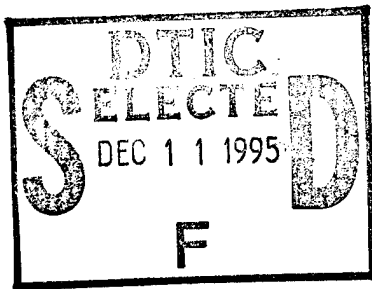


IDA PAPER P-3105

CONDUCTING SOFTWARE CAPABILITY EVALUATIONS: 1995



Beth E. Springsteen

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July 1995

Prepared for
Ballistic Missile Defense Organization

Approved for public release, unlimited distribution: October 23, 1995.

19951208 068



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PREFACE

This document was prepared by the Institute for Defense Analyses (IDA) under the task order, Ballistic Missile Defense (BMD) Software Assessments, and fulfills an objective of the task, to prepare “a draft report providing updated lessons and guidance for conduct of contractor Software Capability Evaluations in the BMD program.”

This document is an updated version of an earlier IDA study, IDA Paper P-2771, *Conducting Software Capability Evaluations*. Since then, the model and evaluation process used for conducting Software Capability Evaluations have evolved. The BMD evaluation teams have performed evaluations for the Battle Management Command, Control and Communications/Systems Engineering and Integration Program. Consequently, this document was written to provide new lessons learned, findings, and recommended procedures and techniques, all based on the BMD teams’ experiences in 1995.

This document was reviewed by IDA research staff members Dr. Richard Ivanetich, Dr. Judy Popelas, and Mr. David A. Wheeler. Their contributions, and in particular the contributions of the BMD evaluation teams, are gratefully acknowledged.

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SUMMARY

Software has become a critical element in Department of Defense (DoD) programs, and the DoD has increased its emphasis on the need to evaluate and monitor software contractors and subcontractors. Consequently, the Software Engineering Institute (SEI) was tasked by the Air Force to develop a software evaluation methodology; the results included the SEI Capability Maturity Model (CMM), containing five levels of process maturity and their associated Key Process Areas (KPAs), and the evaluation methodology called the Software Capability Evaluation (SCE). The Ballistic Missile Defense Organization (BMDO) is using the SCE method to determine whether developers have good software practices that help avoid cost and schedule overruns. In conducting SCEs, the BMDO is encouraging continuous process improvement by software development contractors. SCEs have been scheduled throughout the BMD program life cycle, and program offices use SCEs for input to the source selection process as well as for monitoring existing contracts.

Research staff members from the Institute for Defense Analyses (IDA) were trained at SEI in conducting SCEs and participated as technical advisors for the SCEs performed for the National Test Facility, Brilliant Pebbles, and Brilliant Eyes programs. The lessons learned were incorporated in an earlier study, IDA Paper P-2771, *Conducting Software Capability Evaluations*. Since then, the SEI model and evaluation process have evolved and the BMD evaluation teams have gained additional experience by conducting SCEs for the BMDO Battle Management Command, Control, and Communications/Systems Engineering and Integration (BMC3/SE&I) program. This document is an update of P-2771, based on the BMD teams' experience in 1995. It describes the primary team activities and responsibilities in conducting SCEs for BMD programs. It includes specific procedural guidance for each activity, and key artifacts such as text in the Request for Proposal (RFP) for informing contractors of SCE requirements. Because of the extensive experience behind these recommendations, other DoD programs may find this guide helpful for their SCE teams.

The content of this guide, in terms of recommended activities and guidance, is summarized below for the three time frames of the evaluation process, i.e., before, during, and after performing the SCE team's site visits to the contractors.

Activities Prior To Conducting Evaluations

Develop inputs to the RFP. Prospective offerors must be made aware of the SCE requirements in the RFP. Text is given within this report that can be used to insert the SCE requirements notice within the RFP and the associated Instructions for Preparation of Proposals.

Establish evaluation criteria. The Source Selection Authority (SSA) may choose to use the SCE results for source selection either as a specific criterion, general consideration, or as a performance risk factor. The SSA may request that the evaluation results support a color rating, numerical rating, or risk rating. Examples of these rating systems are included in this report.

Identify specific program needs. Each BMD program office may have specialized software evaluation needs not currently emphasized in the CMM. Additional KPAs may be added to the standard SEI CMM or the evaluation requirements may be tailored to emphasize program office needs. A list of questions is provided to help tailor the CMM to meet these special needs.

Notify contractor prior to evaluation. When performing SCEs, it is important to notify contractors in advance how the SCEs will be conducted. During the pre-proposal conference or a similar coordination meeting, it is necessary to describe the evaluation process, pertinent requirements in the RFP, site visit coordination activities, and how the results will be used.

Select the evaluation team. Detailed qualifications of team members must be identified. Qualifications include training and technical or managerial experience in the area of software development or acquisition support. BMD teams should not consist only of members from a single Service or Government organization. Assigning team members from multiple Service organizations, National Laboratories, and Federally Funded Research and Development Centers should be considered. Other considerations include team skills, leadership, and lack of conflict of interest. All SCE team members will be required to sign a Procurement Integrity Certificate (PIC) for the source selection at hand. The PIC requires disclosure of financial interest in any of the RFP offerors. Finally, additional training should be arranged for SCE teams who have little SCE experience or who have not worked together on an actual evaluation.

Assign KPAs to SCE team members. Even though the entire SCE team is responsible for understanding and evaluating all KPAs under review, individual team members should be assigned primary responsibility for a subset of KPAs. For each assigned KPA,

individuals are responsible for developing interview questions, submitting documentation requests, interviewing candidates, and generating findings. The assignments help to guarantee all KPAs are adequately and consistently evaluated. Included is a list of KPA assignments used by a previous SCE team.

Estimate SCE expenses. Due to the extensive travel associated with conducting SCEs, expenses must be estimated and BMD program management must make a financial commitment to the process. Included in this section of the paper is a list of actual travel expenses incurred by a previous SCE team.

Conducting Evaluations

Select projects to be evaluated. The contractor will provide information on four to six projects. The SCE team will select three projects to review during a three-day site visit. The projects selected must adequately represent the contractor's proposed role and help to judge the risk associated with awarding the proposed project to the contractor. Guidance for selecting the appropriate projects is provided.

Establish site visit schedule. A detailed schedule identifying the activities during the three-day site visit is described. It includes a list of interview candidates, a prioritized list of topics to explore during each interview, and the allotted time for document reviews and for finalizing SCE findings and results.

Submit documentation requests to the contractor. The SCE team will submit a list of documents to be made available to the SCE team prior to the site visit and during the site visit. Prior to the site visit, the contractor will furnish the software development plan, project profiles, an organization chart, and a completed SEI questionnaire form. This documentation is used by the SCE team to plan an interview schedule, identify issues and questions, and form a basis for the findings. During the site visit, additional documentation is requested to substantiate findings. A detailed list of documents is identified for each KPA.

Assemble packing list. The SCE team should bring a set of reference material, team notes, and all necessary forms to be used while on site at the contractor's facility.

Develop entrance briefing. The SCE team and the contractor will each provide an entrance briefing to identify the scope of the SCE and the contractor's software process. Recommended topics for the presentations are listed along with a sample set of slides.

Notify contractors. Contractors should receive a detailed notice for the site visit one week in advance of the SCE. A sample notification letter used by previous SCE teams is provided.

Establish interview approach. Interviews are conducted with project personnel, and project documentation is reviewed to verify the adequacy of the contractor's software practices. All information gathered during the site visit will be documented to support SCE findings. Recommendations are included for conducting interviews, establishing SCE team member roles, documenting interview notes, and completing specific objectives while on site.

Activities After Conducting an Evaluation

Final report. The SCE team will prepare a report of its findings for the contractor, the Source Selection Evaluation Board (SSEB), the BMD program office, and the BMDO. The report will be labeled *Proprietary Information* and distribution will be controlled. Descriptions of the report format and content are included in this section.

Contractor feedback of evaluation results. The winning contractors will be briefed after the contract is awarded; at this time the contractors can provide feedback. Guidance is included for providing SCE results to the contractor.

Use of evaluation results in source selection. This section provides guidance for reporting SCE results to the SSEB.

Use of evaluation results for contract monitoring. An SCE may be used to help monitor a contract. The program office can compare the results of the evaluation with the contractor's process improvement plans. If there are discrepancies, the program office should notify the contractor to produce an acceptable plan to mitigate the risks and to reduce the principal weaknesses over the length of the contract. Other approaches for mitigating risks are provided.

Registry of evaluation results. The results of an SCE should be stored by BMDO in a repository for possible reuse in later procurements. This can reduce time, effort, and expense. Using an SCE repository could also shorten the procurement cycle, provided previous results are used and the number of new SCEs that must be performed is reduced.

Issues Related to SCE Findings. Other issues associated with SCE findings are clarified for future evaluations: consistency of results, evaluating new company divisions, summarizing KPA findings, weighting SCE results in a teaming arrangement, establishing acceptable levels of process maturity, and saving evidence.

1. INTRODUCTION

1.1 Purpose

This paper provides the means for improving the effectiveness of the Ballistic Missile Defense (BMD) Software Capability Evaluation (SCE) teams and the quality of their results. The originator of the SCE concept and process, the Software Engineering Institute (SEI), provides basic information for performing the evaluations in the SCE Team Members Guide and the associated training course [SEI 1993a, 1994]. In practice, additional information and procedures are necessary to help achieve the best possible results.

The SCE is a valuable tool that assists in ensuring that the Federal Government gets a timely quality product for its software investment. SCEs are being used in the BMD program as part of two distinct activities: source selection and contract monitoring. When used in source selection, SCE results figure into the overall scores of the offerors. When SCEs are used for contract monitoring, the program office can use the results as a risk management indicator, validate whether the contractor's software development process has been maintained, and determine whether improvement has occurred.

This paper is for use within the BMD program by teams already trained to conduct SCEs by SEI-licensed trainers. It is intended to supplement the training material and reports with other information and procedures the BMD teams have learned and used through their experiences performing SCEs. In particular, this paper captures the lessons learned by 1995 BMD SCE teams and revises lessons which were documented in an earlier Institute for Defense Analyses (IDA) report [Springsteen 1994]. The previous report was also based on an earlier version of the evaluation model and methodology which have since been updated and incorporated into BMD's SCE practices.

1.2 Background

In the last decade, the visibility and importance of software in Department of Defense (DoD) programs have increased the need to improve the Federal Government's ability to evaluate and monitor software contractors. Responding to a request by the United States Air Force, SEI developed a software evaluation methodology.

The SEI methodology provides five levels of process maturity, each associated with key process areas (KPAs). Refer to Table 1 for details [SEI 1993b].

Table 1. SEI Capability Maturity Model

Level	Characteristics	KPAs
5 Optimizing	Continuous process improvement	Process Change Management Technology Change Management Defect Prevention
4 Managed	Product quality planning and tracking of measured software processes	Software Quality Management Quantitative Process Management
3 Defined	Development process defined and institutionalized to provide product quality control	Peer Reviews Intergroup Coordination Software Product Engineering Integrated Software Management Training Program Organization Process Definition Organization Process Focus
2 Repeatable	Management oversight and tracking of project; stable planning and product base-lines	Software Configuration Management Software Quality Assurance Software Subcontract Management Software Project Tracking and Oversight Software Project Planning Requirements Management
1 Initial	Ad hoc (unpredictable and chaotic)	"People"

BMD evaluation teams attend a five-day training course to learn how to apply the basic methods for conducting an SCE. The training course reviews the main process maturity concepts, teamwork skills, interview techniques, scoring project questionnaires, and the exit briefing containing the SCE findings. These methods are taught at a high level and are documented in a training manual [SEI 1994].

