, the evaluations from the SLAT course will highlight areas so the observers can focus their mentoring tasks. The CLF will be used as a basis for evaluating the performance of a candidate during the observation.

Future definitions and descriptors for mature or exemplary behavior would require extensive analysis and significant input from experienced practitioners. Once these are established, new or modified PQEs can be identified and developed using the competency lifecycle framework. This will be essential so that mature PQEs and associated tasks and measures can be identified and implemented. Understanding exemplary behaviors and associated measures might also help determine how best to select and qualify SCAMPI Lead Appraisers to per-

form formal observations of candidates, as well as to conduct high maturity appraisals (i.e., appraisals at maturity or capability levels 4 and 5).

ICR data should be compiled, particularly to test the instrumentation itself, and to understand and refine the PQEs, lifecycle components, and requirements for baseline and exemplary performance. An ICR repository will be needed to maintain the ICRs of candidate and authorized individuals. The primary purpose of the repository will be to provide access *only* to people authorized to update or reference existing ICRs, or to initiate new ones. Mechanisms to provide access by individuals to their own records will probably be separate from normal online access. Such access might be provided by printouts or duplicate records.

In addition, the relationships among competency maturation, credentials for certification, and individual competency records should be explored.

Appendix A: Example of a CLF

SCAMPI A Lead Appraiser authorization is used in this example. Mature acquisition and demonstration examples are not included, but they could be recorded in additional columns or tables.

SCAMPI Lead Appraiser Training (SLAT) Competency Lifecycle Framework

Part 1: Prior to SLAT Course

Competency Clusters	Opportunities to Acquire Competence			Opportunities to Demonstrate Competence		
	A) Prior to any training or appraisal experience	**B) During required prerequisite training**	**C) During participation in SCAMPIs (prior to training)**	**A) During required prerequisite training**	**B) During participation in SCAMPIs (prior to training)**	**C) Through required pre-SLAT assignments**
1) Achieving and Managing Agreements - reaching agreements with sponsors about appraisal planning and conduct - reaching agreements with appraisal team members about appraisal operations - monitoring agreements with sponsors and team members and taking corrective action as needed	Assumed to be acquired during earlier training and experience.	Not covered.	Assumed to be acquired.	Not an opportunity for demonstration.	Demonstrated through active participation in team activities; adherence to agreements made; and communication of risks associated with prior agreements.	Could be demonstrated in a scenario-based pre-test or left for later demonstration.
2) Decision Making and Problem Solving - teaching, leading, and managing consensus decision making, as required by the appraisal method - identifying and evaluating alternative solutions to appraisal issues and problems as they arise and selecting a successful solution - effectively making use of team members, site coordinator, sponsor, participants, and other potential resources in solving problems	Assumed to be acquired during earlier training and experience.	Appraisal team training covers central role of consensus decision making in appraisals.	Might acquire experience with consensus decision making for first time.	Not an opportunity for demonstration.	Demonstrated when problems or issues encountered during appraisal planning and conduct are recognized and communicated to LA. Active support for effective resolution of issues as a team member also demonstrated.	Could be demonstrated in a scenario-based pre-test involving problems typically encountered by LAs, or could be left for demonstration during SLAT or authorizing observation.

