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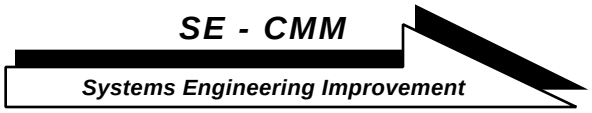
Carnegie Mellon University
Software Engineering Institute

Relationships Between the Systems Engineering Capability Maturity Model℠ and Other Products, Version 1.0



Systems Engineering
Capability Maturity Model Project

November 1995

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Relationships Between the Systems Engineering Capability Maturity Model (SM), and Other Products, Version 1.0

Systems Engineering Capability Maturity Model Project

Software Engineering Institute

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Pittsburgh, PA 15213

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The ideas and findings in this report should not be construed as an official DoD position. It is published in the interest of scientific and technical information exchange.

FOR THE COMMANDER

(signature on file)

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SEI Joint Program Office

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To the Reader

Background

By analyzing sources of knowledge related to systems engineering practice, Systems Engineering Capability Maturity Model[SM] (SE-CMM[SM]) authors have created a matrix that shows relationships between the topics covered by the SE-CMM and other related systems engineering standards. Specifically, the products compared to the SE-CMM are

- Mil-Std-499b (prior to its progression to Electronics Industry Association [EIA])
- IEEE P1220 (final balloting version)
- Software Development Capability Evaluation (SDCE)
- CMM for Software v1.1 (SW-CMM)

This is not the only set of products amenable to this type of mapping. Therefore, as resources become available to update and enrich this relationship document, other products will be added.

Who should use this document

Anyone who is interested in understanding where the content of the SE-CMM overlaps with the content of other related products will benefit from using this document. However, it should be clearly noted that the relationships documented herein are the opinions of the authors, and do not necessarily reflect the views of the authors of the documents against which the SE-CMM is being compared.

Overview of document

This document primarily addresses relationships between the SE-CMM and other products of interest. The content of each chapter is as follows:

- Chapter 1: Introduction to the document and context information for its use
- Chapter 2: Relationships between the SE-CMM and the SW-CMM at the process area (PA)/key process area (KPA) level
- Chapter 3: Relationships table between the SE-CMM and other products

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Cautions

In this document, we do not attempt to judge the degree or type of relationship between the content of the SE-CMM and the content of other products. The SE-CMM may provide abstractions of a related concept or more detail about a related concept, and may express a customer need or a supplier viewpoint. Inclusion of a base practice in the detailed matrix (Ch. 2) merely indicates that the *content* of the base practice relates in some way to the *content* of the cited section of the related document. At a higher level of abstraction (e.g., relationships between process areas and key process areas), customer, supplier, and peer relationships are defined between the SE-CMM and the SW-CMM.

SE-CMM steering group members

The 1994 steering group for the SE-CMM Project has provided both traditional management oversight functions and extensive technical and strategic input to the project, and their individual and collected contributions to the project are appreciated beyond measure. The names and organizations of the SE-CMM Steering Group members, as of May 1995, are provided in the table below:

Organization	Contacts
Department of Defense/OSD	John Burt
General Dynamics - Electric Boat Division	Bob Fox
Hughes Aircraft Company	Ilene Minnich
Lockheed Martin Corporation	Douglas Bowman
Loral Federal Systems Company	Gary Kennedy
National Institute of Standards and Technology	Roger Martin
Software Engineering Institute	Julia Allen
Software Productivity Consortium	Art Pyster, PhD
Texas Instruments, Incorporated	Merle Whatley, PhD
European Software Institute	Colin Tully, PhD

SE-CMM Collaboration Contacts

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Additional information-project office

If you have any questions about this method or about pilot appraisals using the SE-CMM, please contact the SE-CMM Project. The maintenance site for the project is the Software Engineering Institute of Carnegie Mellon University. The product managers, Peter Malpass and Curt Wells, may be contacted at

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Data rights associated with the SE-CMM

Chapter 1: Introduction

Abstract

The SE-CMM is a document that describes characteristics, both domain and process-management focused, of systems engineering processes that contribute to successful product development. From the beginning of the effort, users of the SE-CMM have requested information on how SE-CMM practices relate to other products. This document is an initial effort at identifying and characterizing these relationships.

Product versions used

Table 1-1 shows the versions of the products that we used to develop the comparison table. Updates will be made on a periodic basis to reflect new versions, provided project resources are available.

Product Name	Version
A Systems Engineering Capability Maturity Model	Version 1.0
Capability Maturity Model for Software	Version 1.1
IEEE 1220	Trial use, 1220-1994
SDCE	Version 1.0
Mil-Std-499b	Version 1.0, prior to turnover to EIA; Notes on initial review of EIA-IS-632 are included in Chapter 3
SPICE BPG	Version 1.0

Table 1-1. Product Name and Version Comparison Table

In this chapter

The following table lists the information found in this chapter.

1.1 Overview of Document

Issues in providing relationship information

When writing a document such as this, there will be differing opinions regarding the primary relationships between one or more source documents. The opinions expressed herein are those of the authors and may differ from opinions of individual readers. This cross reference is provided as a guide to help users of the multiple documents understand areas of overlapping content, but is not in any way "certified" by the authors of all the source documents.

SE-CMM and SW-CMM are higher abstractions than "a" process

Both the SE-CMM and the SW-CMM provide information on characteristics expected to be seen in performed processes. Neither describes an individual, performable process.

Assumptions

It is assumed that the reader is familiar with both the SE-CMM and SW-CMM. Discussion of the structure and content of these documents is found in their respective overviews and is not repeated in this document. In addition, it is assumed that readers have basic familiarity with the contents of the other documents included in the relationship tables. Therefore, only brief descriptions of them are included in this document.

1.2 Important Usage Contexts for the SE-CMM

Introduction

The SE-CMM exists as an abstraction of process characteristics; however, it is used in the context of an organizational system. The following discussion uses an organizational systems view that permits delineation of the major boundaries of the SE-CMM. This should help readers understand in what areas of their enterprise the SE-CMM would be useful.

Organizations as sociotechnical systems

The following diagram represents an organization as a series of related subsystems. The following discussion relates the SE-CMM to this view of an organization.

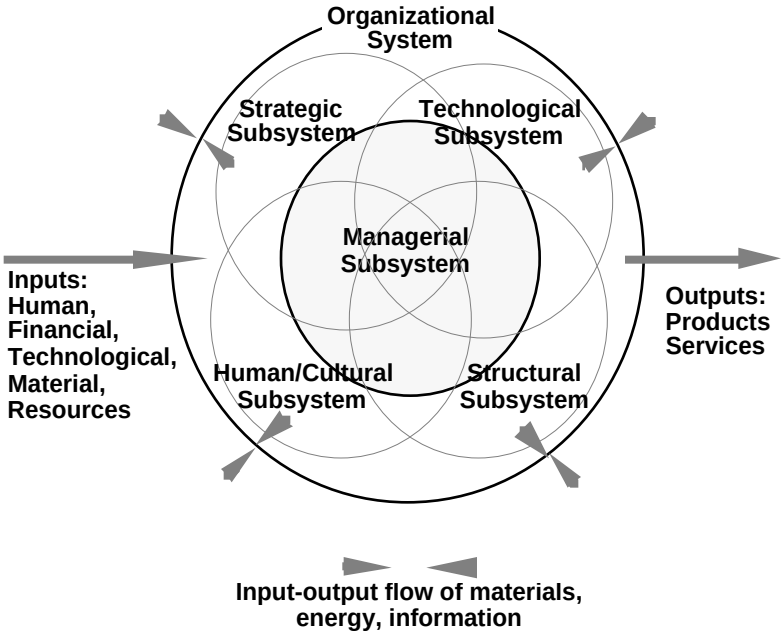

Figure 1-1. Organization as a System

Strategic subsystem

The strategic subsystem defines the mission and focus of the organization. For example, the strategic focus of an airplane manufacturer and the implications of that business are different than those of a shrink-wrap software developer. The SE-CMM makes only one assumption about the strategic subsystem in an organization: it assumes that the organization is engaged in the development of products complex enough to benefit from a disciplined approach for designing processes and producing products.