IDA began to identify better practices in 1991 after participating as technical advisors for the SCEs performed at the National Test Facility (NTF) and on the two Brilliant

Pebbles (BP) contractors. We applied the lessons learned from the NTF and BP SCEs in subsequent SCEs performed on offerors for Brilliant Eyes (BE) and Battle Management Command, Control, and Communications/Systems Engineering and Integration (BMC3/SE&I) programs. The additional lessons collected and observations made during these SCEs are used as the basis of the information presented in this document.

1.3 Approach

The following steps were taken in preparation for the analyses in this paper.

a. Trained IDA personnel at SEI.

SEI has developed and administers a five-day training course for conducting an SCE. The course introduces the software evaluation methodology that focuses on KPAs tied to the maturity model. SEI's case studies and mock evaluations are used to provide some initial hands-on experience to the trainees. Currently, six IDA research staff members have completed training.

b. Developed supplemental training materials.

Based on previous experiences in conducting SCEs for BMD, IDA reexamined SEI's training course and training materials for completeness and applicability to the BMD program. IDA developed additional training materials to emphasize the information-gathering aspects of conducting an SCE and to share the lessons learned from earlier SCEs. A course was administered at IDA for the BE and BMC3/SE&I evaluation teams previously trained by SEI licensed vendors.

c. Participated in conducting evaluations.

IDA participated in over 14 SCEs performed in support of BMD programs, specifically NTF, BP, BE, and BMC3/SE&I. The IDA members of an evaluation team acted as technical advisors, providing additional depth to the government team.

d. Developed recommended procedures and techniques.

The supplemental training materials developed by IDA and the lessons learned by the various evaluation teams have been collected and are the basis for this document.

1.4 Organization

Section 1 presents a brief background of the origins of the evaluation method and the approach taken in writing this paper. Section 2 describes the views of the Ballistic Missile Defense Organization (BMDO) on SCEs and how these views apply to the BMD program. In Sections 3, 4, and 5, suggestions and lessons learned are presented in the context of the activities that surround an SCE. The appendices provide plans, worksheets, and sample findings the evaluation teams can use in obtaining the SCE results. A list of acronyms and a list of references are provided at the end.

2. BMD OBJECTIVES IN USING SCEs

To help ensure that BMD software developers have good software practices and to reduce the risk of software cost and schedule overruns, SCEs are conducted for the BMD program using the Capability Maturity Model (CMM). BMDO's Software Policy 3405 establishes the basis of the plans and requirements to use SCEs across the program.

Since the CMM is limited in scope, the model and the evaluation criteria may be extended to help evaluate and monitor other areas of importance to the BMD software program. Such areas include trusted software, evolutionary prototyping, and reusable software. This section of the report describes how the CMM can be applied within the BMD program and tailored to best satisfy the program's needs.

2.1 Use the Current Evaluation Method and Maturity Model

The BMD program uses the current SEI evaluation methodology and the CMM [SEI 1993a, 1993c]. The SCE methodology has undergone two major changes in the last five years and is still evolving. As SEI methods are updated, BMDO plans to retrain the BMD teams to use the most recent version.

The first SEI process maturity model was documented in 1987 by Humphrey and Sweet [1987]. This method was based on a questionnaire consisting of 101 questions. Since 1991, the model evolved from a questionnaire into what is known as the CMM which includes goals and practices associated with KPAs [SEI 1993c]. BMD teams plan to use the most current version of the maturity model as it continues to evolve.

2.2 Encourage Continuous Process Improvement

The underlying goal when conducting SCEs is to encourage continuous process improvement among software development contractors. It should be an on-going effort within a contractor's organization rather than something done only once to satisfy a Source Selection Evaluation Board (SSEB). Continuous process improvement will not simply happen because a contractor or program office wishes or requires it. Rather, a comprehensive process improvement plan should be put in place and followed.

Due to the large number of contractors involved in the BMD program, it is desirable to use both the SCE and the software process assessments (SPA) to encourage continuous process improvement. SCEs are evaluations performed by a government team on the contractor's process, whereas a SPA is performed by a contractor team on its own software process. Another name for the SPA is a CMM Based Appraisal - Internal Process Improvement (CBA-IPI). BMDO Software Directive 3405 specifies an evaluation and assessment hierarchy, as pictured in Figure 1.

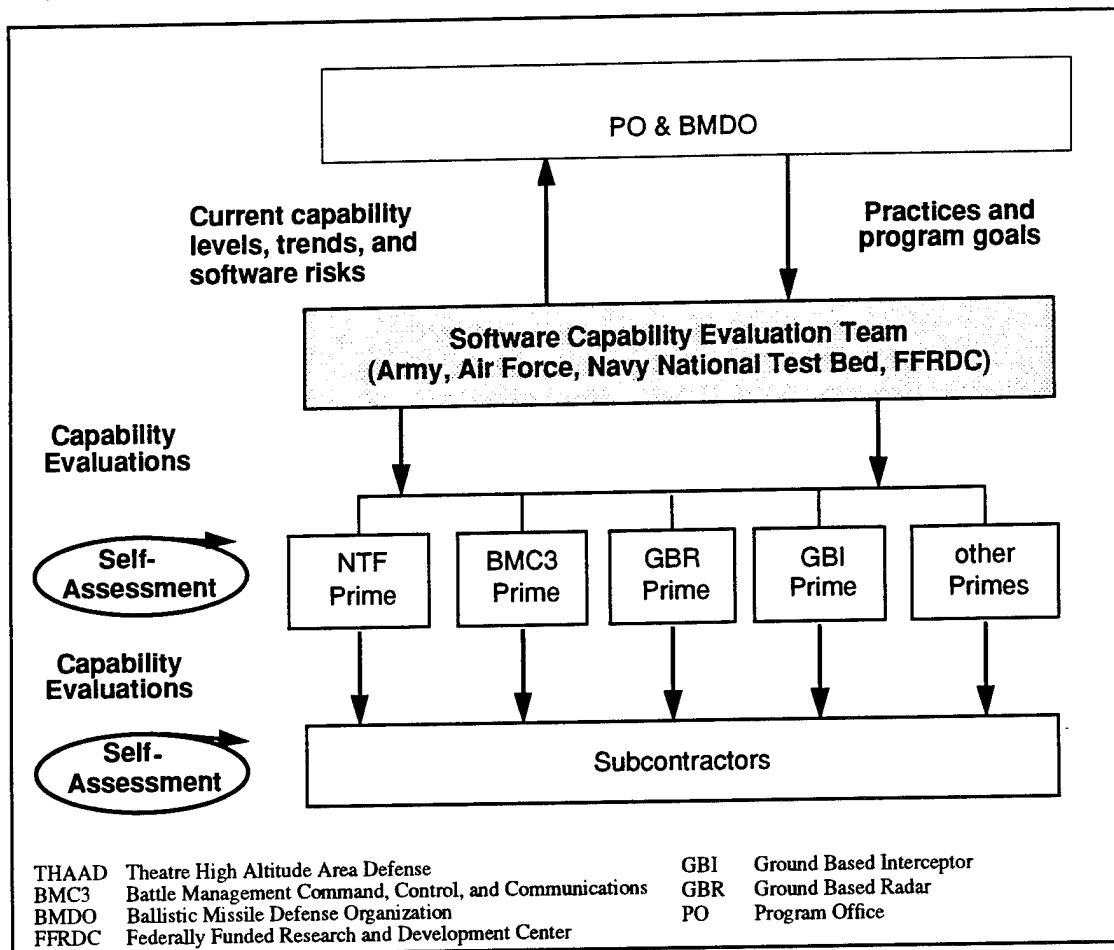


Figure 1. BMD Contract Monitoring Process

The Directive 3405 specifies that the subcontractors and the prime contractors perform annual self-assessments of their development processes and develop annual software process improvement plans. The contractors are responsible for identifying and improving their process over the life of the BMD program. In addition, prime contractors are responsible for the quality and cost of their subcontractors' software. Thus, the prime contractors are encouraged to perform annual SCEs on their subcontractors.

The BMD evaluation team may only evaluate prime contractors and not all of the subcontractors. But the BMD teams will look closely at how well the prime contractors oversee their subcontractors and will validate the results of the self-assessments and the quality of the contractor's software process improvement plans. The results of the SCEs are provided to the contractor and the element program managers for input to their risk management process.

2.3 Schedule SCEs Throughout BMD Life Cycle

BMD program offices will use SCEs for input to the Source Selection Evaluation Board (SSEB) and to help monitor contracts previously awarded. SCEs will be used for source selection for both Demonstration/Validation (Dem/Val) and Engineering Manufacturing and Development (EMD). Since it may take one to three years for a contractor to advance from one maturity level to another, BMD plans include the use of SCEs as a contract monitoring mechanism to encourage the contractors to continuously improve their software development process, as noted in Figure 2.

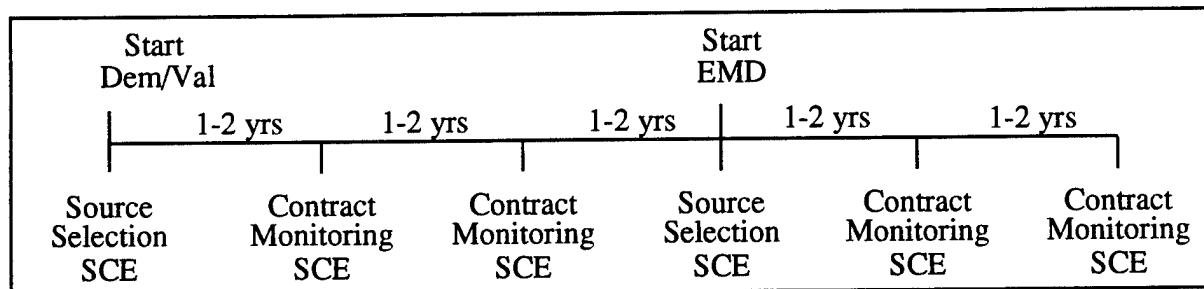


Figure 2. Schedule for SCEs

The first SCE should be performed during source selection, the next SCE one to two years later to give the contractor an opportunity to improve and to monitor their progress. Contractors typically welcome SCEs as a contract monitoring mechanism since it gives them an independent view of their process and an opportunity to prepare for the SCE that will be used at the next source selection. If, however, an SCE was not performed during source selection, an SCE should be done approximately six to nine months after the contract is awarded, as noted in Figure 3. By this time, the contractor should have the software process defined and documented in a software development plan (SDP). It is important to have the SDP available prior to an SCE so that the evaluation team can verify that the process being described in the interviews is the same process described in the SDP and applied to the BMD element.