Competency Clusters	Opportunities to Acquire Competence			Opportunities to Demonstrate Competence		
	A) Prior to any training or appraisal experience	**B) During required prerequisite training**	**C) During participation in SCAMPIs (prior to training)**	**A) During required prerequisite training**	**B) During participation in SCAMPIs (prior to training)**	**C) Through required pre-SLAT assignments**
3) Project Planning and Management - collecting status information from team members on a routine basis - making sure team members are aware of appraisal status, as compared to plans, throughout the on-site period - putting the appraisal back on schedule after some tasks fall behind (e.g., providing help when needed, changing team member assignments, reallocating work) - establishing contingency plans as part of appraisal planning; determining when and how to exercise them	Assumed to be acquired during earlier training (e.g. Project Management Institute training) and experience.	Not covered.	Assumed to be acquired during appraisals.	Not an opportunity for demonstration.	Demonstrated through self-management of mini-team tasks; presentation of mini-team status information; and identification of appraisal risks and potential mitigation strategies.	Could be demonstrated in a scenario-based pre-test involving project management challenges typically encountered by LAs, or could be left for demonstration during SLAT or authorizing observation.
4) Interpersonal Communication and Facilitation - establishing a comfortable and encouraging atmosphere for interview sessions and internal team discussions - facilitating effective and successful individual and group interviews through effective use of question scripts, vocal inflection, reflective listening, eye contact, body language, and time management - facilitating efficient and effective team discussion sessions through identification of sources of tension and conflict, summarizing and articulating points made thus far, and reframing issues so that they can be more effectively resolved	Assumed to be acquired during earlier training and experience.	Appraisal team training covers the effective facilitation of discussions (for individual and group interviews in appraisals).	Assumed to be acquired during appraisals.	Rarely demonstrated during team training interviewing skills exercises.	Primarily demonstrated when team members are given the opportunity to facilitate appraisal interviews. Might also be demonstrated when team members make helpful contributions during facilitation of team discussions.	Normally demonstrated during SLAT or authorizing observation.
5) Integration, Articulation, and Expression of Information - abstracting key points from a large amount of detailed appraisal data - finding the right ways to convey key points so they will be understood by the intended audience, particularly when crafting findings and recommendations - expressing information effectively in oral presentations and written reports	Assumed to be acquired during earlier training and experience.	Appraisal team training covers some aspects of effective communication of appraisal findings.	Best acquired when crafting and reviewing findings during appraisals.	Might be demonstrated during findings-crafting exercises in team training.	Primarily demonstrated when mini-teams prepare initial draft findings and during team reviews of draft and final findings. Might also be demonstrated when team members draft final written appraisal report.	Normally demonstrated during SLAT or authorizing observation.

Competency Clusters	Opportunities to Acquire Competence			Opportunities to Demonstrate Competence		
	A) Prior to any training or appraisal experience	**B) During required prerequisite training**	**C) During participation in SCAMPIs (prior to training)**	**A) During required prerequisite training**	**B) During participation in SCAMPIs (prior to training)**	**C) Through required pre-SLAT assignments**
6) Understanding and Adapting to Organization Contexts - when needed, identifying and recruiting someone to serve as a "local cultural guide" for organizational and/or national cultural issues - asking key questions and making key observations that highlight cultural issues - making appropriate adjustments (suitable clothing, appropriate terminology and speech patterns, sensitivity to power relationships outside the documented ones, etc.) - demonstrating understanding of the process patterns common to specific industries and project types	Assumed to be acquired during earlier training and experience.	Not covered.	Best acquired during planning and conducting appraisals within an organizational context, especially if the context involved is not the candidate's home context.	Not an opportunity for demonstration.	For internal team members, demonstrated when they provide cultural information and insights to other team members. For external team members, demonstrated by the effective use of organization's cultural information.	Could be demonstrated in a scenario-based pre-test involving organizational culture adjustments typically encountered by LAs, or could be demonstrated during SLAT or authorizing observation.
7) Model Interpretation - mapping reference model terminology and concepts to corresponding local terminology and concepts - recognizing which aspects of practices are especially important or relatively unimportant in the current context - demonstrating understanding of the ways local alternative practices can contribute to goal satisfaction in a manner equivalent to the reference model's stated practices	Not assumed to be acquired during prior training or experience, although some candidates will have substantial prior model interpretation experience (some of which might have to be unlearned).	Introduction to CMMI covers to a limited extent; Intermediate Concepts of CMMI covers in much greater depth.	Best acquired during experience as SCAMPI team member, particularly for the PAs that are assigned to the person as a mini-team member.	Demonstrated through exercises and class discussions in Intermediate Concepts of CMMI, and especially in final exam results. (Understanding of PA subject matter; SP and GP structure/content; and ML and CL concepts demonstrated. Some demonstration of mapping these practices and concepts to specific organizational contexts.)	Might be demonstrated through SCAMPI conduct, especially in mini-team work and in whole team discussions.	Demonstration not required since prerequisite training demonstration is sufficient.