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Technological subsystem

The technological subsystem defines how the organization accomplishes the mission of its strategic focus – it is the subsystem for "how we build our products." The SE-CMM addresses issues in the technological subsystem via the process areas in the engineering category. However, it does not address the details of the "how"; nor does it deal with the underlying support tools and environment needed to support the way products are built, other than to provide guidance on the process for managing the support environment for systems engineering. No particular technology base is assumed by the SE-CMM.

Structural subsystem

The structural subsystem is how the organization is structured to produce the products that support its strategic mission. The SE-CMM uses only two constructs related to structure: organization and project. The usage of these terms in the SE-CMM is discussed in Section 2.2, "Key Concepts of the SE-CMM" of *A Systems Engineering Capability Maturity Model, Version 1.0*, [Bate 94]. Essentially, the SE-CMM assumes that the organization has some organizational structure that is used as a vehicle for structuring the effort to produce a product (e.g., a project) and that these projects live in some kind of infrastructure which shares common policies (e.g., an organization). Beyond that, the character of the other subsystems is expected to determine the nature of the organizational structure.

Human/cultural subsystem

The human/cultural subsystem defines what it is like to live in the organization as the work is being done to accomplish the organization's mission. It addresses such issues as how people are motivated and the values of the organization. The only issue related to this subsystem that is addressed by the SE-CMM is that of training. The SE-CMM does not address how organizations build skills in their employees. However, the mandate to support training at an organizational level is a fundamental contributor to institutionalization of effective process management principles and is, therefore, germane to the SE-CMM.

Managerial subsystem

The management subsystem defines how the organization plans and controls the work within the structure established to support the organization's strategic focus. The project and organization categories of the SE-CMM address issues related to management, as do the process capability levels, common features, and generic practices, introduced in Chapter 2 of the SE-CMM.

Chapter 2: Comparison of SE-CMM to SW-CMM

Introduction

This chapter outlines relationships between the SE-CMM and SW-CMM. It is intended, at an abstract level, to provide a view of places where each model plays a supplier or customer role to the other, versus where they are in a peer relationship with each other. A peer relationship indicates that the individual elements cited have related content but are not a supplier or customer to each other.

In this chapter

The following table lists the information found in this chapter.

2.1 Comparison of the SE-CMM to SW-CMM

Architecture differences

There are currently two major representations of maturity models: a staged model, which uses key process areas residing at particular maturity levels to focus the organization's efforts in improvement; and a continuous model, which uses a combination of process areas and capability levels to describe the evolving capability of individual processes. Each representation has strengths and weaknesses (which are not the primary topic of discussion here), but each is based on fundamental concepts from the quality management and organizational development fields.

The SW-CMM is an example of a staged model, while the SE-CMM is an example of a continuous model.

At an abstract level, the staged model can be seen as a filtered subset of base practice/generic practice cross products. For example, a key practice in the SW-CMM which is of the form "Do X according to the project's defined software process" can be viewed as a cross product of a base practice that says "Do X" and a generic practice that says "Use the tailored version of the organization's standard software process in performing the process." One can also draw an analogy from the database development world – each representation can be described as a different "view" into the same database of information related to disciplined practices, process improvement, and institutionalization.

The maturity model integration initiative at the SEI is exploring the ramifications and implications of these two representations and the issues that need to be resolved to help the community make best use of these different points of view.

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Comparison table

Table 2-1 compares the SE-CMM to the SW-CMM.

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Analyze candidate solutions	Software product engineering	*Supplier-customer* *Peer*	
Derive and allocate requirements	Software product engineering; Requirements management; Intergroup coordination	*Supplier-customer*	
Develop physical architecture	Software product engineering	*Supplier-customer*	
Integrate disciplines	Intergroup coordination	*Supplier-customer* Intergroup Coordination is essentially the customer of the Integrate Engineering Disciplines PA of the SE-CMM.	
Integrate system	Software product engineering	*Customer-supplier*	

Table 2-1. Comparison of SE-CMM and SW-CMM

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Understand customer needs and expectations	None explicitly	*NA* When a system that is primarily software is being developed, adding the base practices from Understand Customer Needs and Expectations may be beneficial to the software organization's improvement efforts.	The Requirements Management KPA assumes that the kinds of issues raised in Understand Customer Needs and Expectations have already been hashed out by the time the requirements are allocated to software.
Verify and validate system	Software product engineering	*Customer-supplier* The system is the general customer of the software products; once software work products have been integrated and verified, they are provided to the systems integrators/ verifiers to ensure that they meet the overall system requirements and user needs.	As with several other PAs, the base practices in Verify and Validate System are reflected in processes throughout the system development life cycle, and are expected to iterate as the development progresses. This iteration includes communication with suppliers such as the software developers.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Ensure quality	Software quality assurance	*Peer* The activities of both system and software quality assurance efforts contribute to an overall quality focus for the product development. This does not necessarily imply that two quality "organizations" must be in place.	Similar focus, although the Ensure Quality PA is stated in much broader terms.
Manage configura-tions	Software configuration management; Requirements management	*Customer-supplier* The overall system integrity, including requirements and work products, must be maintained to assure overall product integrity. Software Configuration Management is a significant contributor to the system configuration management effort.	Both the SE-CMM and SW-CMM focus on baseline, rather than developmental, configuration management.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Manage risk	Integrated software management (ISM); Quantitative process management (QPM)	*Customer-supplier* Elements of risk management are included in ISM/QPM; it is anticipated that some of these risks will have implications at the system level and should be appropriately communicated and managed.	The Manage Risk PA provides a richer context for the practices of risk management than SW-CMM v1.1. Organizations seriously undertaking risk management approaches may wish to use the SE-CMM as their improvement reference.
Monitor and control technical effort	Software project tracking and oversight; Integrated software manage-ment; Quantitative process management	*Customer-supplier* This is essentially the reverse of the former relationship; the systems engineering function depends on data from the software managers to make timely and accurate decisions.	Some areas covered by the SE-CMM PA may not directly apply to software.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Plan technical effort	Software project planning; Integrated software manage-ment; Quantitative process management	*Supplier-customer* The planning information generated from systems engineering is an essential input to the planning activities at any maturity level.	As the customer for this PA, the software planning activities have an obligation to provide feedback on the utility of the planning information as well as feedback on the technical content of the plans.
Define organization's systems engineering process	Organization process definition	*Peer*	Similar focus: this is an area where the system and software improvement efforts can gain significant leverage by working together.
Improve organization's systems engineering processes	Organization process focus; Process change management	*Peer* The SW-CMM focus is specifically organizational, while the SE-CMM PA can be applied at multiple organizational levels (e.g., process, project, org'n).	Similar focus: this is an area where the system and software improvement efforts can gain significant leverage by working together.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Manage product line evolution	None explicitly	*NA* If the organization is primarily focused on producing software systems, using the base practices from the SE-CMM may benefit the organization in its improvement efforts.	One could conceive of the Technology Change Management KPA dealing with some of these issues; also, the focus of Software Quality Management KPA on relating product quality to business goals implies an understanding of product line.
Manage systems engineering support environment	Technology change management (TCM)	*Peer* Both of these address the introduction of technology into the environment; however, TCM addresses technology of products as well as technology for the support environment	Manage Systems Engineering Support Environment addresses the support environment as a whole, not just new technologies being used.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
Manage systems engineering training	Training program	*Peer*	With little exception, the same issues are addressed in each of these.
None specifically	Subcontract management	*NA* There is some debate as to whether the SE-CMM should contain a separate Subcontract Management PA. The position of the v1.0 author team was that the project process areas applied equally well to managing internal and external suppliers.	The 1995 SE-CMM workshop will revisit this issue.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Comparison table, continued