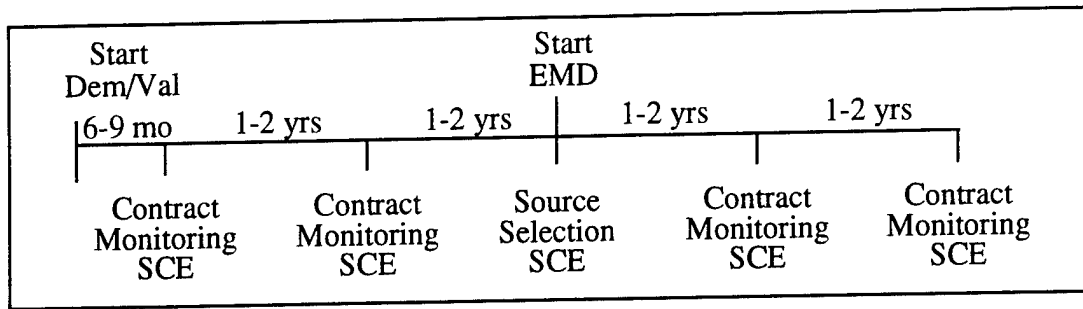


Figure 3. Alternative Schedule for SCEs

2.4 Emphasize BMD Projects in SCEs

When performing an SCE, the evaluation team looks at several projects within the contractor's organization to gain an understanding of the contractor's software development process. The SCE team reviews information on four to six of the contractor's projects and interviews people from three projects. Section 4.1 describes in more detail how the team selects the projects to review.

In general, the team looks at several projects in order to determine what processes are unique at the project level and what processes are standard across the organization and applied to all of the projects. When new software projects are initiated, it is desirable to have a well-defined organizational approach to software process development from which a new software project can draw. The organization's standard software process should be derived and refined, based on the experience and "lessons learned" from the projects within the organization. It is not desirable for each project to learn the lessons first hand, but rather to learn from the trial and error of previous projects. Thus, an SCE evaluates the organization's approach to software development by looking at the organizational practices and how they are used in on-going projects.

When a project is initiated, the organization's standard approach to software development has much more effect than when a project is nearing completion. Consequently, the focus of a BMD SCE will vary, depending on whether the BMD project is just being initiated or whether it is well into development. For example, at the start of Dem/Val, the offerors will not have a well-defined software process for the BMD element for which they are competing. An SCE for Dem/Val source selection should therefore evaluate the processes being applied to other projects within the contractor's organization supporting BMD. Once the Dem/Val contract is awarded, the contractor will begin to define the soft-

ware process for the BMD element. By the time Dem/Val is completed, the process being applied to the EMD contract is well defined for the BMD element. The SCE performed for EMD source selection will focus less on the organization's process and more on the process being used on the BMD element.

2.5 Extend the Capability Maturity Model

The KPAs in SEI's CMM cover certain components that are recognized as good software development practice. BMDO's efforts to improve the development process further raise additional requirements that could be included in SCEs such as the BMD Trusted Software Methodology (TSM) and use of a common information architecture. The basic approach for extending the CMM into additional areas involves tailoring the existing CMM KPAs or adding other KPAs to address the unique requirements. For reference, these may be called program-defined KPAs, in contrast to SEI-defined KPAs included in the CMM. Refer to Section 3.3 for information on tailoring the existing KPAs to satisfy specific program needs.

When adding program-defined KPAs, it is most important to preserve intact SEI's model and evaluation approach for several reasons. First, this allows a program to leverage off SEI-developed training experience applying SEI's approach. Second, a program can use the benefit data emerging from this experience as an aid to assessing its own improvement achievements or problems. Third, a program should find it expeditious and economical to address the added requirements with the same team and during the same SCE site visit.

The addition of a program-defined KPA, such as for the BMD TSM, involves developing a set of goals and practices for satisfying the KPA. The goals may be flexible and permit multiple ways of satisfying the KPA. They may be expressed in terms of trust principles and supported with a set of candidate interview questions to be answered through the SCE interviews. The criteria also must lead to a report for the added KPA, similar to the one prepared for SEI's KPAs; that is, it must help identify strengths and weaknesses, and support a clear resolution of whether or not the KPA is satisfied.

Any score or level scale associated with program-defined KPAs should be separate and distinct from SEI maturity levels to preserve SEI's approach without change. Strengths, weaknesses, and KPA satisfaction should be the important consideration in either case, not overall score or maturity level.

A program-defined KPA may involve requirements in which SCE team members are not well versed. This means that special training may have to be established for SCE

teams, so that they can consistently judge various implementations of requirements they will encounter in practice.

Program-defined KPAs may depend in part upon evidence and requirements established for CMM KPAs. An SCE team should have this overlap clearly in mind during interviews in order to gather all the pertinent facts at the most convenient time, rather than doing repeat interviews to handle added KPAs separately from the CMM.

Other evaluation methods such as Software Development Capability/Capacity Review (SDC/CR) [AFSC 1991] and Software Productivity Research (SPR) [SPR 1991] also show that the CMM is not exhaustive and could be extended further to explore other potential risk areas. For example, additional areas of investigation in SDC/CR not found in the CMM KPAs are systems engineering and development tools. SPR has additional areas of coverage such as the physical environment, experience of the staff, and development methodologies.

An SCE team must be able to address all added KPAs within a reasonable additional time on site, perhaps no more than one additional day. This factor especially limits the number and scope of additional requirements. Experience with added KPAs is still needed to provide firm guidelines on scheduling. For specific guidance on extending the CMM to include the TSM requirements refer to [Springsteen 1993].

3. ACTIVITIES PRIOR TO CONDUCTING EVALUATIONS

Prior to performing SCEs, several activities need to be accomplished so that the contractor and government program office can incorporate the SCEs into their schedules and budgets. In order of occurrence, they are 1) develop inputs to the Request for Proposal (RFP), 2) establish evaluation criteria, 3) identify specific program needs, 4) notify contractor prior to the evaluation, 5) select the evaluation team, 6) assign KPAs to SCE team members, and 7) estimate expenses. This section will discuss these activities in more detail.

3.1 Develop Inputs to RFP

When using SCEs for source selection and contract monitoring, the offerors must be made aware of the requirement in the RFP. Appendix A of this document provides text that can be used to insert the SCE requirements notice within the RFP, specifically, Sections L and M of the RFP. The text is expected to be tailored to accommodate the specific requirements of the acquisition.

Appendices B and C of this document provide additional information that should be included in the RFP. Appendix B is a sample project profile that each contractor should complete. The project profile requests general information about a software development effort, such as coding language used, host development system, and applicable standards. Appendix C is a form for recording the answers to the SEI Maturity Questionnaire. The questionnaire requests detailed information on the software engineering practices used on a project. Each of the contractors should use this form to record the answers for four to six projects. The SCE team will then review both the project profiles and the questionnaire responses to select the set of projects to examine during the site visit.

3.2 Establish Evaluation Criteria

The Source Selection Authority (SSA) will use the results of an SCE during source selection as either a specific criterion, general consideration, or a performance risk. A specific criterion is preferred since the SCE process can provide valuable information useful in selecting a contractor. In any case, the SSA will request that evaluation criteria be estab-

lished for using SCE results to support a color, numerical, or risk rating, depending on whether the procurement is for the Air Force or the Army.

These rating systems can be applied to the results of all the KPAs combined or singularly. When the KPA results are combined, the rating should identify the offeror as high risk if it has a low process maturity, and low risk if the maturity rating is high. In other words, contractors with a level 1 maturity would be ranked lower than those with a level 3 maturity. Instead of applying the rating systems to a maturity level, they can be applied to each KPA individually. For example, an offeror's ability to satisfy all or some of the goals of a KPA can be used to assign a color, number, or risk rating to each KPA.

The following criteria may be used to map overall SCE results to the Air Force's color rating scheme:

- Blue: A blue rating is given when the SCE findings show that the offeror is acceptable in all level 2 and level 3 KPAs.
- Green: A green rating is given when the SCE findings show the offeror is acceptable in all level 2 KPAs. In addition, the offeror is acceptable in at least three of the following level 3 KPAs: Organization Process Focus, Organization Process Definition, Peer Reviews, Intergroup Coordination, Software Product Engineering, Training Program.
- Yellow: A yellow rating is given when the SCE findings show the offeror is acceptable in at least four of the following level 2 KPAs: Software Project Planning, Software Project Tracking and Oversight, Software Configuration Management, Software Quality Assurance, Requirements Management, Software Subcontract Management.
- Red: The red rating is given when the SCE findings show the offeror is acceptable in fewer than four of the following level 2 KPAs: Software Project Planning, Software Project Tracking and Oversight, Software Configuration Management, Software Quality Assurance, Requirements Management, Software Subcontract Management.

As an alternative, the following numerical rating method might be used. In this example, a total of 13 points can be earned as follows:

- For each of the following level 2 KPAs that are acceptable, the offeror earns a point: Software Project Planning, Software Project Tracking and Oversight,

Software Configuration Management, Software Quality Assurance, Requirements Management, Software Subcontract Management.

- For the offeror to earn any additional points, the offeror must have been acceptable in at least four of the level 3 KPAs identified above. The offeror can earn an additional point for the following KPAs, provided that they were acceptable: Organization Process Focus, Organization Process Definition, Peer Reviews, Intergroup Coordination, Integrated Software Management, Software Product Engineering, and Training Program.

The SSEB could apply one of these rating schemes to the SCE results. The examples given previously may be tailored to meet the specific acquisition needs. If the program office is selecting between two contractors that have similar maturity levels, the criteria should be more stringent to differentiate between them. Depending on the program office's concerns, the evaluation criteria can be tailored to emphasize specific KPAs.

3.3 Identify Specific Program Needs

Each BMD element program office may have specialized software needs. It is conceivable that the specialized needs of one or more of the elements would not be appropriately addressed in an SCE performed with the standard CMM-based KPA set. The program office will need to determine if additional KPAs need to be added or if the existing requirements need to be tailored.

Following is a list of sample questions to ask the program manager when tailoring the scope of the existing KPAs. In parentheses are the KPAs that would be affected by the response to the question.

- a. Are specific cost or schedule reports required of the contractor (e.g., specific cost, schedule, accounting reports)? (Software Project Tracking and Oversight KPA)
- b. Is the RFP requiring the offerors to use advanced software engineering tools and techniques (e.g., object-oriented development, commercial-off-the-shelf integration, software reuse)? (Software Product Engineering, Organization Process Focus KPAs)
- c. Is a particular software life cycle model being mandated (e.g., evolutionary prototyping vs. full-scale development)? (Software Project Planning and Organization Process Definition KPAs)

- d. What level of involvement will the customer have with the contractors (e.g., periodic formal reviews vs. integrated product teams)? (Requirements Management and Intergroup Coordination KPAs)
- e. Who will be responsible for performing Software Configuration Management and Software Quality Assurance (e.g., prime contractor, subcontractor, or government)? (Software Configuration Management and Software Quality Assurance KPAs)
- f. Will subcontractors be used to develop software? (Software Subcontract Management KPA can be eliminated if answer is negative.)

Depending on the level of importance, these requirements can be added as separate KPAs or emphasized within the scope of existing KPAs. If given the opportunity during a source selection process, SCE teams could review proposals to determine what methods, tools, and processes were being proposed and target them during the on-site evaluation. Usually, however, there is no time for the SCE team to evaluate proposals since the evaluation and contract award schedule is too demanding [Ragan 1995].

In addition to adding requirements, the program manager should be interviewed to determine if any of the KPAs can be deleted from the scope of the evaluation process. Due to the time constraints, it is not recommended that the SCE team evaluate all of the level 2 and level 3 KPAs in the three-day evaluation period. It is too difficult for the team to scrutinize all 13 KPAs to a significant level of detail. Based on the experience of the previous BMD SCE teams, there are certain KPAs which all of the contractors have passed and for which significant weaknesses have not been identified, i.e., Software Configuration Management and Software Quality Assurance. At minimum, it is recommended that these KPAs be eliminated from the SCE review process so that the team may perform a more thorough evaluation on the remaining areas of interest.

3.4 Notify Contractor Prior to Evaluation

Prior to an SCE, it is important to meet with a contractor to formally notify them of the SCE requirements and describe the general evaluation process that BMD will use.