Competency Clusters	Opportunities to Acquire Competence			Opportunities to Demonstrate Competence		
	A) Prior to any training or appraisal experience	**B) During required prerequisite training**	**C) During participation in SCAMPIs (prior to training)**	**A) During required prerequisite training**	**B) During participation in SCAMPIs (prior to training)**	**C) Through required pre-SLAT assignments**
8) Product or Service Tailoring, Adaptation and Application - identifying the characteristics of a particular appraisal that will most influence the tailoring choices (e.g., appraisal mode, organization size, sponsor needs, geography,) - identifying critical requirements that will drive appraisal team selection - identifying, together with the appraisal sponsor and the site coordinator, a suitable representative sample of projects to be included in the appraisal - specifying the various participants and groups to be interviewed - identifying data gathering strategies and events (including highlighting opportunities for simultaneous, parallel events) - specifying the findings validation events to be conducted	Not assumed to be acquired in earlier training or experience.	SCAMPI appraisal team training covers to limited extent. (Covered in much greater depth in SLAT.)	Best acquired while planning and conducting appraisals within an organizational context.	Not an opportunity for demonstration.	Might be demonstrated during SCAMPI planning if team members contribute substantial planning ideas or options.	Could be covered in a scenario-based pre-test, or could be left for demonstration during SLAT or authorizing observation.
9) Professionalism - mapping the duties and obligations listed in the SEI Professional Code of Conduct to the circumstances of a given appraisal - carrying out one's role in a manner fully consistent with the letter and the intent of the code - taking steps to promote one's own professional growth and development - contributing to the profession's body of knowledge through papers, presentations, etc.	Not assumed to be acquired in earlier training or experience.	All prerequisite SEI courses might touch on this topic; covered in much more depth in SLAT course.	Acquired through observation of Lead Appraiser planning and conducting appraisals, but formal presentations about professionalism not provided.	Not an opportunity for demonstration.	Might be demonstrated through adherence to team member behavior expectations during the conduct of a SCAMPI. (Conduct provides some indication of future adherence to LA behavior expectations, especially if there are problems.)	Normally demonstrated during SLAT or authorizing observation.

SCAMPI Lead Appraiser Training (SLAT) Competency Lifecycle Framework

Part 2: During SLAT Course

Competency Clusters	Opportunities to Acquire Competence		Opportunities to Demonstrate Competence		
	A) During lectures and readings in the SLAT course	**B) During exercises (both in-class and take-home) in SLAT course**	**A) During participation in class activities (this includes questions asked and contributions to class discussions)**	**B) During role-play exercises and in the production of artifacts during in-class and take-home exercises**	**C) Through end-of-class examination (written or oral)**
1) Achieving and Managing Agreements - reaching agreements with sponsors about appraisal planning and conduct - reaching agreements with appraisal team members about appraisal operations - monitoring agreements with sponsors and team members and taking corrective action as needed	Assumed to be acquired earlier; lectures might cover use in an appraisal context.	Experience in making and managing agreements in an appraisal context acquired by some candidates through role-play exercises.	Not an opportunity for demonstration.	Might be demonstrated through role-play exercises involving the creation and management of agreements. (It might not be possible to observe everyone in a class.)	Not an opportunity for demonstration. This competency is not likely to be a focus of end-of-class exams.
2) Decision Making and Problem Solving - teaching, leading, and managing consensus decision making, as required by the appraisal method - identifying and evaluating alternative solutions to appraisal issues and problems as they arise and selecting a successful solution - effectively making use of team members, site coordinator, sponsor, participants, and other potential resources in solving problems	Assumed to be acquired earlier; lectures might cover use in an appraisal context.	Decision making and problem-solving skills in an appraisal context acquired through role-play exercises.	Might be demonstrated during classroom discussions of theoretical problem solving situations and how different decision-making strategies could best be applied.	Might be demonstrated during role-play exercises involving team activities or through the discussion of "war stories." (It might not be possible to observe everyone in a class.)	Could be demonstrated through end-of-class exam question asking for a solution to typical problems encountered during appraisals, or through a question asking the candidate to identify the appropriate decision-making strategies for various circumstances.
3) Project Planning and Management - collecting status information from team members on a routine basis - making sure team members are aware of appraisal status, as compared to plans, throughout the on-site period - putting the appraisal back on schedule after some tasks fall behind (e.g., providing help when needed, changing team member assignments, reallocating work) - establishing contingency plans as part of appraisal planning; determining when and how to exercise them	Assumed to be acquired during earlier training and experience; use in an appraisal context is covered in depth in SLAT lectures.	Appraisal planning skills acquired through exercises. Role-play exercises involving management of team activities will probably not be long enough, detailed enough, or realistic enough to provide opportunities to learn about collecting status and taking corrective action.	Might be demonstrated during classroom discussions of the methods and approaches to collecting status data and through suggestions of corrective actions that could be taken in various situations.	Best demonstrated through appraisal planning exercises. Role-play exercises that involve managing team activities will probably not be long enough, detailed enough, or realistic enough to provide opportunities to demonstrate competence in collecting status and taking corrective action.	Could be demonstrated through end-of-class exam question asking prospective Lead Appraisers to describe how they would monitor work status during an appraisal and suggest ways to put the appraisal back on schedule when needed.