SE-CMM Process Area	SW-CMM Key Process Area	Relationship Notes	Other Notes
None; covered in capability level 3 generic practices as "defect reviews"	Peer reviews		Peer reviews are considered a particular method of verification and were not included as a separate process area in the SE-CMM. They were renamed "defect reviews" in the SE-CMM to reflect cultural differences between the systems and software engineering communities.
None specifically	Software quality management		The concepts of Software Quality Management are primarily captured in the capability level 4 generic practices.
None specifically	Defect prevention		The concepts of Defect Prevention are primarily captured in the capability level 5 generic practices.

Table 2-1. Comparison of SE-CMM and SW-CMM, continued

continued on next page

Usage notes for "software-only" systems

Organizations that primarily produce complex software and that perform systems engineering as part of product definition and development may wonder whether they should focus on guidance provided by the SE-CMM or the SW-CMM.

The decision regarding which model to apply, when to apply it, and in what context depends on several factors, including the business segment to which the business belongs, their prior experience with the SW-CMM, and their prior experience with systems engineering as a unique discipline. In general, the key practices of the SW-CMM that relate to the topics covered in the SE-CMM could be viewed as example practices for some of the SE-CMM base practices, especially in the project and organization categories.

The table in Chapter 4 provides content relationships between the SE-CMM and SW-CMM at the base practice/key practice level.

2.2 A Different View of Relationships Between the SE-CMM and SW-CMM

Introduction

This section separates and regroups the content of Table 2-1 from the view of customer, supplier, and peer relationships and provides a table for each type of relationship.

Basic relationship types

Table 2-2 describes the three basic types of relationships between the SE-CMM PAs and SW-CMM KPAs.

Relation-ship Type	Description
SE-CMM PA as supplier to SW-CMM KPA	In this type of relationship, the outputs and artifacts of the processes embodying the SE-CMM process area would be expected to be supplied to and used by the processes embodying the SW-CMM key process area. For example, the requirements that result from the SE-CMM PA Derive and Allocate Requirements would be expected to be an input to the SW-CMM KPAs Requirements Management and Software Product Engineering.
SE-CMM PA as peer to SW-CMM KPA	In this type of relationship, the activities embodying the practices of the SE-CMM process areas would be similar to those of the SW-CMM key process area, but with different targets. For example, the Manage Configurations PA could be considered a peer of the Software Configuration Management KPA, since the activities are similar, but the targets are different. The target of Manage Configurations is the entire system configuration, whereas the target of Software Configuration Management is only the software portion of the system.
SE-CMM PA as customer to SW-CMM KPA	This relationship is the opposite of the supplier relationship. Here, the outputs and artifacts of the processes embodying the SW-CMM key process areas would be expected to be used by the processes embodying the practices of the SE-CMM process areas. For example, the Verify and Validate System PA can be seen as the customer of some aspects of the Software Product Engineering KPA.

Table 2-2. SE-CMM and SW-CMM Relationship Types

continued on next page

Multiple relationships are possible

Note that in the first and third examples of Table 2-2, Software Product Engineering (SPE) is viewed as both a customer and supplier to different process areas of the SE-CMM. If this analysis were to be done at a lower level of detail, it would be apparent that certain activities of SPE relate as customers to SE-CMM base practices, while others relate primarily as suppliers. This document permits multiple relationships to be expressed in the tables.

Different types of relationships between particular PAs and KPAs also occur because the SE-CMM base practices related to engineering activities are presented in much more detail than in the SW-CMM. In the SE-CMM, there are seven process areas related to engineering aspects of systems engineering activities, versus one SW-CMM KPA (Software Product Engineering) specifically focused on activities related to software engineering product development.

SE-CMM PAs that are suppliers to SW-CMM KPAs

Table 2-3 lists SE-CMM process areas that are primarily suppliers to SW-CMM KPAs:

SE-CMM PA	SW-CMM KPA
Derive and allocate requirements	Requirements management Software product engineering Intergroup coordination
Analyze candidate solutions	Software product engineering
Develop physical architecture	Software product engineering
Integrate disciplines	Intergroup coordination
Plan technical effort	Software project planning Integrated software management Quantitative process management

Table 2-3. Primary Suppliers to SW-CMM Key Process Areas

continued on next page

SE-CMM PAs that are peers of SW-CMM KPAs

Table 2-4 lists SE-CMM process areas that are primarily peers to SW-CMM KPAs:

SE-CMM PA	SW-CMM KPA
Analyze candidate solutions	Software product engineering
Ensure quality	Software quality assurance
Define organization's systems engineering process	Organization process definition
Improve organization's systems engineering processes	Organization process focus Process change management
Manage systems engineering support environment	Technology change management
Manage systems engineering training	Training program

Table 2-4. Primary Peers to SW-CMM Key Process Areas

SE-CMM PAs that are customers to SW-CMM KPAs

Table 2-5 lists SE-CMM process areas that are primarily customers to SW-CMM KPAs:

SE-CMM PA	SW-CMM KPA
Integrate system	Software product engineering
Verify and validate system	Software product engineering
Manage configurations	Software configuration management Requirements management
Manage risk	Integrated software management Quantitative process management
Monitor and control technical effort	Software project tracking and oversight Integrated software management Quantitative process management

Table 2-5. Primary Customers to SW-CMM Key Process Areas

continued on next page

SE-CMM PAs without explicit relationship to SW-CMM KPAs

Table 2-6 lists SE-CMM process areas that do not have explicit relationships to SW-CMM KPAs.

SE-CMM PA	Notes
Understand needs and expectations	It is assumed in the SW-CMM that the activities described in this PA have been dealt with outside the software engineering organization. However, software engineering interface to the customer is likely to be defined as a result of interactions resulting from intergroup coordination and integrating disciplines.
Manage Product Line Evolution	It is assumed in the SW-CMM that the activities described in this PA have been dealt with outside the software engineering organization. However, it is reasonable to expect the software engineering organization to provide input to the development of organizational strategies for managing product lines.

Table 2-6. SE-CMM Process Areas Not Related to SW-CMM

continued on next page

SW-CMM KPAs without explicit relationship to SE-CMM PAs

Table 2-7 lists SW-CMM key process areas that do not have explicit relationships to SE-CMM PAs.