During a source selection, all potential offerors will be notified through the RFP and the pre-proposal conference that SCEs will be conducted. Some offerors may not be familiar with the CMM and the SCE process; hence it is important to provide a brief overview during the pre-proposal conference. The overview should include a general description of

the evaluation process, the pertinent requirements in the RFP, site visit coordination activities, and a description of how the SCE results will be used in the source selection process. Refer to Appendix D for a sample of the slides that were used at earlier pre-proposal conferences. These same slides apply when coordinating an SCE for the purposes of monitoring a contract. It is recommended that the coordination meeting be held approximately three months in advance of the SCE.

3.5 Select the Evaluation Team

When forming an SCE team, the program office should coordinate through BMDO which is responsible for SCE team training and schedules. There are several qualification requirements that BMDO requires of the team and its members.

All team members must have attended an SCE training course, preferably together. Currently, SEI has certified vendors to provide a five-day training course for first time evaluators. A two-day refresher training course is available for individuals who were previously trained on earlier versions of the SCE method.

Before being selected for SCE training, potential trainees must have adequate software technical or managerial experience. SEI recommends that trainees have at least seven years of software development or acquisition experience. It is not adequate to have a SCE team consist solely of software acquisition experts or development experts. It is desirable to have a mix of both professions on the team; at least one representative must have extensive software acquisition experience and at least three representatives must have software development experience. When deciding the team composition, it is also important that at least two of the members have a strong background in each of SEI's KPAs.

BMD teams should not consist of members from a single Service or government organization. Representatives from the Air Force, Army, NTF, and Federally Funded Research and Development Centers (FFRDCs) should be considered for the team.

Other considerations for selecting SCE team members include team skills, leadership, and lack of conflict of interest. Team skills are an important aspect during an evaluation. Those who find the consensus process difficult or who are unable to contribute to the SCE process will not be effective SCE team members. Team members must have good communication skills in order to work with other team members and with contractors during the evaluation process. Team members must be good listeners so that they can judge what they hear during the evaluation process. Team members should also take initiative. Without such initiative, the evaluation process might become shallow and superfluous. It is

also important to have some team members who can take a leadership role during an SCE to ensure that the SCE progresses smoothly and effectively.

All SCE team members will be required to sign a Procurement Integrity Certificate (PIC) for the source selection at hand. The SCE team leader with the assistance of the program office should check to ensure that all potential SCE team members will be able to sign the PIC. (Among other things, the PIC requires disclosure of financial interest in any of the RFP offerors.) PICs should be signed and returned to the contracting officer within the program office prior to the start of the SCE activities.

If the chosen SCE team has little previous SCE experience or has not worked together on an actual evaluation, it is beneficial to arrange additional training. The purpose of such training is to sharpen skills learned during formal SCE training and to develop interpersonal team building skills. The CMM and the SCE process discussed during the SCE training course should be reviewed. In particular, each KPA should be reviewed to familiarize team members with the criteria to be used during the evaluation. If possible, a practice SCE should be arranged, consisting of interviews, documentation reviews, and the team consensus process. If a practice SCE is unmanageable given the time and resource commitments, a mock SCE should be arranged with “typical” people encountered during site visits.

3.6 Assign KPAs to SCE Team Members

Due to the scope of the CMM and the time constraint of the SCE process, KPAs should be divided amongst the SCE team members. Prior to the start of an SCE, each team member at a minimum is responsible for thoroughly understanding his or her assigned KPAs, developing interview questions, and listing potential documents to evaluate once on site. During the evaluation, each team member will be responsible for interviewing candidates to better understand the contractor’s ability to address each KPA goal, reviewing documents which substantiate that the process is being used, and generating findings in terms of strengths and weaknesses. While a team member may have been assigned a primary set of KPAs, all team members should be prepared to support the other team members in their evaluation of all the KPAs.

When assigning KPAs to team members, it is important to understand which KPAs individuals feel most knowledgeable about. There are logical grouping of KPAs that will help establish continuity among team members and help to define their areas of responsi-

bility. Following is a list of the KPA groups that were assigned to a five-member team during previous BMD SCEs:

- a. Software Project Planning, Software Project Tracking and Oversight, Integrated Software Management
- b. Requirements Management, Software Product Engineering
- c. Software Quality Assurance, Software Configuration Management, Training Program
- d. Organization Process Focus, Organization Process Definition
- e. Software Subcontract Management, Intergroup Coordination, Peer Review

3.7 Estimate SCE Expenses

The program manager and BMDO should be aware of the anticipated expenses for conducting SCEs. There are expenses associated with team preparation, site visits, and final report preparation. Assuming BMDO already funds the labor associated with each team member, the added expenses are generally travel related. Table 2 contains a list of the actual expenses incurred by an SCE evaluation team to perform one contractor evaluation.

Table 2. Example of SCE Travel Expenses

Category	Range of Expenses (\$)	Quantity per Person	Average Expense per Person (\$)	Total Expense per Team (5 Members)(\$)
Airfare	436-1,432	1 round trip	949	4,745
Hotel	42-102	4 nights	288	1,440
Per diem	26-38	5 days	160	800
Car rental	36-42	4 days	156	780
Miscellaneous:			90	450
Hotel parking	5	4 days		
Phone calls	10	1		
Local mileage	15	1		
Airport parking	30	1		
Personal gas	15	1		
TOTAL			1,643	8,215

4. CONDUCTING EVALUATIONS

This section provides guidance to an SCE team for the period between when RFP responses are received and the team has completed the three-day on-site evaluation of each contractor. In order of sequence, the SCE team will 1) select projects to be evaluated, 2) establish site visit schedule, 3) submit documentation requests to the contractor, 4) assemble packing list, 5) develop site visit entrance briefings, 6) notify contractors, and 7) establish interview approach. This section provides additional details on each of these activities.

4.1 Select Projects To Be Evaluated

In response to the RFP, a contractor will provide information on four to six projects. From these projects, the SCE team selects three projects it wishes to examine during the SCE. The SCE team will use information contained in both project profiles and the SEI questionnaire to select the projects to be evaluated in greater detail during the site visit. This selection process is critical to the success of an SCE. The projects selected must provide data that can be used to judge the risk associated with awarding the proposed project to the contractor. The following paragraphs provide guidance for selecting the projects.

Projects examined during an SCE must be from the same site, division, group or profit center as that of the proposed project. These organizational divisions vary considerably in industry. During an evaluation, the team will be looking for an organization-level set of policies and procedures that are applied consistently across all projects. Specifically, the team will seek to examine projects with a common software quality assurance (SQA), software configuration management (SCM), and software engineering process group (SEPG). One way to determine whether the selected projects are appropriate for examination is to trace the management control from each of these functions up through the organization. These lines should converge at a point also in the management structure of the proposed project; i.e., the SQA manager, SCM manager, and SEPG managers should be the same for all the projects being reviewed.

Contractor responsibilities on the selected projects should be similar as those on the proposed project. If the contractor is the prime on the proposed project, it is important that

the projects selected for examination represent examples where the contractor also served as the prime. This will allow the SCE team to evaluate the contractor's ability to assess and guide the processes used by the subcontractor. If the contractor has never been the prime before but will be in the proposed contract, this is a risk that must be brought to the attention of the SSA.

In addition, projects are less suitable for an SCE if they were subcontracted from another prime contractor, used substantial government-furnished software, or were developed as an internal research and development (IRAD) project. Projects subcontracted from another contractor are not good candidates since the development processes used by the subcontractor may have been influenced and guided by the prime contractor and do not represent those of the subcontractor. Similarly, the SCE team should avoid evaluating projects where most of the software was government furnished since the team is evaluating the contractor's development process rather than the ability of the contractor to integrate government-furnished software. IRAD software projects are developed internal to the contractor with no government interface. The project management and development practices may not be representative of a larger government-funded project.

Projects selected for examination during an SCE should be technically related to the proposed project. For example, a management information system (MIS) project may not provide adequate information for judging the risk involved with building a sophisticated launch control system.

The scale of the development effort on the selected projects should be roughly equivalent to that of the proposed project. Staff resources and lines of source code are two possible indicators of the scale of the projects. Despite guidance provided to the contractor, the team may find wide-ranging projects offered for their consideration.

It is preferable that the projects selected for examination be on-going development projects. At worst the projects may be up to six months into the maintenance phase. After a project is completed or is in the advanced maintenance phases, people, documentation, and tools used in the project tend to be harder to locate. Often people cannot remember how tasks were performed or what was done on older projects.

4.2 Establish Site Visit Schedule

SEI provides a strawman site visit schedule in the SCE training manual. This strawman has been elaborated to illustrate the breadth and depth of interview coverage desirable during the three-day site visit.

Table 3 represents a suggested scheme for allocating time for interviews during a site visit. The job titles used in the table are generic and refer to typical areas of responsibility. The amount of time allocated to interview individuals in an area is proportional to the number of KPAs typically under the responsibility of that individual. The SCE team should use organizational charts and other documentation to identify the actual titles and names of the individuals with the responsibilities listed in Table 3. In addition, it is recommended that the SCE team lead verify the actual scope of responsibilities for each interview candidate prior to establishing the site visit schedule so the proper adjustments can be made to the schedule.

Some functions may be grouped under a single person, others may be spread across several individuals. Table 4 identifies the typical responsibilities of these key positions as they relate to the KPAs. The numbers in Table 4 correspond to the order in which the KPAs can be probed during the interview. These priorities, however, are very dynamic. They will change based on the responses the SCE team receives from earlier interviews. If time runs out during the interview, the KPAs with the highest priority will at least be addressed.

Table 3. Allotted Time for Interviews

Position	Length of Interview (hrs)	Number Interviewed
Project Managers	0.50	1
Software Managers	1.25	3
Manager of SQA	0.50	1
Project SQA	0.50	1
Manager of SCM	0.50	1
Project SCM	0.50	1
SEPG Manager	1.00	1
Test Engineer	0.50	1
System Engineer	0.50	1
Manager of Subcontractor	0.50	1
Developer	0.75	2

Using the allocation from Table 3, the site visit schedule may look something like Figures 4, 5, and 6. These schedules allow 15-minute breaks between interviews. This time

can be used to discuss findings, modify an interview approach, check documentation or organization charts, modify the schedule for the day, or take a necessary break. It is recommended that the SCE team use the breaks to gain consensus along the way and to avoid over-scheduling. Always prioritize the list of people to interview and the topics to be covered during each interview. Allow extra time in the schedule to accommodate unanticipated interviews or document reviews.

Table 4. Topic Priorities for Interviews

Position	Priorities of Key Process Areas ^a												
	RM	SPP	SPTO	SSM	SQA	SCM	OPF	OPD	TP	ISM	SPE	IC	PR
Project Managers			2	3				4				1	
Software Managers	3	1	2				5	6				4	7
Manager of SQA					1			4	5			2	3
Project SQA					1			4	5			2	3
Manager of SCM						1	3	2	4				
Project SCM						1	3	2	4				
SEPG							2	1	3	4			
Test Engineer	3		4								1	2	
System Engineer	1		3			5					4	2	
Manager of Subcontract				1			3	2	4				
Developer (2)							4		3		2		1

a. RM - Requirements Management; SPP - Software Project Planning; SPTO - Software Project Tracking and Oversight; SSM - Software Subcontract Management; SQA - Software Quality Assurance; SCM - Software Configuration Management; OPF - Organization Process Focus; OPD - Organization Process Definition; T - Training Program; ISM - Integrated Software Management; SPE - Software Product Engineering; IC - Intergroup Coordination; PR - Peer Reviews.