Competency Clusters	Opportunities to Acquire Competence		Opportunities to Demonstrate Competence		
	A) During lectures and readings in the SLAT course	**B) During exercises (both in-class and take-home) in SLAT course**	**A) During participation in class activities (this includes questions asked and contributions to class discussions)**	**B) During role-play exercises and in the production of artifacts during in-class and take-home exercises**	**C) Through end-of-class examination (written or oral)**
4) Interpersonal Communication and Facilitation - establishing a comfortable and encouraging atmosphere for interview sessions and internal team discussions - facilitating effective and successful individual and group interviews through effective use of question scripts, vocal inflection, reflective listening, eye contact, body language, and time management - facilitating efficient and effective team discussion sessions through identification of sources of tension and conflict, summarizing and articulating points made thus far, and reframing issues so that they can be more effectively resolved	Assumed to be acquired during earlier training and experience. Application of skills in an appraisal context will be covered in depth in SLAT lectures.	Experience in facilitating individual interviews and group discussions acquired through role-play exercises.	Might be demonstrated during classroom discussions of models of team management and methods for handling various individual and group facilitation situations.	Might be demonstrated during role-play exercises involving the facilitation of individual interviews and group discussions. (It might not be possible to observe everyone in a class.)	Not an opportunity for demonstration. This competency is not likely to be a focus of end-of-class exams.
5) Integration, Articulation, and Expression of Information - abstracting key points from a large amount of detailed appraisal data - finding the right ways to convey key points so they will be understood by the intended audience, particularly when crafting findings and recommendations - expressing information effectively in oral presentations and written reports	Assumed to be acquired during earlier training and experience. Applications of these skills in an appraisal context (especially in finding briefings and final reports) will be covered in depth in SLAT lectures.	Experience in integrating and expressing information in an appraisal context acquired through writing appraisal products in homework exercises, and to a lesser extent through role-play exercises involving team data consolidation and/or data presentation activities.	Might be demonstrated during classroom discussions requiring the integration and articulation of information, such as self-introductions and discussions of different appraisal applications.	Demonstrated thorough homework writing appraisal products, and to a lesser extent during role-play exercises involving team data consolidation and/or data presentation. (Everyone can do homework assignments but it might not be possible to observe everyone in a class.)	Could be demonstrated through an end-of-class exam question giving prospective Lead Appraisers a list of key facts and asking them to formulate a clear and accurate summary finding statement.
6) Understanding and Adapting to Organization Contexts - when needed, identifying and recruiting someone to serve as a "local cultural guide" for organizational and/or national cultural issues - asking key questions and making key observations that highlight cultural issues - making appropriate adjustments (suitable clothing, appropriate terminology and speech patterns, sensitivity to power relationships outside the documented ones, etc.) - demonstrating understanding of the process patterns common to specific industries and project types	SLAT lectures cover ways to apply organizational culture understanding and the adaptation of skills in the context of appraisals.	Experience in understanding and adapting to an organizational context acquired in role-play exercises that involve planning discussions with sponsors and conducting and managing team activities--if the simulation is rich and detailed enough to introduce significant cultural issues.	Demonstrated during classroom discussions designed to allow candidates to describe issues of organizational culture and context that they have encountered and how they have seen them handled (successfully and unsuccessfully).	Might be demonstrated during role-play exercises that involve planning discussions with sponsors and conducting and managing team activities. (It might not be possible to observe everyone in a class.)	Not usually an opportunity for demonstration. This competency is not likely to be a focus of end-of-class exams.