SW-CMM KPA	Notes
Peer reviews	The concepts in Peer Reviews are embodied implicitly in the generic practice 3.2.2 Perform Defect Review.
Software subcontract management	The authors saw the entire management cycle as applying to either in-house or externally subcontracted product developments.
Software quality management	Most of the content of this KPA is subsumed into the generic practices of SE-CMM capability level 4.
Defect prevention	Most of the content of this KPA is subsumed into the generic practices of SE-CMM capability level 5.

Table 2-7. SW-CMM Key Process Areas Not Directly Related to SE-CMM Process Areas

Chapter 3: Relationships Between SE-CMM and Other Products

Introduction

This chapter compares the SE-CMM with five other relevant documents: the IEEE Systems Engineering Standard [IEEE 1220], the Military Standard for Systems Engineering [Mil-Std-499B], the SPICE Baseline Practices Guide [SPICE BPG}, the Capability Maturity Model for Software [Paulk 93a], and the Air Force Software Development Capability Evaluation Model [SDCE].

The intent of this chapter is to provide a mapping of processes or requirements that identify common elements of implementation between the SE-CMM and the various related products.

In this chapter

The following table provides a guide to the information found in this chapter.

3.1 General Information on Relationship Tables

Product versions used

Table 3-1 shows the versions of the products that we used to develop the comparison table. Updates will be made on a periodic basis to reflect new versions, provided project resources are available.

Product Name	Version
A Systems Engineering Capability Maturity Model	Version 1.0
Capability Maturity Model for Software	Version 1.1
IEEE 1220	Trial use, 1220-1994
SDCE	Version 1.0
Mil-Std-499b	Version 1.0, prior to turnover to EIA
SPICE BPG	Version 1.0

Table 3-1. Product Name and Version

Matrix format

This chapter is primarily composed of a matrix that presents the base practices contained within the SE-CMM. This matrix also shows if the same or similar processes and/or requirements are found in the other products. The relevant paragraph numbers (for standards), or key process area/activity level (for models), are presented in the matrix.

Each paragraph or activity level selected is the most closely related in concept to the associated base practice of the SE-CMM. There may be many paragraphs or activities that are related in some way to a SE-CMM practice. The authors attempted in each instance to select the paragraph or key practice that most closely matches the intent of the base practice within the SE-CMM.

Terminology

Some of the terms contained in the SE-CMM may be used in different ways in the other documents. For example, "training" in the SE-CMM refers to the training of employees in the policies and practices that define internal work processes or the enhancement of employees' technical skills. However, "training" in Mil-Std-499B refers to the training of users within the context of using the system being developed.

continued on next page

3.1 General Information on Relationship Tables, Continued

Focus of relationships table	The SE-CMM is a "systems engineering"-level improvement model. Consideration is therefore given to the physical architecture and associated hardware. Some of the documents that we are comparing it against are software intensive (SW-CMM, SPICE BPG, and the Air Force SDCE). The software-intensive documents can, and do, have a "systems" connotation as in the "software system" under development. As such, we considered "system"-level practices in the SE-CMM with "system" considerations within the software-intensive documents. Where physical architecture is the obvious issue, the software-intensive documents are noted as nonapplicable (N/A).

3.2 Summary of Products in Relationships Table

SE-CMM v1.0	The SE-CMM is a model for organizational-level improvement written from a perspective of what is needed for systems engineering to be performed effectively. It is project and role independent. It contains 17 process areas, each of which is further decomposed into base practices. The base practices provide the foundation for successful and consistent systems engineering efforts. The model also includes common features that are applicable to all base practices. The common features address organizational infrastructure and institutionalization issues, which ensure that the base practices are applied consistently throughout the organization and establish the foundation for continuing process improvement.
IEEE 1220-1994	The IEEE Systems Engineering Standard (IEEE 1220) is a project-specific requirements document. This document prescribes system engineering activities and functions deemed necessary throughout the life cycle for a program. This document was written from a developer's perspective.
SPICE BPG v1.0	The SPICE BPG is a model for organizational-level improvement in software engineering. This model was written from a developer perspective. It is project independent and contains multiple base practices embedded within five major process categories. The application of the base practices provides a foundation for consistent software engineering efforts. The model includes common features that are applicable to all base practices. The common features address organizational issues, which ensure that the base practices are applied consistently and provide the foundation for continuous improvement.
Mil-Std-499B	Mil-Std-499B is a systems engineering standard that contains project-specific requirements. This standard dictates activities and functions deemed necessary for a successful systems engineering effort from the perspective of an acquirer, as well as developer. This standard addresses the entire life cycle. It is being converted into a commercial standard (preliminary number EIA-IS-632) by a collaboration led by the Electronics Industries Association.

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EIA-IS-632

The interim standard EIA-IS-632 is intended to replace MIL-STD-499B. The intent is to demilitarize 499B.

An initial review of EIA-632 produced the following results.

- There are virtually no changes incorporated in EIA-632 that will affect the Relationships Document.
- The paragraph numbering scheme has changed because EIA-632 removed Section 2 of 499B. Section 2 was a one-line section that merely states there are no documents referenced in the standard. This minor modification has altered the paragraph numbers in that the first digit of a paragraph in 499B is one digit less in EIA-632. For example: Paragraph 4.2, Systems Engineering Input, in 499B is now 3.2, Systems Engineering Input, in EIA-632.
- There are five other changes worth noting:
  - Paragraph 5.2.8, Integrated Logistics Support, in 499B has a name change in EIA-632. It is 4.2.8 Product Support.
  - Paragraph 5.6, Implementation Tasks, in 499B has a name change in EIA-632. It is 4.6, Support Tasks.
  - Paragraph 5.7.1, Review Responsibilities, in 499B is not contained in EIA-632.
  - EIA-632 has added two paragraphs: Paragraphs 3.3.1.2, Requirements Validation, and 3.3.2.3, Functional Verification.
  - Page 26 of 499B has been eliminated. This page lists all the various military-standards or DOD standards that one may find required for use in a system development effort.

AF SDCE

The Air Force's SDCE is a model for the acquisition of software intensive systems. This model serves as a basis for an acquirer to determine the software development capability of a developer. It is a project-oriented model that was developed from an acquirer's perspective. It contains a set of critical capability areas that are deemed necessary for a successful software engineering effort. The model focuses on the developer's ability to meet the requirements specified within each critical capability area for the project under proposal.

continued on next page

3.2 Summary of Products in Relationships Table, Continued

SW-CMM	The SW-CMM is a model for organizational-level improvement in software engineering practices. It is project independent and contains key process areas that provide recommendations for successful and consistent software engineering applications. It provides a description of practices expected to be seen as organizations mature, without being prescriptive (i.e., it does not specify how to perform an activity). The model includes common features applicable to all key process areas. The common features address organizational infrastructure and institutionalization issues that ensure the consistent application of the key process areas throughout the organization and provide the foundation for continuing and measurable process improvement.

3.3 Levels of Abstraction

Introduction

Each product operates from a particular viewpoint (e.g., acquirer, developer) and a specific level of abstraction. This section addresses the difference in levels of abstraction of the different products in the table.