Figure 5 provides the sample schedule for the first day of the site visit. The site visit begins with time allotted for the SCE team to pass through security and to get situated in the interview room. The entrance briefings are scheduled to begin at 8:30 a.m. for the evaluation team and contractor.

The remainder of the morning will be spent reviewing documents. It is important for the SCE team to do preliminary documentation review prior to the interviews so that they are generally acquainted with the types of documents the contractor supplied to support their defined process. It also allows the SCE team to ask more pointed interview questions based on what they learned from the document review.

- 7:30-8:30 SCE team arrives on site
- 8:30-9:00 SCE team introduction briefing to contractor
- 9:00-10:00 Contractor entrance briefing
- 10:00-1:30 Documentation review with lunch
- 1:30-5:30 Interviews
 - Hrs 1.25 Software manager (project 1)
 - 0.25 Break
 - 0.50 Project manager (project 1)
 - 0.25 Break
 - 1.00 Manager of software process improvement
 - 0.25 Break
 - 0.50 SQA manager
- 5:30-7:30 End-of-day caucus
- 7:30+ Document review at hotel

Figure 4. Schedule for Day One

The second day of the site visit involves interviewing personnel responsible for specific KPAs such as SCM and SQA. Substantial time is also allotted for documentation review. Refer to Figure 5 for additional details.

The third day of the site visit is reserved primarily for consolidation interviews, team caucus, and documenting the SCE findings. Refer to Figure 6 for details.

- 7:30-8:30 Document review
- 8:30-12:00 Interviews
 - Hrs 0.50 SQA (project 2)
 - 0.25 Break
 - 0.50 Subcontractor software manager (project 2)
 - 0.25 Break
 - 0.50 System engineer (Project 1)
 - 0.25 Break
 - 0.50 SCM manager
 - 0.25 Break
 - 0.50 Test engineer (project 2)
- 12:00-2:00 Document review with lunch
- 2:00-5:00 Interviews
 - Hrs 0.75 Developer/Group lead (project 2)
 - 0.25 Break
 - 1.25 Software manager (project2)
 - 0.25 Break
 - 0.50 SCM (project 1)
- 5:30-7:30 End-of-day caucus

Figure 5. Schedule for Day Two

4.3 Submit Documentation Requests

Organization and project documentation is requested at three stages for an SCE: prior to a site visit, at the start of a site visit, and during the interviews.

- 7:30-9:00 Document review
- 9:00-10:30 Team meeting/consolidation plan
- 10:30-12:30 Interviews
 - Hrs 0.50 Developer/Group lead (project 1)
 - 0.50 Software manager (project 3)
 - 0.25 Break
 - 0.75 other
- 12:30-1:30 Additional documentation review with lunch
- 1:30-5:00 Preparation of findings

Figure 6. Schedule for Day Three

Prior to arrival on site, the SCE team may request a Software Process Improvement Plan, project profiles, organization charts, and a completed SEI questionnaire. When performing SCEs for contract monitoring purposes, a software development plan (SDP) should also be requested. The SDP should be either generic, a corporate standard, or from one of the projects offered for examination.

At the start of a site visit, the contractors will be directed to provide documentation which supports their responses to the maturity questionnaire. These references should be organized by each selected project and by question in the Maturity Questionnaire. The SCE team, however, should be aware that the supporting rationale provided by the contractors may not be accurate, up to date, or substantiate the questionnaire response. Hence, it must be reviewed thoroughly. Figure 7 lists the documents typically requested at the start of the site visit.

During a site visit the team may request additional documentation. These requests come as a result of information gained during the interview process. Information contained in these documents will be used to support information learned during the interview, and may be used to corroborate findings in the final report. Sample documents to collect during the interview process are listed in Figure 8.

Project Documents:	Program Management Plan
	Software Development Plan
	Software Configuration Management Plan
	Software Quality Assurance Plan
	Software Test Procedures
	Software Standards and Procedures Manual
	Sample Software Development Folder
Division Documents:	Software Policy, Standards, and Procedures
	Generic Software Development Plan
	Software Quality Assurance Plan
	Software Configuration Management Plan

Figure 7. Documents To Request Upon Arrival

4.4 Assemble Packing List

A list of items each SCE team member must bring to a site visit should be prepared. Figure 9 contains a sample list.

- CMM manual
- Spiral notebook (blank)
- KPA interview scripts
- SCE team members guide appendices
- Project profiles, questionnaire responses, organization charts, software process improvement plan (i.e., contractor's RFP response)
- Blank forms: interview priority form, document tracking form

Figure 9. Packing List

4.5 Develop Entrance Briefing

At the beginning of the site visit, the evaluation team and the contractor provide entrance briefings which respectively identify the scope of the SCE and the contractor's software process.

Software Project Planning Documents • Progress tracking reports or software status reports • Estimation process (size, schedule, cost) • Risk management procedures and plans Software Project Tracking and Oversight Documents • Metrics reports (size, quality, progress, computer performance) • Policy for tracking and reporting project status • Description of central estimation database Requirements Management Documents • Requirements change request • Requirements document and traceability matrix Software Subcontract Management Documents • Procedures for selecting and planning subcontract work • Policy and procedures for monitoring subcontractors • Subcontractor, SCM, and SQA status reports Software Quality Assurance Documents • Project SQA plan • SQA policies, procedures, and standards • Audit checklists, schedules, non-compliance reports • Summary reports to senior management (e.g., non-concurrence reports) Software Configuration Management Documents • Software configuration management plan • SCM policies, procedures, and standards • Change control board membership, minutes, action list	Peer Reviews Documents • Checklist and schedules (design, code, and test case) • Summary statistics (e.g., type of errors found per life cycle phase) • Policy and procedures • Minutes (design, code, test case) Training Program Documents • Training policy and requirements • Training records • Training plan, schedule, curriculum Organization Process Definition Documents • Organization software standards, procedures, policies • List of items in database, process library Organization Process Focus Documents • Software process improvement plan • SEPG membership, responsibilities, charter, minutes • Practices for submitting revisions to standards and procedures Software Product Engineering • SDP • Software development folder, test plans Intergroup Coordination • Procedures, schedules, plans for tracking intergroup issues • Procedures for controlling critical dependencies between groups • Minutes from intergroup technical meetings Integrated Software Management • Templates (SDP, SCM, SQA) • Tailoring guidelines
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Figure 8. Documents To Request During Interviews

The evaluation team's entrance briefing is given to the contractors on the first morning of the site visit. The purpose of the briefing is to describe the SCE process and what the contractor can expect over the next three days. A standard BMD entrance briefing is available in Appendix E. The briefing should make a point of informing the contractor that the SEI questionnaire is used by the team only to become acquainted with the contractor and its processes and that the SCE findings will be based on information collected during the site visit.

The contractor's entrance briefing is an opportunity for the SCE team to become acquainted with the contractor's organization and begin to collect information. The direction the team provides to the contractor's point of contact will determine the quality and amount of useful information received during the entrance briefing. It is important that the contractor's entrance briefing not concentrate on findings from other SCEs or SPAs. A contractor could use this information to try to influence the SCE team. Since time is limited, the SCE team should ensure the entrance briefing contains as much useful information as possible. Following is a list of topics the contractor should include in the entrance briefing:

- Overview of organization structure (selected project- and organization-level groups that support the projects)
- Responsibilities of organization-level groups which support the software-intensive projects (e.g., groups responsible for software process improvement, software quality assurance, software configuration management, training program, development of software policies and standards, and software technology change management)
- Overview of organization's software development process (e.g., standards, policies, and procedures)

A significant amount of information can be learned from a review of the contractor's organization charts. This information can help the team plan its strategy for the interviews by identifying specific offices or individuals responsible for key management or technical functions. The team should specifically request that the briefing include a discussion of the lines and scope of authority represented by the organization charts. This information indicates the extent to which policies and procedures are institutionalized. It may also begin to indicate inhibitors to process improvement.

During a discussion of the organization charts, the team should identify or ask where the SEPG, SCM, SQA, Costing, Standards and Procedures, and Training managers

are in the organization hierarchy. These are critical functions. The team may want to suggest or request a short briefing by each of these managers. The team can make a formal request for specific information, possibly to include organizational charts, in these briefings, identifying the roles and responsibilities of the individual, the scope and influence of his function on the projects being examined, the resources under his control, and the products, standards, and tools he provides to the rest of the organization.

4.6 Notify Contractors

Contractors should be notified one week in advance of the SCE site visit. The notice should be faxed to the contractor's designated point of contact and receipt verified. The notice includes the specific dates of the SCE, interview schedule, documentation request, direction on the entrance briefing, and a list of special supplies the SCE team will need. A sample of the notification letter used on previous SCEs can be found in Appendix F.

4.7 Establish Interview Approach

The site visit allows the SCE team an opportunity to assess and verify the software practices being used by the contractor. During the site visit, interviews are conducted with project personnel, and project documentation is reviewed to verify the adequacy of the practices being employed by the contractor. This section describes the approach taken by the SCE team to conduct and document the interviews.

4.7.1 SCE Interview Questions

To ensure consistency among BMD SCEs, a standard list of KPA questions has been developed and is available from IDA on request. During the course of the interviews, these KPA questions offer the SCE team a quick reference to ensure that all appropriate goals are covered. The questions only serve as a starting point for the SCE team. Follow-up questions are encouraged, based on the contractor's response. If the KPAs are tailored to emphasize program issues, the standard question set must be modified accordingly.

4.7.2 Additional Team Member Roles

The SEI SCE training program materials provide guidance on the roles of SCE team members during a site visit. This section includes additional roles created from the lessons learned in recent SCEs. If possible, roles should be rotated during subsequent evaluations to increase the experience of each team member.

a. Door Keeper

This person has the responsibility of ensuring that the interviews proceed uninterrupted. The door keeper should arrive at the site with signs that indicate “SCE Interviews In Progress. Please Do Not Disturb.” These signs should be posted for the duration of the visit. The door keeper will ensure that the doors to the interview room remain closed during the interview and will escort an interviewee in or out of the room.

b. Introducer

This person will introduce the team members to the contractor and give any introductory remarks. The introducer should reiterate to the contractor that all information will be kept in strict confidence and that all comments made during interviews will remain non-attributed. Appendix G contains a list of the points that should be covered during the introduction at the start of each interview.

c. Document Tracker

This person will keep a log of all documents requested during the interviews. The log should include the following information: document number, name of interviewee, document name, who requested it, associated KPA, delivered (check), reviewed (check). All documents provided to the SCE team during the visit should be logged, distributed, and maintained by the document tracker. Refer to Appendix H for a sample document tracking form

The document number should be identified in the document log and on the document itself. It is helpful to number the documents with a different series per project. For example, use 100’s for project 1, 200’s for project 2, and 300’s for project 3. Reserve the 400’s for division-level documents. It is also helpful for the SCE team members to record the document number in their notes so that they can easily identify which documents they requested and need to review.

d. Consensus Builder

This individual ensures that each team member is afforded the opportunity to express opinion on a given issue. The consensus builder will focus the team during discussions, possibly by suggesting what additional information may help the group reach consensus.

e. Time Keeper

This individual keeps track of the time during the interviews, breaks, and the consensus meetings and is responsible for keeping the SCE team on schedule.

f. Report Organizer

This person maintains the final reports and all the supporting documentation.