Competency Clusters	Opportunities to Acquire Competence		Opportunities to Demonstrate Competence		
	A) During lectures and readings in the SLAT course	**B) During exercises (both in-class and take-home) in SLAT course**	**A) During participation in class activities (this includes questions asked and contributions to class discussions)**	**B) During role-play exercises and in the production of artifacts during in-class and take-home exercises**	**C) Through end-of-class examination (written or oral)**
7) Model Interpretation - mapping reference model terminology and concepts to corresponding local terminology and concepts - recognizing which aspects of practices are especially important or relatively unimportant in the current context - demonstrating understanding of the ways local alternative practices can contribute to goal satisfaction in a manner equivalent to the reference model's stated practices	Not covered in SLAT lectures. (Covered in depth in Intermediate Concepts of CMMI.)	Not covered. (Exercises focus more on appraisal method issues than on model interpretation issues.)	Could be demonstrated during classroom discussions designed to allow candidates to describe issues of model mapping and interpretation that they have encountered and how they have seen them handled (both generic practices and PA-specific practices).	Not usually an opportunity for demonstration. (Role-play exercises focus more on appraisal method issues than model interpretation issues.)	Not usually an opportunity for demonstration. (This competency is covered in end-of-class exam in Intermediate Concepts of CMMI.)
8) Product or Service Tailoring, Adaptation and Application - identifying the characteristics of a particular appraisal that will most influence the tailoring choices (e.g., appraisal mode, organization size, sponsor needs, geography,) - identifying critical requirements that will drive appraisal team selection - identifying, together with the appraisal sponsor and the site coordinator, a suitable representative sample of projects to be included in the appraisal - specifying the various participants and groups to be interviewed - identifying data gathering strategies and events (including highlighting opportunities for simultaneous, parallel events) - specifying the findings validation events to be conducted	SLAT lectures cover acceptable tailoring and adaptation of the SCAMPI method, ways the method can be applied, and circumstances that lead to choosing different alternatives.	Experience with tailoring and adapting appraisal method acquired during role-play exercises that involve team activities and planning discussions with sponsors, and through homework assignments that involve preparation of appraisal products (especially planning products).	Demonstrated during classroom discussions that highlight candidates' understanding of appraisal method tailoring and adaptation issues, especially related to the method overview and planning lectures.	Demonstrated during role-play exercises that involve planning discussions with sponsors and team activities, and through homework assignments that involve preparation of appraisal products (especially planning products).	Demonstrated through questions on end-of-class exam question about the flexibility and limitations of the appraisal method and appropriate tailoring options for a variety of circumstances.
9) Professionalism - mapping the duties and obligations listed in the SEI Professional Code of Conduct to the circumstances of a given appraisal - carrying out one's role in a manner fully consistent with the letter and the intent of the code - taking steps to promote one's own professional growth and development - contributing to the profession's body of knowledge through papers, presentations, etc.	SLAT lectures cover the SEI Professional Code of Conduct and professional behavior expected of Lead Appraisers.	Experience with applying the SEI Professional Code of Conduct acquired during role-play exercises that involve planning discussions with sponsors and conducting and managing team activities--if the simulation is rich and detailed enough to introduce significant cultural issues.	Could be demonstrated during classroom discussions (introduced with a scenario-based exercise) asking candidates to describe issues that arise when applying the SEI Code of Conduct in theoretical situations and how they applied it in the past.	Might be demonstrated during role-play exercises involving planning discussions with sponsors and managing team activities. (It might not be possible to observe everyone in a class.)	Best demonstrated through an end-of-class exam question asking the candidate to articulate the behavioral obligations of Lead Appraisers under the Code of Conduct and describe what the code would require under various scenarios.