Levels of abstraction table

Product	Level of Abstraction
SE-CMM	Contains many base practices embedded within each of the 17 process areas. These base practices define the essential activities necessary for a successful systems engineering effort. The base practices are populated with activities that describe what should be done without being directive. These characteristics are presented at a very high level of abstraction.
IEEE 1220	Addresses the entire systems life cycle with a very detailed set of requirements.
SPICE BPG	Contains many base practices within each of the 35 major process areas. The base practices are described at a very high level of abstraction without being prescriptive.
Mil-Std-499B	Addresses the entire systems life cycle with a very detailed set of requirements. The requirements are expressed in terms of the attributes of a process as viewed by a process model.
AF SDCE	Contains a very detailed set of questions within each of the 38 defined critical capability areas. The questions cover the complete system life cycle and tend to be open ended, thereby requiring much elaboration regarding developer capability within each critical capability area.
SW-CMM	Contains many key practices embedded within 18 key process areas. The key practices are at a detailed level of abstraction. The key practices are fairly descriptive without being overly directive. They support the implementation of a set of goals, which are much less directive and describe the achievement of the key process area's purpose.

Table 3-2. Levels of Abstraction

3.4 General Content Comparisons/Notes

Introduction	This section provides an overview of the content of each product in Table 3-2 and relates the product to the SE-CMM. Some of the information provided is in the form of areas covered/not covered by a particular product.
IEEE 1220	IEEE 1220 does not assume a contract-driven approach to systems engineering. Therefore there are no requirements for customer interaction or customer relationship issues. IEEE 1220 addresses some areas that the SE-CMM does not: predominately, production environment, logistic support, safety, security, health, and environmental impacts.
SPICE BPG	The SPICE BPG touches upon a few basic concepts of systems engineering at an extremely high level. These concepts can be found in the engineering process category (ENG.1), of the BPG. The remainder of the BPG is software specific. Many of the concepts contained in the SE-CMM can be interpreted in the BPG when considered in the context of a software "system." When we consider software as a system, it is possible to identify a variety of relationships between the SPICE BPG and SE-CMM in the relationship table. Processes contained in the SE-CMM that are hardware related (i.e., Develop Physical Architecture) are not always relevant to a software model.
SW-CMM	The SW-CMM and the SE-CMM have a relationship similar to the BPG and SE-CMM relationship. The SW-CMM focuses on the software process, but it contains many of the concepts presented in the SE-CMM. Since both models were developed for process improvement, there is a lot of similarity in terms of common features that describe institutionalization and organizational-infrastructure issues. Also, as with the BPG, when we consider software from a software "system" perspective, we are able to identify many relationships in the relationship table. Any processes contained in the SE-CMM that address hardware issues would not be relevant to the SW-CMM.

continued on next page

Mil-Std-499B/ EIA-IS-632	The comparison between the content of Mil-Std-499B and the SE-CMM is virtually the same as the IEEE 1220 and SE-CMM comparison, other than the fundamental difference that 499B acknowledges the possibility of contracting portions of a development. In addition, Mil-Std-499b addresses some issues that the SE-CMM does not: reliability and maintainability, disposal analysis, and the training of user personnel in the operation of the system under development. Mil-Std-499B assumes a contractual relationship between the acquirer and developer. Therefore, it contains many requirements for formal reviews and audits that are not found in the SE-CMM or IEEE 1220. It also address financial and contract requirements not found in the SE-CMM.
AF SDCE	The SDCE is a software-intensive source selection tool; however, it does contain a systems engineering critical capability area. The combination of a software "systems" view and the systems engineering critical capability area addresses the majority of the systems engineering issues. The areas that the SDCE does not address are developing the physical architecture, understanding customer needs, and managing product-line evolution. The areas that the SDCE does address that the SE-CMM does not are software life-cycle issues that address design, development, and support, as well as contracting and financial issues related to the software system.

3.5 Product Listings

Introduction

This section provides a reference list with the complete title and reference information for each of the products in the table.

Reference List

[IEEE 1220]	IEEE P1220. *IEEE Standard for Systems Engineering*, Preliminary, 1993.
[MIL-STD-499B]	Draft Systems Engineering Standard, AFMC, 1994.
[Paulk 93a]	Paulk, Mark; Curtis, William; & Chrissis, Mary Beth. *A Capability Maturity Model for Software v1.1*, (CMU/SEI-93-TR-24, ADA 263403). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, February 1993.
[SDCE]	*AF 800-Software Development Capability Evaluation* (SDCE)
[Bate 94]	Bate, R., Garcia, S. et al. *A Systems Engineering Capability Maturity Model, Version 1.0* (SECMM-94-04|CMU/SEI-94-HB-04). Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute: December 1994.
[SPICE BPG]	*SPICE Baseline Practices Guide* (BPG), Version 1.0, September 22, 1994.

3.6 Relationships Table

Introduction

Table 3-3 provides the detailed relationships between the documents reviewed. Each product is compared to the SE-CMM. Although indirect relationships between the other products can be inferred, these relationships were not explicitly sought nor checked.