4.7.3 Document Interviews

It is important that all information gathered during the site visit be documented so that it may later be used to support findings. During the site visit, SCE team members' notes serve to record interviews, stimulate further questions and documentation requests, and to build consensus. Since time is limited, the notes must be recorded efficiently. Experience has shown that an interview note template may help organize the note taker's thoughts and better support the consensus-building process.

Figure 10 contains a template which is convenient for formatting interview notes.

Questions
<u>Name, title of interviewee</u>
Name of KPA - Relevant notes during interview
<u>Requested documents</u>
Name of document, who requested it, associated KPA

Figure 10. Template for Interview Notes

The following procedures are recommended:

a. Use a new notebook for each contractor.

The team avoids the possibility of confusing one contractor's findings with another and illegally sharing information among the competitors.

b. Start a new page for each person interviewed.

Clearly identify the interviewee at the top of the page. This will eliminate any confusion regarding who may have provided what information.

c. Identify KPAs.

Label the individual pieces of information provided during the interview with the name or initials of the KPA that it relates to. By using the KPA labels, information will be easy to find later during team discussions.

d. List documents.

List all the documents requested during the interview in a box at the bottom of the page. The document tracker can then do a quick check when requesting information from the contractor to ensure all requests are satisfied. It will also help the evaluator to recall what documents to review before establishing KPA findings.

e. List questions.

List questions that arise during the interview in a box at the top right-hand corner of the page. If one team member is leading the questioning, it is not appropriate for other team members to interrupt to ask their pressing questions. Rather than miss an opportunity to pursue an issue, document the questions as they come to mind so they can be asked at a more appropriate time.

f. Identify strengths and weaknesses.

Label relevant notes with a "+" or "-" to help identify strengths or weaknesses, respectively. This will help when compiling findings for each KPA.

4.7.4 Daily Objectives

To ensure the team allocates its time appropriately during the three-day site visit, the following objectives must be achieved each day:

a. Day One

The SCE team should revisit the schedule following the first day of interviews. Names of people to be interviewed may need to be added or removed from the schedule for the succeeding days. Time allocations may need to be adjusted, based on information learned during the first day of interviews. A list of all the documentation requested but not yet received by the team should be provided to the contractor point of contact at the end of day one.

After revisiting the schedule, the SCE team should gather in the evening to discuss the results from the first day of interviews. A high-level pass through each

KPA should be performed, writing down initial thoughts and impressions. These impressions should indicate where the contractor appears to be strong or weak. All conclusions must be corroborated by information provided by either another interviewee or by documentation. The SCE team should plan how it will uncover additional information to substantiate its initial conclusions.

b. Day Two

Following the contractor interviews on day two, the SCE team should be continuing to develop initial impressions and findings on the strengths and weaknesses of the contractor. The team may need to readjust the site schedule based on information gathered on day two. For this reason, the SCE team should prioritize the KPAs that still require evidence to support an unacceptable rating.

At the end of day two, each member of the SCE team should write a preliminary summary of the strengths and weaknesses for each assigned KPA; e.g., the preliminary findings should be approximately 90% complete. Each team member should record and distribute other KPA findings to appropriate team members. The following morning, the team should review initial findings to ensure that sufficient information will be gathered during the remainder of the visit.

c. Day Three

At the beginning of day three, the SCE team should review each KPA individually. This should be done in a round-robin fashion. The discussion should enable each team member to provide feedback on his or her understanding of the information gathered during the visit from interviews and documents. The team should identify areas of agreement and disagreement within the team, and generate a formal list of questions that remain to be asked in subsequent interviews.

All interviews must be concluded before noon on the third day. This will allow sufficient time for the team to prepare its findings. Before the team departs from the contractor's facility at the end of the third day, the SCE team should complete the report of its findings. This schedule assumes that all exit briefings of the findings occur at a later time; refer to Section 5 for further details.

4.7.5 Other Interview Practices

Following are other good practices for performing SCEs.

- a. Record information from document review.

During any phase, details must be kept on information found while reviewing documents. The individual reviewing a document should log the title and date of the document in their notebook. If a process or lack of a process is identified in the documentation, the facts should be logged in the team member's notebook.

- b. Establish privacy for SCE team.

The SCE team requires privacy during the interview process. The SCE team coordinator should request a soundproof room with locking doors if one is available. A room with non-soundproof walls will not permit free discussion among the SCE team members.

- c. Use the CMM.

The members of an SCE team should use the CMM as reference material during a site visit. This material contains valuable information and should often clarify any confusion among team members. Each team member should bring a personal copy to each site visit.

- d. Be aware of terminology differences.

Terms may be understood by people to have different meanings. An example of this is the term "peer review." Many contractors use other term to represent the same activity, e.g., walk through, inspection, and desk check. Even commonly understood terms may be used by a contractor in an entirely different way. The SCE team must be flexible in conversing with a contractor. Understand the contractor's use of a term rather than insisting that the contractor use the terms familiar to the team.

- e. Conduct interviews with the entire SCE team present.

Although time is limited during the SCE site visit, it is critical that the team remain together and conduct every interview with all the team members present. Due to schedule constraints, it is tempting to break the team into subgroups to conduct interviews in parallel. When building consensus the team will need input from every member. Thus, it is vital that all interviews occur as a group.

- f. Take advantage of breaks between interviews.

The breaks between interviews can be effectively used by the SCE team. Breaks provide an opportunity for the team members to discuss information gathered during the last interview and information remaining to be confirmed or pursued during the next interview. Breaks can also be used by the team members to discuss the interview process, or a team member's approach to seeking specific information, or to clarify or improve the effectiveness of questions being asked.

- g. Establish consensus.

During the consensus building process the team should listen to each member. The Consensus Builder is responsible for ensuring that this occurs. Avoid trying to force consensus too early since information is still being collected. Verify all conclusions by cross-checking with other team members' interview notes and with documents provided by the contractor.

It is important to avoid having one person dominate the process and rule over the SCE team. It is best if everyone's opinions and concerns are heard and addressed. Hence it is important to make the environment conducive for discussion among all team members, not just the most vocal members. If possible, the team leader and the consensus builder should attend a course on facilitation.

It is important to determine early if there are different opinions on whether the contractor is satisfying a KPA. If consensus is not established, this indicates that more information is needed. Identify what information is necessary to support the different view points and appropriately adjust the interview schedule and document request list. Consensus must be established when ranking the KPAs as acceptable or unacceptable. It is less critical, however, to have consensus on the contractor's individual strengths and weaknesses for particular KPAs. In this event, the team should reach a compromise on the wording of the strength or weakness to accurately reflect the contractor's process.

5. ACTIVITIES AFTER CONDUCTING AN EVALUATION

This section of the report will review the activities that occur after the SCE site visit. Included in this section is a description of the final SCE report and the feedback to the contractor, the SSEB, the program office, and BMDO concerning the results of the SCE.

5.1 Final Report

The SCE team must prepare a report of its findings and their rationale for the contractor, SSEB, program office, and BMDO. Refer to Figure 11 for a depiction of the outline of the report.

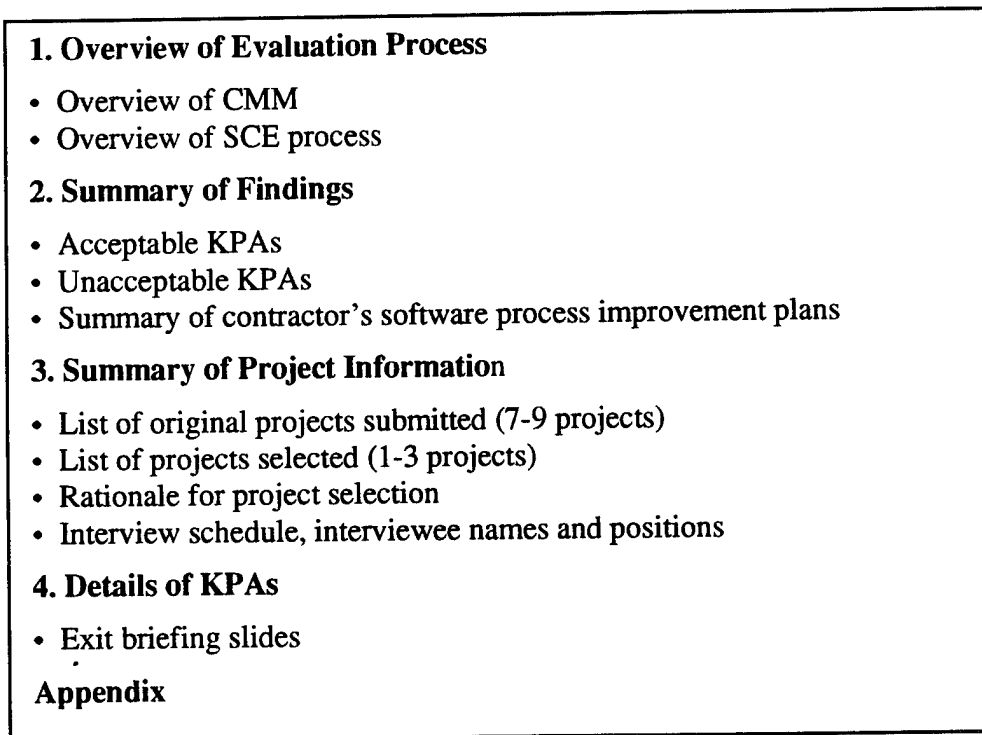


Figure 11. Report Outline

The first chapter of the SCE report should include a high-level overview of the CMM and the SCE process since few members of a program office or SSEB are familiar with them. It is important to describe the model used to measure the contractors and the pro-

cess the SCE team used to generate its findings. This description should be included in the presentation to the SSEB and program management as well.

The second chapter of the report should include a summary of the findings. A list of the acceptable and unacceptable KPAs should be provided along with an overview of the contractor's software process improvement plans.

The third chapter should describe the focus of the site visit. It should include a summary of the project profiles submitted by the contractors and the rationale for selecting the three projects which were reviewed by the SCE team. In addition, the site visit schedule should be included, identifying the names and titles of individuals interviewed. Other items to add in this section of the report include copies of the contractor's entrance briefing or the most important slides that would be meaningful for the SSEB.

The fourth chapter of the report will contain the SCE exit briefing. Each of the slides should contain a summary statement of the KPA, and a list of KPA strengths, weaknesses, and noted improvement activities the contractor has planned or is underway. The summary statement of the KPA should identify whether the KPA was acceptable or unacceptable and the prevailing rationale. This is the most important section of the report. Refer to Figure 12 for an example of an exit briefing slide.

The SCE team should make an effort to identify strengths and weaknesses for all KPAs. For example, there may be aspects of the contractor's process that are viewed as weaknesses even though the KPA is rated as acceptable overall. The noted weaknesses are very informative to the program manager and the SSA since they help to identify potential risks. Avoid having no strengths or weaknesses noted for any KPA.

In this report, Appendix I contains a list of strengths and weaknesses for each of the KPAs used by previous BMD teams. The SCE team can use these to help formulate the wording of its findings. It is important, however, to use only the findings that have been verified through the interview process or documentation reviews.

The appendix of the final report should contain the team members' notebooks, the contractor's project profiles, and responses to the maturity questionnaire. The team members' notebooks contain documentation of the interviews and document reviews conducted at the contractor's facility.