SCAMPI Lead Appraiser Training (SLAT) Competency Lifecycle Framework

Part 3: After the SLAT Course

Competency Clusters	Opportunities to Demonstrate Competence				
	A) During formally observed appraisal, and possibly during planning, team training, and readiness review events	**B) Through products resulting from the formally observed appraisal (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**C) Through formal or informal feedback received from the sponsor or the team members of the observed appraisal**	**D) Through products resulting from all subsequent reported appraisals (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**E) Through formal or informal feedback received from the sponsor or the team members of all subsequent reported appraisals**
1) Achieving and Managing Agreements - reaching agreements with sponsors about appraisal planning and conduct - reaching agreements with appraisal team members about appraisal operations - monitoring agreements with sponsors and team members and taking corrective action as needed	Demonstrated during appraisal, through the management of previously made agreements and the creation of new agreements with sponsors, site coordinators, team members, and participants. Best demonstrated during planning and team training, if observed by a qualified observer.	Demonstrated in appraisal input and appraisal plan, which should reflect clear and unambiguous agreements with sponsors, site coordinators, and other participants. The change history of these items might also suggest how well agreements were managed.	Not usually an opportunity for demonstration. (Will probably not come up in feedback unless there are major problems in making or managing agreements.)	Demonstrated in appraisal input and appraisal plan, which should reflect clear and unambiguous agreements with sponsors, site coordinators, and other participants. However, these documents do not usually receive extensive attention unless a problem is reported.	Not usually an opportunity for demonstration. (Will probably not come up in feedback unless there are major problems in making or managing agreements.)
2) Decision Making and Problem Solving - teaching, leading, and managing consensus decision making, as required by the appraisal method - identifying and evaluating alternative solutions to appraisal issues and problems as they arise and selecting a successful solution - effectively making use of team members, site coordinator, sponsor, participants, and other potential resources in solving problems	Demonstrated during appraisal, especially during team work sessions and interview sessions. Also demonstrated during planning, if observed by a qualified observer.	Not usually an opportunity for demonstration. Products indicate the decisions and solutions that were reached, but rarely indicate how or what problems were intended to be resolved.	Sponsor feedback not usually an opportunity for demonstration. Might be demonstrated through team member feedback if there was a memorable incident during the appraisal, either positive or negative.	Not usually an opportunity for demonstration. Products indicate the decisions and solutions that were reached, but rarely indicate how or what problems were intended to be resolved.	Sponsor feedback not usually an opportunity for demonstration. Might be demonstrated through team member feedback if there was a memorable incident during the appraisal, either positive or negative.
3) Project Planning and Management - collecting status information from team members on a routine basis - making sure team members are aware of appraisal status, as compared to plans, throughout the on-site period - putting the appraisal back on schedule after some tasks fall behind (e.g., providing help when needed, changing team member assignments, reallocating work) - establishing contingency plans as part of appraisal planning; determining when and how to exercise them	Best demonstrated during appraisal, especially during team work sessions when team work status is reviewed. Also demonstrated during planning, if observed by a qualified observer.	Demonstrated in appraisal plan, especially through detailed scheduling, resource planning, identification of logistical needs, and identification and mitigation of risks. Some aspects of project monitoring and control might be visible in the change history of the appraisal plan.	Demonstrated in comments from sponsors and team members about the management of the appraisal. (A question about project planning and management should be included on the feedback form.)	Demonstrated in appraisal plan, especially through detailed scheduling, resource planning, identification of logistical needs, and identification and mitigation of risks. However, these documents do not usually receive extensive attention unless a problem is reported.	Demonstrated in comments from sponsors and team members about the management of the appraisal. (A question about project planning and management should be included on the feedback form.)

Competency Clusters	Opportunities to Demonstrate Competence				
	A) During formally observed appraisal, and possibly during planning, team training, and readiness review events	**B) Through products resulting from the formally observed appraisal (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**C) Through formal or informal feedback received from the sponsor or the team members of the observed appraisal**	**D) Through products resulting from all subsequent reported appraisals (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**E) Through formal or informal feedback received from the sponsor or the team members of all subsequent reported appraisals**
4) Interpersonal Communication and Facilitation - establishing a comfortable and encouraging atmosphere for interview sessions and internal team discussions - facilitating effective and successful individual and group interviews through effective use of question scripts, vocal inflection, reflective listening, eye contact, body language, and time management - facilitating efficient and effective team discussion sessions through identification of sources of tension and conflict, summarizing and articulating points made thus far, and reframing issues so that they can be more effectively resolved	Facilitation skills best demonstrated during individual and group interviews and during team discussions of findings and ratings. Also demonstrated during planning and team training, if observed by a qualified observer.	Not usually an opportunity for demonstration. Products might indirectly indicate the outcomes of discussions and interviews, but rarely demonstrate the facilitation skills involved.	Sponsor feedback not usually an opportunity for demonstration. Might be demonstrated through team member feedback about facilitation skills during formal interviews and group discussions within the team. (A question about communication and facilitation should be included on the feedback form.)	Not usually an opportunity for demonstration. Products might indicate the outcomes of discussions and interviews but rarely indicate the facilitation skills involved.	Sponsor feedback not usually an opportunity for demonstration. Might be demonstrated through team member feedback about facilitation skills during formal interviews and group discussions within the team. (A question about communication and facilitation should be included on the feedback form.)
5) Integration, Articulation, and Expression of Information - abstracting key points from a large amount of detailed appraisal data - finding the right terminology and expressions to convey key points so that they will be understood by the intended audience, particularly when crafting findings and recommendations - expressing information effectively in both oral presentations and written reports	Best demonstrated during the appraisal, particularly during the preparation and presentation of draft findings and final findings. Also demonstrated during planning, if observed by a qualified observer.	Demonstrated in the integration and articulation of the findings in the Final Findings Briefing, and possibly in other products.	Demonstrated in comments from sponsors and team members about clarity of findings and the effectiveness of findings presentations. (A question about findings should be included on the feedback form.)	Demonstrated in the integration and articulation of the findings in the final findings briefing, and possibly in other products. However, the findings do not usually receive extensive attention unless a problem is reported.	Demonstrated in comments from sponsors and team members about clarity of findings and the effectiveness of findings presentations. (A question about findings should be included on the feedback form.)
6) Understanding and Adapting to Organization Contexts - when needed, identifying and recruiting someone to serve as a "local cultural guide" for organizational and/or national cultural issues - asking key questions and making key observations that highlight cultural issues - making appropriate adjustments (suitable clothing, appropriate terminology and speech patterns, sensitivity to power relationships outside the documented ones, etc.) - demonstrating understanding of the process patterns common to specific industries and project types	Ability to identify and adapt to organizational culture and context best demonstrated during planning and team, if observed by a qualified observer. Also demonstrated during appraisal as new information about context and culture is discovered.	Not usually an opportunity for demonstration. appraisal input and appraisal plan might indicate how well the Lead Appraiser adjusted to the local culture, but additional information will be needed for evaluation.	Not usually an opportunity for demonstration. (Will probably not come up in feedback unless there are major problems in misreading or violating local culture.)	Not usually an opportunity for demonstration. appraisal input and appraisal plan might indicate how well the Lead Appraiser adjusted to the local culture, but additional information will be needed for evaluation.	Not usually an opportunity for demonstration. (Will probably not come up in feedback unless there are major problems in misreading or violating local culture.)