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Analyze Candidate Solutions**				
BP 01.01 Establish Evaluation Criteria	6.7.5 Trade Study Scope	N/A	N/A	4.3.4.1 Trade-off Studies	N/A
BP 01.02 Define Analysis Approach	6.7.5 Trade Study Scope	N/A	N/A	4.3.4.1 Trade-off Studies	N/A
BP 01.03 Identify Additional Alternatives	6.7.5.2 Alternatives	N/A	N/A	4.3.4.1 Trade-off Studies	2.5.2 Systems & S/W Relationship (C2)
BP 01.04 Analyze Candidate Solutions	6.7.3 Solution Alternatives 6.7.6 Trade Study	N/A	N/A	4.3.4.1 Trade-off Studies	2.5.2 Systems & S/W Relationship (C2)
BP 01.05 Select Solution	6.7.3 Solution Alternatives 6.7.8 Alternative Recommendations	N/A	N/A	4.3.4.1 Trade-off Studies	2.1.4 S/W Impact Analysis (C2)
BP 01.06 Capture Results	6.7.6 Trade Study 6.7.9 Trade-Offs and Impacts	N/A	N/A	4.3.4.6 Data Management	2.1.4 S/W Impact Analysis (C2)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Derive and Allocate Requirements**				
BP 02.01 Develop Detailed Operational Concept	6.1.4 Operational Scenarios 6.1.15 Human Factors	Engineering ENG 2.1 & 2.3	Intergroup Coordination Activity 1	5.2.2 Survivability 5.2.4 Human Factors 5.2.5 System Safety & Health 5.5.4 Operational Analysis and Assessment	2.2.1 Architecture Definition (C4)
BP 02.02 Identify Key Requirement Issues	6.1 Requirements Analysis	N/A	Intergroup Coordination Activity 1	4.3.1 Requirements Analysis	2.1.4 S/W Impact Analysis (C4)
BP 02.03 Partition Functions	6.3 Functional Analysis	Engineering ENG 1.1	Intergroup Coordination Activity 2	4.3.2 Functional Analysis and Allocation	2.2.1 Architecture Definition (C1)
BP 02.04 Derive Requirements	6.3.1 Functional Decomposition	Engineering ENG 3.3	N/A	4.3.3 Synthesis	N/A
BP 02.05 Develop Interface Requirements	6.1.7 Interfaces 6.3.1.2 Functional Interfaces	Engineering ENG 2.1	Intergroup Coordination Activity 2	4.3.4.5 Interface Management	2.2.1 Architecture Definition (C2)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Derive and Allocate Requirements (continued)**				
BP 02.06 Allocate Requirements	6.3.1 Functional Decomposition	Engineering ENG 1.3	Intergroup Coordination Activity 2 Requirements Management Abilities 1 & 2	4.3.3 Synthesis	2.2.1 Architecture Definition (C1)
BP 02.07 Ensure Requirement Verifiability	6.4 Functional Verification	Engineering ENG 4.2	Requirements Management Activity 1	5.5.2 Verification Analysis and Assessment	2.2.1 Architecture Definition (C1)
BP 02.08 Maintain Requirement Sufficiency and Traceability	6.4.2 Verification Evaluation	Engineering ENG 3.4	Intergroup Coordination Activity 2	4.4 Systems Engineering Output	2.2.1 Architecture Definition (C1)
BP 02.09 Capture Results and Rationale	6.4.4 Verified Functional Architecture	N/A	S/W Product Engineering Activity 10	4.4 Systems Engineering Output	2.1.3 Requirements Change Control (C1)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices Process Area :	IEEE P1220 Requirements Develop Physical Architecture	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
BP 03.01 Derive the Physical Architecture Requirements	6.1.11 Performance Requirements 6.1.14 Physical Characteristics	N/A	N/A	4.3.3 Synthesis	N/A
BP 03.02 Identify Key Design Issues	6.5.2 Physical Solution Alternatives	N/A	N/A	4.3.3.1 Design	N/A
BP 03.03 Develop Physical Structure	6.5.2 Physical Solution Alternatives 6.5.18 Physical Architecture	N/A	N/A	4.3.3 Synthesis	N/A
BP 03.04 Develop Physical Interface Requirements	6.5.7 Physical Interfaces	N/A	Requirements Management Ability 1	4.3.3 Synthesis	N/A
BP 03.05 Allocate Physical Requirements	6.5.1 Group and Allocate Functions 6.5.6 Physical and Performance Characterisctics	N/A	N/A	4.3.3.1 Design	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Develop Physical Architecture (continued)**				
BP 03.06 Maintain Requirement Sufficiency and Traceability	6.6.2.1 Architecture Completeness	N/A	N/A	4.3.4 Systems Analysis & Control 4.3.4.5 Configuration Mngt	N/A
BP 03.07 Capture Results and Rationale	6.6.4 Verified Physical Structure	N/A	N/A	4.3.4.6 Data Management	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Integrate Disciplines**				
BP 04.01 Identify Essential Disciplines	4.11 Integration of Systems Engineering Effort	Organization ORG 1.4	Intergroup Coordination Ability 4	5.1.1.3 Technical Integration Planning 4.3.4 (e) Systems Analysis & Control	2.4.1 Group Interfaces (C2)
BP 04.02 Train Interdisciplinary Roles	N/A	N/A	Intergroup Coordination Abilities 4 & 5	N/A	N/A
BP 04.03 Foster Cross-Discipline Understanding	4.11.1 Concurrent Engineering	N/A	Intergroup Coordination Ability 5	5.1.1.3 Tech Integration Planning 4.3.4 (e) Systems Analysis & Control	2.4.1 Group Interfaces (C4)
BP 04.04 Establish Coordination Methods	4.11.1 Concurrent Engineering	N/A	Intergroup Coordination Activity 3	5.1.1.2 Technical Review Planning	2.4.1 Group Interfaces (C2)
BP 04.05 Establish Resolution Methods	N/A	N/A	Intergroup Coordination Activity 2	5.1.1.2 Technical Review Planning	2.4.1 Group Interfaces (C3)
BP 04.06 Use Interdisciplinary Methods	4.11 Integration of Systems Engineering Effort	Organization ORG 1.4	Intergroup Coordination Activity 5	4.3.4 (e) Systems Analysis & Control	2.4.1 Group Interfaces (C2)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Integrate Disciplines (continued)**				
BP 04.07 Communicate Results	5.3.4 Technical Reviews	N/A	Intergroup Coordination Activity 7	5.1.1.2 Technical Review Planning	N/A
BP 04.08 Develop and Communicate Project Goals	6.8.7 Product and Process Metrics	Organization ORG 1.2 &1.5	Intergroup Coordination Activity 2	4.3.4.8 Technical Performance Measurement	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Integrate System**				
BP 05.01 Define Interfaces	5.1.2.1 System, Product, and Subsystem Interface Specifications	Engineering ENG 3.2	Intergroup Coordination Activity 2 (1)	4.3.2.1 Functional Analysis 4.3.3 Synthesis	3.4.1 Design Methodology (C3)
BP 05.02 Control Interfaces	5.1.2.1 System, Product, and Subsystem Interface Specs 6.8.2.2 Configuration Management	Support SUP 2.4 & 2.5	Intergroup Coordination Activity 4	4.3.4.5 Interface Management	3.4.2 Design Assurance (C3)
BP 05.03 Verify Receipt of System Elements	5.4.1 Systems Integration & Test	N/A	Intergroup Coordination Activity 5	5.7.10.6 Physical Configuration Audit (PCA)	4.7.2 Baseline/CM (C3)
BP 05.04 Verify System Element Correctness	5.3.4.1 Component Reviews	N/A	Intergroup Coordination Activity 5	5.7.10 (.5) & (.6) Functional & Physical Configuration Audits	N/A
BP 05.05 Verify System Element Interfaces	6.8.2.3 Interface Management	N/A	S/W Product Engineering Activity 6	5.6.1 Verification 4.3.4.5 Interface Management	2.6.1 Integration & Test Planning (C2)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Integrate System (continued)**				
BP 05.06 Assemble Aggregates of System Elements	5.4.1 Systems Integration & Test	Engineering ENG 6.1	S/W Product Engineering Activity 7	N/A	4.7.2 Baseline/CM (C3)
BP 05.07 Check Aggregates of System Elements	5.4.1 Systems Integration & Test	Engineering ENG 6.3	S/W Product Engineering Activity 7	N/A	2.6.1 Integration & Test Planning (C2)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Understand Customer Needs and Expectations**				
BP 06.01 Elicit Needs	6.1.1 Customer Expectations 6.1.5 Measures of Effectiveness	Customer-Supplier CUS 3.1	Requirements Management Ability 2 Intergroup Coordination Activity 1	4.3.1 Requirements Analysis 4.2 Systems Engineering Input	N/A
BP 06.02 Analyze Needs	6.1.4 Operational Scenarios 6.2.1 Customer Expectations	Customer-Supplier CUS 3.2	S/W Product Engineering Activity 2	4.3.1 Requirements Analysis 4.2 Systems Engineering Input	N/A
BP 06.03 Develop System Requirements	6.1 Requirements Analysis	Engineering ENG 2.4	S/W Product Engineering Activity 2 Requirements Management Abilities 1 & 2	4.3.1 Requirements Analysis 4.3.2 Functional Analysis 4.3.3 Synthesis	N/A
BP 06.04 Obtain Concurrence	6.2.1 Customer Expectations	Customer-Supplier CUS 3.3	S/W Product Engineering Activity 2	5.1.1.2 Technical Review Planning 5.7 Technical Reviews	N/A
BP 06.05 Inform Customer	N/A	Customer-Supplier CUS 3.3	S/W Project Tracking & Oversight Activity 13	5.1.1.2 Technical Review Planning 5.7 Technical Reviews	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Verify and Validate System**				