The report must be labeled *Proprietary Information*. In support of the source selection process, the report must also be labeled as *Source Selection Sensitive*. In this case, the report should be made available only to those that have signed the proper Procurement

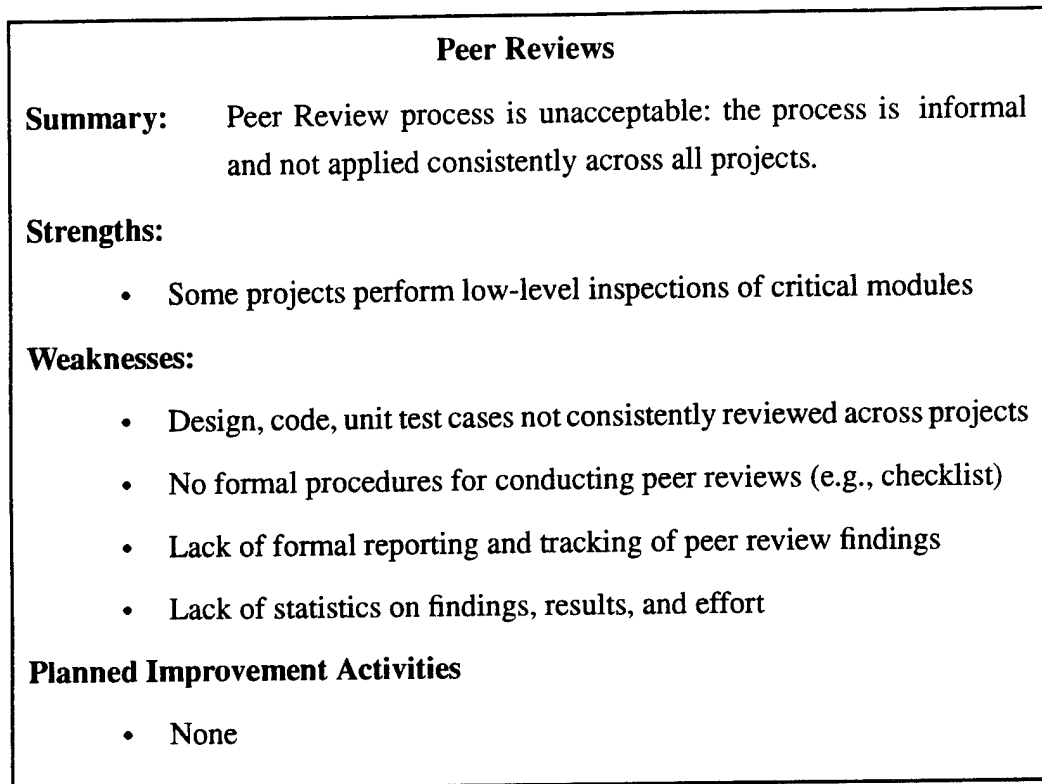


Figure 12. Sample Exit Briefing Slide

Integrity forms, e.g., the SSEB, the element program manager, element software lead, and the Director of Computer Resources Engineering at BMDO.

5.2 Contractor Feedback of Evaluation Results

The contractor may provide feedback on the SCE. When SCEs are used for source selection, the competing contractors will not receive an exit briefing at the end of the SCE site visit. Instead, the winning contractors will be briefed soon after the contract is awarded. At that time the winning contractors have an opportunity to provide feedback of the SCE results and to clarify any questions. The losing contractors will receive a very high-level overview of the SCE results at the “loser’s conference,” and no detailed feedback will be provided of the SCE results at that time.

When SCEs are used to help monitor a contract, the contractors will receive a detailed exit briefing at the end of the SCE site visit. The exit briefing offers the contractor an opportunity to understand the SCE results and to question the team on its findings. Since the exit briefing slides are not very detailed and the audience is generally very large, contractors may request a follow-up meeting with their SEPG and the SCE team to ensure that

the findings are interpreted correctly and incorporated into their software process improvement plans.

5.3 Use of Evaluation Results in Source Selection

One of the most important program management responsibilities in using an SCE for source selection is defining how the SCE results should be communicated to the SSEB. The SCE team and the SSEB must agree upon the format. One successful method is for the SCE team to provide the SSEB a copy of the SCE report after each individual site visit or after all site visits have been completed. The report contains a summary of the contractor's strengths, weaknesses, and improvement plans for each KPA. In addition, the summary identifies each KPA as acceptable or unacceptable. Refer to Section 5.1 for additional details of the final report format.

This summary of the KPAs is used by the SSEB and is incorporated with the rest of the source selection process. Refer to Section 3.2 for details of the criteria the SSEB may use to assign a color, numerical, or risk rating. In the event that the SSEB requires additional clarification of the findings, the SCE team leader should be available to respond to any questions.

5.4 Use of Evaluation Results for Contract Monitoring

When an SCE is performed to help monitor a contract, the SCE team, with the approval of the program manager, should present its findings on the morning of the fourth day to the contractor. The three-day SCE schedule is too full; there is no time to present the findings any earlier. As part of the contract monitoring process, the program office should compare the results of the evaluation with the contractor's process improvement plans. If there is a discrepancy between the weaknesses identified by the independent SCE team and those of the contractor's self-assessment, the contractor should be made aware of the differences. The program office should ensure that the contractor has an acceptable plan to mitigate the risks that could result from the weaknesses and to reduce the principal weaknesses over the length of the contract.

There are several approaches the program office can take to encourage contractors to improve their software development processes. One is to emphasize to the contractor the importance of software process improvement in the BMD program. If there are two or more contractors competing for a future contract, the program office can state its plans to use SCE results during the next source selection process. This should help to motivate the competing contractors to improve so that they can better their scores during the next source

selection. In addition, the contractors can report the status of their process improvement program at the software reviews (e.g., preliminary design review or critical design review). At the program reviews, the contractors should be required to describe their improvement plans and accomplishments.

Another means of encouraging contractors to improve is to incorporate software process improvement into an award-fee program. Since process improvement focuses on the organization rather than on a specific program, not all projects are good candidates for an award fee. The best candidates are those contractors who have an organization devoted to the BMD program and are working on several BMD projects. For example, the National Test Bed and Integration Contractor (NTBIC) would be a suitable candidate.

If an award fee is suitable, the award fee plan should contain incentives for improving the software process. Depending on the length of the contract and the initial maturity of the contractor, the plan should include intermediate goals that emphasize the benefits of advancing from a level 1 maturity up to a level 5. Since it is estimated to take at least a year to improve from one level to another, the award fee should be staggered. Assuming that the contractor's initial maturity rating is a level 1, there should be a minimal award at the end of the first year for advancing from a level 1 to a level 2. At the end of the second or third year, there should be a larger reward for advancing from a level 2 to a level 3, and so on. Sample award fee plans can be provided by BMDO.

5.5 Registry of Evaluation Results

As described in Sections 3, 4, and 5, the preparation, conduct, and follow-up for an SCE consume considerable amounts of time, effort, and expense on the part of both the Government and the contractor. Subjecting a contractor to multiple SCEs in the context of several procurements compounds this problem. Reducing the results of an SCE to a meaningful, concise form that can be stored in some repository and reused in later procurements can greatly reduce this time, effort, and expense. Use of an SCE repository could also shorten the procurement cycle considerably by reducing the number of "fresh" SCEs that must be done in order to evaluate fairly and fully the software development process maturity of all the contractors who may respond. Therefore, SCE results should be archived by BMDO for potential use in future procurements.

5.6 Issues Related to SCE Findings

Based on the earlier experiences of BMD SCE teams, there are several issues associated with the findings that should be clarified for future evaluations: consistency, evalua-

tion of new divisions, rating method, weighting the results, maturity of the process, and saving evidence. Each issue is discussed in more detail in the following subsections.

5.6.1 Establish Consistency Between Site Visits

When performing several SCEs in support of a source selection, how consistent do the findings have to be? It is important to probe each of the offerors the same way initially for each KPA. However, after the first pass of general questioning, the SCE team will ask follow-up questions which are based on the offeror's initial responses. The follow-up questions do not have to be identical from one offeror to the next.

Similarly, the findings do not have to be identical. It is not important to have the same number of strengths and weaknesses with the same wording for each offeror unless they have identical processes. It is more important for the SCE team to discriminate between offerors.

5.6.2 Evaluate New Divisions

Many defense contractors are routinely reorganizing and consolidating divisions. This may make it difficult for an SCE team to evaluate an offeror's standard software development process which is in the works. When two divisions are in the process of merging their software development policies, procedures, and practices, the SCE team must look at both divisions. The SCE findings should, in essence, reflect the least common denominator. In other words, if one of the former divisions has a well-established process but the other one does not, this must be reflected in the findings as a weakness. It is also important to understand how the new policies are being adopted and enforced by both of the pre-existing divisions.

5.6.3 Color Code KPA Summary Statements

In the past, each KPA summary statement characterized whether the KPA is evaluated by the SCE team as acceptable or unacceptable. This, however, may not offer a program manager or SSEB sufficient discrimination between offerors. It is better if the SCE team can identify within the summary statement whether the individual KPA is blue, green, yellow, or red. Previous SCEs used several qualitative words to distinguish between these categories. Refer to Figure 13 for details.

<u>Blue Words</u>	<u>Green Words</u>
Exceptional	Adequate
Superior	Acceptable
Complete	Sufficient
Outstanding	
<u>Yellow Words</u>	<u>Red Words</u>
Inadequate	Unacceptable
Insufficient	Scarce
Incomplete	Flawed
Impaired	Significantly deficient

Figure 13. Qualitative Words for Use in KPA Summary Statements

It is important to coordinate with the SSEB in advance of the SCE in order to define the qualitative terms that will be the most meaningful.

5.6.4 Weight SCE Results

In the past, SCE teams evaluated both the subcontractors and the prime contractors responsible for developing or integrating any portion of the software system. The SCEs were performed on these two types of contractors regardless of the amount of software they each developed. A better approach is to determine if the contractor is suitable for an SCE once the SSA is informed of the division of labor. If, for example, a prime contractor is developing 90% of the software and its subcontractor only 10%, it may be cost effective to only evaluate the prime contractor. If the subcontractor is developing 90% of the software, the SCE should be done on only the subcontractor. But if the work load is evenly distributed, it would be wise to evaluate both the subcontractor and the prime contractor. After the SCEs are complete, the SSEB will weight the SCE results accordingly. Hence it is not wise to spend the time and money performing SCEs on both types of contractors if the results will not be used. This issue should be discussed in detail with the SSA.

5.6.5 Evaluate Process Maturity

How mature does a process have to be? Frequently an SCE team will be exposed to a new process that is being adopted by a contractor's organization, and the evaluation team

must determine if it has been in place long enough to receive an acceptable rating. If a new process is supported by the appropriate policies and procedures and if it is implemented on all new programs, it may be evaluated as acceptable. If, however, it is not routinely implemented by new programs, it may not be sufficiently mature. A process that is supported by draft policy or one that is in place less than three months may also not be mature enough to receive an acceptable rating. However, these are both strengths that should be noted in the findings. In general, the SCE team must see evidence that the process is institutionalized and reinforced through policy, training, and appropriate review processes.

5.6.6 Save Evidence

The SCE team member notebooks should be collected at the end of each site visit and given to the SSA at the time of the final report. Included with the notebooks should be other pertinent evidence, e.g., actual interview schedule, document tracking forms, interview priority forms, project profiles, questionnaires, organization charts, process improvement plan, contractor's entrance briefing, and any SCE team correspondence with the offerors in advance of the site visit.

APPENDIX A.
RFP WORDING

The following sample text illustrates how SCEs might be inserted within Sections L and M of the RFP. This example assumes that two SCE teams will be used and the results will be a risk factor for source selection. The outline of the project profile and the summary recording form can be found in Appendix B and Appendix C, respectively, of this report.