Competency Clusters	Opportunities to Demonstrate Competence				
	A) During formally observed appraisal, and possibly during planning, team training, and readiness review events	**B) Through products resulting from the formally observed appraisal (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**C) Through formal or informal feedback received from the sponsor or the team members of the observed appraisal**	**D) Through products resulting from all subsequent reported appraisals (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**E) Through formal or informal feedback received from the sponsor or the team members of all subsequent reported appraisals**
7) Model Interpretation - mapping reference model terminology and concepts to corresponding local terminology and concepts - recognizing which aspects of practices are especially important or relatively unimportant in the current context - demonstrating understanding of the ways local alternative practices can contribute to goal satisfaction in a manner equivalent to the reference model's stated practices	Best demonstrated during appraisal, particularly during the PIID review, interview consolidation, and findings preparation activities. Also demonstrated during team training and readiness review, if observed by a qualified observer.	Demonstrated in the final findings briefing, which should reflect the influence of the Lead Appraiser in interpreting the reference model and mapping organizational practices, artifacts, and terminology to corresponding model elements. Might also be demonstrated in other products.	Sponsor feedback not usually an opportunity for demonstration. Might be demonstrated through team member feedback about ability the Lead Appraiser's ability to help the team interpret the process reference model with understanding and insight. (A question about model interpretation should be included on the feedback form.)	Demonstrated in the final findings briefing, which should reflect the influence of the Lead Appraiser in interpreting the reference model and mapping organizational practices, artifacts, and terminology to corresponding model elements. However, the findings do not usually receive extensive attention unless a problem is reported.	Sponsor feedback not usually an opportunity for demonstration. Might be demonstrated through team member feedback about ability the Lead Appraiser's ability to help the team interpret the process reference model with understanding and insight. (A question about model interpretation should be included on the feedback form.)
8) Product or Service Tailoring, Adaptation and Application - identifying the characteristics of a particular appraisal that will most influence the tailoring choices (e.g., appraisal mode, organization size, sponsor needs, geography,) - identifying critical requirements that will drive appraisal team selection - identifying, together with the appraisal sponsor and the site coordinator, a suitable representative sample of projects to be included in the appraisal - specifying the various participants and groups to be interviewed - identifying data gathering strategies and events (including highlighting opportunities for simultaneous, parallel events) - specifying the findings validation events to be conducted	Demonstrated during appraisal. The results of method-tailoring and adaptation decisions can be observed, as well as the candidate's ability to modify those decisions if necessary. Best demonstrated during planning and team training, if those events are observed by a qualified observer.	Demonstrated in appraisal input and appraisal plan, which should reflect tailoring choices and method adaptations. Constraints in appraisal input show how appropriate tailoring choices were.	Demonstrated in comments from sponsor and team members about how effectively the method was tailored to meet the needs of the organization. (A question about the effectiveness of method tailoring should be included on the feedback form.)	Demonstrated in all appraisal inputs and appraisal plans, which should reflect tailoring choices and method adaptations. However, the input and plan do not usually receive extensive attention unless a problem is reported.	Demonstrated in comments from sponsors and team members about how effectively the method was tailored to meet the needs of the organizations. (A question about the effectiveness of method tailoring should be included on feedback form.)