BP 07.01 Establish Verification and Validation Plans	4.3.4 Technical Plans	Engineering ENG 4.4	S/W Product Engineering Activities 5 & 7	5.2.9 Test & Evaluation	2.6.1 Systems Integration & Test Planning (C2)
BP 07.02 Define Incremental Verification	6.2 Requirements Validation 6.4 Functional Verification 6.6 Physical Verification	N/A	S/W Product Engineering Activity 6	4.3.3.2 Design Verification	2.6.1 Systems Integration & Test Planning (C2)
BP 07.03 Define System Verification	5.4.1 Systems Integration & Test	Engineering ENG 6.4	S/W Product Engineering Activity 7	5.6.1 Verification	2.6.1 Systems Integration & Test Planning (C2)
BP 07.04 Define Validation	N/A	N/A	N/A	N/A	N/A
BP 07.05 Perform and Capture Verification and Validation	5.4.1 Systems Integration & Test 6.2.5 Validated Requirements	Engineering ENG 6.5	S/W Product Engineering Activity 7	5.6.1 Verification 5.7.8 System Verification Review	N/A
BP 07.06 Assess Verification and Validation Success	5.4.1 Systems Integration & Test 6.2.5 Validated Requirements 6.4.4 Verified Functional Architecture	N/A	S/W Product Engineering Verification 3	5.7.8 System Verification Review	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Ensure Quality**				
BP 08.01 Monitor Conformance to the Defined Process	N/A	Support SUP 3.2 Organization ORG 2.8	S/W Quality Assurance Activity 4	N/A	4.2.1 SQA Approach (C1) 4.2.3 Compliance (C1)
BP 08.02 Measure Quality of the Work Product	6.5.4 Life Cycle Quality Factors	Support SUP 3.3 Organization ORG 2.9	S/W Quality Assurance Activity 5	4.1.(f) Systems Engineering Planning Implementation	4.1.2 Product Evaluations (C1)
BP 08.03 Measure Quality of the Process	N/A	Organization ORG 2.9	Quantitative Process Management Activity 2	N/A	4.1.1 Quality Planning (C4)
BP 08.04 Analyze Quality Measurements	N/A	Organization ORG 3.6	Quantitative Process Management Activity 3	N/A	4.1.1 Quality Planning (C5)
BP 08.05 Foster Quality Environment	N/A	N/A	Defect Prevention Ability 4 Organizational Process Focus Commitment 2	N/A	N/A
BP 08.06 Initiate Quality Improvement Activities	N/A	Organization ORG 3.4	Defect Prevention Activity 1 Organizational Process Focus Activity 1	N/A	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Manage Configurations**				
BP 09.01 Establish Configuration Management Methodology	N/A	N/A	S/W Configuration Management Activity 1	N/A	4.7.1 S/W Configuration Management Planning (C1)
BP 09.02 Identify Configuration Units	5.1.3 Configuration Baselines	Support SUP 2.2	S/W Configuration Management Activity 4	4.3.4.4 Configuration Management	2.2.1 Architecture Definition (C1)
BP 09.03 Maintain Configuration Data	6.8.1.1 Data and Schema	Support SUP 2.3	S/W Configuration Management Activity 3	4.3.4.4 Configuration Management 4.3.4.6 Data Management	4.7.5 Configuration Management Library & Tools (C1)
BP 09.04 Control Changes	6.8.2.2 Configuration Management	Support SUP 2.5	S/W Configuration Management Activity 6	4.3.4.4 Configuration Management 4.3.4.10 Response to Change	4.7.4 Configuration Management Control & Status Accounting (C4)
BP 09.05 Communicate Configuration Status	6.8.2.2 Configuration Management	N/A	S/W Configuration Management Activity 3	4.3.4.4 Configuration Management	4.7.4 Configuration Management Control & Status Accounting (C4) & (C5)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Manage Risk**				
BP 10.01 Develop Risk Management Approach	4.3.4 Technical Plans 6.8.2.4 Risk Management	Project Process PRO 6.1	Integrated S/W Management Activity 10	4.3.4.3 Risk Management	1.5.2 Risk Management (C1)
BP 10.02 Identify Risks	6.7.4 Risk Factors (Identify)	Project Process PRO 2.6 & 6.2	S/W Project Planning Activity 13 Integrated S/W Management Activity 10	4.3.4.3 Risk Management	1.5.2 Risk Management (C2)
BP 10.03 Assess Risks	6.7.6.4 Risk Factors (Quantify)	Project Process PRO 6.3	Integrated S/W Management Activity 10	4.3.4.3 Risk Management	1.5.2 Risk Management (C3)
BP 10.04 Review Risk Assessment	6.7.8 Alternative Recommendation	Project Process PRO 6.4	Integrated S/W Management Activity 10	4.3.4.3 Risk Management 5.7.12 Interim System Reviews	1.5.2 Risk Management (C2)
BP 10.05 Execute Risk Mitigations	6.7.7 Risk Handling Option	Project Process PRO 6.6	Integrated S/W Management Activity 10	4.3.4.3 Risk Management	1.5.2 Risk Management (C3)
BP 10.06 Track Risk Mitigations	6.7.10 Solution Effectiveness Assessment	Project Process PRO 6.5	Integrated S/W Management Activity 10	4.3.4.3 Risk Management 5.7.12 Interim System Reviews	1.5.2 Risk Management (C4)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Monitor and Control Technical Effort**				
BP 11.01 Direct Technical Effort	6.8.2 Technical Management	Project Process PRO 7.3	S/W Project Tracking & Oversight Activities 1, 3, & 9	4.5.4.7 Master Schedule	3.2.1 S/W Tracking (C1)
BP 11.02 Track Project Resources	6.8.6 Progress Against Technical Plans	Project Process PRO 7.2	S/W Project Tracking & Oversight Activity 6	N/A	5.4.2 Resources (C1) 3.2.1 S/W Tracking (C1)
BP 11.03 Track Technical Parameters	6.8.2.5 Performance Based Progress Measurement	Project Process PRO 7.2	S/W Product Engineering Measurement 2 S/W Project Tracking & Oversight Activity 9	5.1.1.1 Technical Performance Measurement Planning	3.2.1 S/W Tracking (C1)
BP 11.04 Review Project Performance	6.8.2.5 Performance Based Progress Measurement	Project Process PRO 7.4	S/W Project Tracking & Oversight Activity 8 Intergroup Coordination Activity 2	5.7 Technical Reviews	3.2.1 S/W Tracking (C1)
BP 11.05 Analyze Project Issues	6.8.2.5 Performance Based Progress Measurement	Project Process PRO 7.4	S/W Project Tracking & Oversight Verification 1, 2, & 3 and Activity 13	5.7 Technical Reviews	3.2.1 S/W Tracking (C1)
BP 11.06 Control Technical Effort	6.8.2.5 Performance Based Progress Measurement	Project Process PRO 7.3	S/W Project Tracking & Oversight Activity 6 Intergroup Coordination Activity 2	4.3.4.9 Technical Reviews 5.7 Technical Reviews	3.2.1 S/W Tracking (C1)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Plan Technical Effort**				
BP 12.01 Identify Critical Resources	4.3.1 Systems Engineering Management Plan	Project Process PRO 7.1	S/W Project Planning Activity 1	N/A	1.2.1 Planning (C2)
BP 12.02 Estimate Project Scope	4.10 System Breakdown Structure 6.7.6.1 Life Cycle Costs	Project Process PRO 2.5	S/W Project Planning Activity 11	N/A (Implied in various planning paragraghs - but not specifically addressed)	3.1.1 S/W Estimating (C1)
BP 12.03 Estimate Project Costs	6.7.6.1 Life Cycle Costs	Project Process PRO 2.5	S/W Project Planning Activity 10	5.5.9 Life Cycle Cost Analysis & Assessment	3.1.1 S/W Estimating (C1)
BP 12.04 Determine Project Process	4.1 Systems Engineering Process 4.2 Policies & Procedures for Systems Engineering	Project Process PRO 1.2	S/W Project Planning Activity 5	4.1 Systems Engineering Planning Implementation 5.1 Systems Engineering Planning	3.1.4 Preparing the S/W Development Plan (C5)
BP 12.05 Identify Technical Activities	4.3.4 Technical Plans	Project Process PRO 1.3	S/W Project Planning Activities 2 & 3	4.2 Systems Engineering Input	1.1.1 Organizational Approach (C3) & (C4)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Plan Technical Effort (continued)**				
BP 12.06 Define Project Interface	N/A	N/A	S/W Project Planning Activity 4	N/A	1.3.2 Subcontractor Mngt (C1)
BP 12.07 Develop Project Schedules	4.3.3 Systems Engineering Detailed Schedules 6.8.10 Project Plans	Project Process PRO 2.5	S/W Project Planning Activity 7	5.1.2 Systems Engineering Master Schedule	1.2.4 Schedules (C2)
Process Area :	**Plan Technical Effort**				
BP 12.08 Establish Technical Parameters	6.8.2.5 Performance Based Progress Measurement	N/A	S/W Project Planning Activity 11	5.1.1.1 Technical Performance Measurement Planning	2.2.2 Adequacy of Architecture Design (C1)
BP 12.09 Develop Technical Management Plan	4.3.1 Systems Engineering Management Plan 4.3.4 Technical Plans	N/A	S/W Project Planning Activities 1 & 2	5.1.1.1 Technical Performance Measurement Planning	1.2.1 Planning (C4)
BP 12.10 Review Project Plans	N/A	N/A	S/W Project Planning Activities 3 & 4	5.1.1.2 Technical Review Planning	3.2.1 S/W Tracking (C1)
BP 12.11 Commit to Project's Plans	N/A	N/A	S/W Project Planning Commitment 2 and Activity 6	N/A	N/A

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Define Organization's Systems Engineering Process**				
BP 13.01 Establish Process Goals	N/A	Organization ORG 2.1	Organizational Process Focus Activity 2 Quantitative Process Management Activity 7	N/A	5.6.1 Process Planning and Coordination (C1) 5.6.2 Improvement Process (C1)
BP 13.02 Collect Process Assets	4.14.2 Self Assessment 4.14.3 Lessons Learned	Organization ORG 2.10	Organizational Process Focus Activities 4, 5, & 7	N/A	5.1.3 Organizational Standards & Procedures (C1)
BP 13.03 Develop Organization's Systems Enginneering Process	N/A	Organization ORG .2 (ALL)	Organizational Process Definition Activity 1	N/A	5.1.3 Organizational Standards & Procedures (C2)
BP 13.04 Define Tailoring Guidelines	N/A	N/A	Organizational Process Definition Activity 4	(Contains Tailoring - but not in the context of the SECMM)	5.1.2 Tailoring (C1)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Improve Organization's System Engineering Process**				
BP 14.01 Appraise the Process	4.14.2 Self Assessment	Organization ORG 3.1	Organizational Process Focus Activity 1	N/A	5.6.1 Process Planning and Coordination (C1)
BP 14.02 Plan Process Improvements	4.14.3 Lessons Learned	Organization ORG 3.5	Process Change Mngt Activity 4	N/A	5.6.2 Improvement Process (C1)
BP 14.03 Change the Standard Process	4.14 Continuing Product and Process Improvement	Organization ORG 3.7	Process Change Mngt Activity 8	N/A	5.6.2 Improvement Process (C3)
BP 14.04 Communicate Process Improvements	4.14.3 Lessons Learned	Organization ORG 3.9	Process Change Mngt Activity 10 Organizational Process Focus Activities 5 & 7	N/A	5.6.2 Improvement Process (C4)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Manage Product Line Evolution**				
BP 15.01 Define Product Evolution	6.5.16 Evolutionary Development	N/A	Technology Change Mngt Activity 2	N/A	N/A
BP 15.02 Identify New Product Technologies	N/A	N/A	Technology Change Mngt Activities 2, 4, & 5	5.1.1.4 Technology Transition Planning	N/A
BP 15.03 Adapt Development Processes	4.4 Evolutionary Development Strategies	N/A	Technology Change Mngt Activities 6 & 7	N/A	N/A
BP 15.04 Ensure Critical Component Availability	5.3.2.2 Component Specifications 5.3.3 Configuration Baselines	N/A	Technology Change Mngt Activities 1 & 7 Intergroup Coordination Activity 5	N/A	N/A
BP 15.05 Manage Product Technology Insertion	4.4 Evolutionary Development Strategies	N/A	Technology Change Mngt Activities 7 & 8	5.1.1.1 Technical Performance Measurement Planning 5.1.1.4 Technology Transition Planning	5.5.3 Technology Selection and Adoption (C1) & (C2)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Manage Systems Engineering Support Environment**				
BP 16.01 Maintain Technical Awareness	A.2.2 New Technological Advances	N/A	S/W Product Engineering Activity 1	N/A	5.7.2 S/SSE Components (C2)
BP 16.02 Determine Support Requirements	N/A	Organization ORG 6.1	S/W Product Engineering Activity 1 S/W Project Planning Activity 14	5.2.1.2 Infrastructure Support	5.7.1 SSE Definition Process (C1)
BP 16.03 Assess Support Environment	N/A	Organization ORG 6.1	Technology Change Mngt Ability 4 Activity 4	N/A	5.7.1 SSE Definition Process (C1)
BP 16.04 Obtain Systems Engineering Support Environment	N/A	Organization ORG 6.2	Intergroup Coordination Ability 2 S/W Product Engineering Ability 1 Technology Change Mngt Activity 5	N/A	5.7.2 S/SSE Components (C2)
BP 16.05 Tailor Systems Engineering Support Environment	N/A	N/A	Organizational Process Definition Activity 4	N/A	5.7.1 SSE Definition Process (C1)

Table 3-3. SE-CMM Cross Reference Matrix

SE-CMM Base Practices	IEEE P1220 Requirements	SPICE BPG Base Practices	CMM Key Practices	MIL-STD-499B Requirements	SDCE Critical Capabilities
Process Area :	**Manage Systems Engineering Support Environment (continued)**				
BP 16.06 Insert New Technology	N/A	N/A	Technology Change Mngt Activity 7	5.1.1.4 Technology Transition Planning	5.7.2 S/SSE Components (C2)
BP 16.07 Maintain Environment	6.8.1.2 Tools	Organization ORG 6.4	Intergroup Coordination Ability 2 S/W Product Engineering Ability 2	N/A	5.7.4 S/SSE Maintainance & User Support (C1)