Competency Clusters	Opportunities to Demonstrate Competence				
	A) During formally observed appraisal, and possibly during planning, team training, and readiness review events	**B) Through products resulting from the formally observed appraisal (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**C) Through formal or informal feedback received from the sponsor or the team members of the observed appraisal**	**D) Through products resulting from all subsequent reported appraisals (e.g., appraisal input, appraisal plan, final findings briefing, and appraisal disclosure statement)**	**E) Through formal or informal feedback received from the sponsor or the team members of all subsequent reported appraisals**
9) Professionalism - mapping the duties and obligations listed in the SEI Professional Code of Conduct to the circumstances of a given appraisal - carrying out one's role in a manner fully consistent with the letter and the intent of the code - taking steps to promote one's own professional growth and development - contributing to the profession's body of knowledge through papers, presentations, etc.	Interpretation of and adherence to the Code of Conduct demonstrated during on-site period. The degree to which duties and obligations under the code are challenged depends on the appraisal. Can also be demonstrated during planning and team training if those events are observed by a qualified observer.	Clear violations of the appraisal method rules and guidelines will, in many cases, be visibly reflected in the appraisal artifacts. However, many other Code of Conduct violations will not be obvious from products alone.	Not usually an opportunity for demonstration. (Will probably not come up in feedback unless there are major problems with Lead Appraiser's behavior.)	Clear violations of the appraisal method rules and guidelines will, in many cases, be visibly reflected in the appraisal artifacts. However, many other Code of Conduct violations will not be obvious from products alone.	Not usually an opportunity for demonstration. (Will probably not come up in feedback unless there are major problems with Lead Appraiser's behavior.)

Appendix B: Example Template for an ICR

SCAMPI A Lead Appraiser authorization is used for this example. In a completed ICR, each cell would contain links to relevant comments and artifacts.

Individual Competency Record (ICR)

Name:	name of certified person
Sponsor:	SEI, or name of partner organization
Contact information:	address, telephone, fax, e-mail
Certifications issued:	SCAMPI A Lead Appraiser; Intro. to CMMI instructor; SCAMPI B&C team lead
Certification Date/Renewal Date:	SCAMPI A Lead Appraiser 2/12/03 // 2/12/06; SCAMPI B&C Team Lead 12/21/04 // 12/12/07
Certifications for which person is candidate:	Intermediate Concepts of CMMI instructor, SCAMPI A observer

Events:	Intro to CMMI	Intermediate CMMI	SCAMPI A Team Member	SCAMPI A Team Member	SLAT	SCAMPI A Observation
Date	MM/DD/YYYY	MM/DD/YYYY	MM/DD/YYYY	MM/DD/YYYY	MM/DD/YYYY	MM/DD/YYYY
General Artifacts & Comments:						

1) Achieving & Managing Agreements						
2) Decision Making & Problem Solving						
3) Project Planning & Management						
4) Interpersonal Communication & Facilitation						
5) Integration, Articulation, & Expression of Information						

6) Understanding & Adapting to Organizational Context						
7) Model Interpretation						
8) Product or Service Tailoring, Adoption, & Application						
9) Professionalism						

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URLs are valid as of the publication date of this document.

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13. ABSTRACT (MAXIMUM 200 WORDS)

This report describes how a competency lifecycle framework can be used as the basis for the Software Engineering Institute's Capability Maturity Model Integration (CMMI)-based professional certifications, in such areas as leading appraisals and instructing CMMI courses. The competency lifecycle framework (CLF) provides a systematic approach to defining the abilities, skills, and knowledge an individual needs in order to successfully perform in a CMMI-based professional role. The overall CLF structure defines competency clusters appropriate for a wide variety of certifications. This report also outlines a supporting mechanism, the individual competency record (ICR), as a basis for tracking and administering certifications in terms of the demonstrated competency growth of candidates.

The expected benefits of using the CLF and ICR are discussed. This report also addresses plans for next steps and opportunities for future work.

This document is intended for anyone who would like to understand the concepts underlying CMMI-based professional certifications. This includes those responsible for developing the tools, documents, and training courses that lead to certifications. In addition, this document might also be of interest to anyone seeking or holding a CMMI-based certification, or anyone who would like to know how such certification programs are defined.

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