Section L: Contractor Software Capability Evaluations [example section L-6.3.3]

The Government will send two small (three to five members) teams of software experts to the appropriate offeror site(s) for three consecutive days to conduct a Software Capability Evaluation (SCE) of the offeror's organization and processes. One team will conduct the evaluation for the major software developer for this acquisition. The other team will conduct the evaluation for the software integrator for this acquisition. In the event that the same contractor/site is doing both the major portion of the development as well as integrating the software, the second team will conduct the evaluation of the next largest software developer. The offeror shall provide the inputs for the software programs/projects to be reviewed by the SCE on-site teams, but the teams will not review Code-word classified information or Sensitive Compartmented Intelligence (SCI) information as part of the review. Offerors are cautioned that they are responsible for making available sufficient non-Code-Word/non-SCI information for the Government evaluation team to conduct a thorough evaluation. Failure to do so may contribute to an unfavorable evaluation. Documentation and information required to support the site visit are identified in *paragraph L-6.4.3.1*. Offerors are cautioned that the Government will use data provided for the visit and information obtained during the visit in performing part of the source selection evaluation as indicated in Section M. There will be no outbrief to the offeror at the conclusion of the SCE site visits.

Appendix E, Software Capability Evaluation (SCE)/Capability Maturity Model (CMM) [example section L-6.4.3.1]

Submit the information identified below for each of the two proposing sites (reference *L-6.3.3 above*). Information submitted must be unclassified. Offerors are advised that the Government will use data provided by each offeror in this Appendix, *Appendix G*, on past performance, and information obtained through the SCE site visit in performing the evaluation in this area. If offerors submit information relative to Code-word classified programs, they are cautioned that the evaluators will not review information or material classified higher than Secret. Offerors remain responsible for providing the on-site evaluators with accessible information that demonstrates the offeror's software capability.

- a. Current Capability. The offeror(s) will complete the Software Engineering Institute (SEI) Software Process Maturity Questionnaire (MQ) (version 1.1, dated April 1994) for three to five (3 to 5) current projects at each of the two sites (reference L-6.3.3 above). (A project that has been completed is acceptable only if it has been completed after January 31, 1994.) The offeror should select those projects that best match the engineering requirements of this contract. For offerors with fewer than three current projects at the proposing site, submit MQ responses for as many projects as are available. For each "yes" response, please note on a separate comment sheet the mechanism or documentation to justify the response. The MQ can be found in *Attachment 5* to these instructions. The answers to the questions will be submitted in this Appendix. There is no specific page limit for completing the questionnaire.
- b. Project Profile. For each project, the offeror(s) will complete a Project Profile and attach it to the respective response to the Maturity Questionnaire, and submit it in this Appendix. The Project Profile Outline can also be found in *Attachment 6* to these instructions. Limit Project Profiles to one (1) page per project. The organization charts required by the last instruction in *Attachment 6* do not count in the page limits.
- c. Software Process Improvement Plan (SPIP). Submit a synopsis of the proposing sites' SPIP in offeror format in this Appendix. This synopsis shall be limited to 25 pages. The SPIP should communicate the offerors' current software process capability as well as the desired maturity level, specific planned improvements, dedicated resources, effort estimates, and a time phasing of those improvements to bring the offerors' software capability to the desired maturity level. Ensure that significant planned improvements are reflected in the Integrated Master Plan (*paragraph L-6.4.5.2.c*).
- d. Points of Contact. Provide for each proposing site a point of contact and an alternate point of contact to schedule the visit and arrange all the administrative aspects. Provide their names, location, phone numbers, fax numbers, and address. If security authorization is necessary for the SCE team to be at the offerors' facilities, the name, fax number, and telephone number of the security officer(s) should also be provided along with any other pertinent information required to obtain security approval.

Management Area [example section M3.2]

This area is divided into three items. Items M-1 and M-2 are equal in importance and are more important than item M-3. For Item M-3, the evaluation will include the Appendix and the results of the on-site Software Capability Evaluation (SCE) Team review. For the SCE, the Government shall not consider Code-word classified or Sensitive Compartmented Intelligence (SCI) information.

Item M-3; Past Performance, Past Experience, and Software Capability. These three elements will be given equal consideration and an evaluation of Item M-3 will be done at the item level. This item will be assessed based on

1. Record of previous performance (quality, cost effectiveness, timeliness and customer satisfaction).
2. Range (varied contracts, number of contracts) and significance (size, complexity, participation) of relevant corporate experience (including subcontractor experience) in accomplishing the efforts described in the SOW.
3. Software Capability Evaluation (SCE). The offeror's software capability as evaluated by the government SCE team based upon (a) the SEI Software Process Maturity Questionnaire, (b) Project Profile, (c) Software Process Improvement Plan, and (d) the site visit.

APPENDIX B.
PROJECT PROFILE OUTLINE

The following form is a sample project profile. A project profile should be filled out for each project.

- a. **Project Name:** name of project listed on the contract.
- b. **Project Number:** unique identifying number on the contract.
- c. **Project Type:** e.g., scientific, human-machine, business, control, support software.
- d. **Customer:** the agency that procured the software and a point of contact within that organization.
- e. **Subcontractors/Prime Contractors:** list any subcontractors employed on the project or list the prime contractor if the offeror was a subcontractor.
- f. **Current Phase:** identify the current phase of the software development process, e.g., requirements definition, detailed design, code and unit test, integration test, maintenance.
- g. **Location:** primary site and organizational unit (e.g., division name) responsible for the software development effort.
- h. **Start Date:** starting date of the contract.
- i. **Design Completion Date:** estimated or actual.
- j. **Code Completion Date:** estimated or actual.
- k. **End Date:** contract completion date.
- l. **Estimated Team Size:** peak staff-month period and average staff-years over the contract period.
- m. **Estimated KSLOC:** estimated/actual thousand source lines of code.
- n. **Programming Languages:** percentage of KSLOC in languages (e.g., Ada, Fortran, Pascal, C, Assembler).
- o. **Target Hardware System:** computer on which software executes.
- p. **Development Hardware System:** host computer for the compiler and support environment.

- q. **Applicable Standards:** e.g., name of commercial standards, DOD-STD-2167A, MIL-STD-498.
- r. **Development Approach:** e.g., rapid prototyping, full-scale development, commercial-off-the-shelf (COTS) products integration.
- s. **SEI Questionnaire:** the attached questionnaire and its answer sheet should be completed for each of the projects.
- t. **Organization Chart:** both project-level and organizational-level charts are requested. For each project, provide the most recent organization chart with titles and individual names. This chart should explicitly identify the individual(s) responsible for the following activities: project management, system engineering, software project management, software engineering, software quality assurance, software configuration management, technical subcontractor management, simulation, and integration and testing. Other technical software activities that should be identified at an organizational level include titles and individual names of persons responsible for software process improvement, training program, evaluation of advanced software technologies, as well as the organization managers of software quality assurance and software configuration management.

APPENDIX C.
SUMMARY RECORDING FORM
FOR CMM QUESTIONNAIRE

This document contains questions about the implementation of important software practices in your software organization. The questionnaire should be completed for four to six software projects from the same organizational site proposing on this solicitation and for projects that best match the engineering requirements of the contract, e.g., size, domain, development process. Code-word classified programs or projects that have been completed for more than four months should not be submitted. Identify the project names that correspond to the assigned labels (A-F).

The questions are organized in groups of key process areas such as software requirements management and software project planning. To the right of each question are boxes to record the response for each of the four to six projects. There are four appropriate responses for each question: Yes (Y), No (N), Not Applicable (N/A), and Don't Know (D/K).

1. Yes: the practice is well established and consistently performed. The practice should be performed nearly always in order to be considered well-established and consistently performed as a standard operating procedure.
2. No: the practice is not well established or inconsistently performed. The practice may be performed sometimes, or even frequently, but it is omitted under difficult circumstances.
3. Not Applicable: you have the required knowledge about your project or organization and the question asked, but you feel the question does not apply for your project. For example, the entire section on "Software Subcontract Management" may not apply to your project if you do not work with any subcontractors.
4. Don't Know: you are uncertain about how to answer the question.

Please answer all of the questions. For each "Yes" response, please note on a separate comment sheet the mechanism or documentation used to justify the response. There is no specific page limit for completing the questionnaire.

For a definition of terms, refer to the Software Engineering Institute's Software Process Maturity Questionnaire, version 1.1.0, April 1994, which is in the BMDO library.

Project Names

Project A: _____

Project B: _____

Project C: _____

Project D: _____

Project E: _____

Project F: _____

QUESTIONS	Project					
	A	B	C	D	E	F
Requirements Management						
1. Are system requirements allocated to software used to establish a baseline for software engineering and management use?						
2. As the systems requirements allocated to software change, are the necessary adjustments to software plans, work products, and activities made?						
3. Does the project follow a written organizational policy for managing the system requirements allocated to software?						
4. Are the people in the project who are charged with managing the allocated requirements trained in the procedures for managing allocated requirements?						
5. Are measurements used to determine the status of the activities performed for managing the allocated requirements (e.g., total number of requirements changes that are proposed, open, approved, and incorporated into the baseline)?						
6. Are the activities for managing allocated requirements on the project subjected to SQA review?						
Software Project Planning						
1. Are estimates (e.g., size, cost, and schedule) documented for use in planning and tracking the software project?						
2. Do the software plans document the activities to be performed and the commitments made for the software project?						
3. Do all affected groups and individuals agree to their commitments related to the software project?						
4. Does the project follow a written organizational policy for planning a software project?						
5. Are adequate resources provided for planning the software project (e.g., funding experienced individuals)?						

QUESTIONS	Project					
	A	B	C	D	E	F
6. Are measurements used to determine the status of the activities for planning the software project (e.g., completion of milestones for the software project planning activities as compared to the plan)?						
7. Does the project manager review the activities for planning the software project on both a periodic and event-driven basis?						
Software Project Tracking and Oversight						
1. Are the project's actual results (e.g., schedule, size, and cost) compared with estimates in the software plans?						
2. Is corrective action taken when actual results deviate significantly from the project's software plans?						
3. Are changes in the software commitments agreed to by all affected groups and individuals?						
4. Does the project follow a written organizational policy for both tracking and controlling its software development activities?						
5. Is someone on the project assigned specific responsibilities for tracking software work products and activities (e.g., effort, schedule, and budget)?						
6. Are measurements used to determine the status of the activities for software tracking and oversight (e.g., total effort expended in performing tracking and oversight activities)?						
7. Are the activities for software project tracking and oversights reviewed with senior management on a periodic basis (e.g., project performance, open issues, risks, and action items)?						
Software Subcontract Management						
1. Is a documented procedure used for selecting subcontractors based on their ability to perform the work?						
2. Are changes to subcontracts made with the agreement of both the prime contractor and the subcontractor?						

QUESTIONS	Project					
	A	B	C	D	E	F
3. Are periodic technical interchanges held with subcontractors?						
4. Are the results and performance of the software subcontractor tracked against the commitments?						
5. Does the project follow a written organizational policy for managing software subcontracts?						
6. Are the people responsible for managing software subcontracts trained in managing software subcontracts?						
7. Are measurements used to determine the status of the activities for managing software subcontracts (e.g., schedule status with respect to planned delivery dates and effort expended for managing the subcontract)?						
8. Are the software subcontract activities reviewed with the project manager on both periodic and event-driven basis?						
Software Quality Assurance (SQA)						
1. Are SQA activities planned?						
2. Does SQA provide objective verification that software products and activities adhere to applicable standards, procedures, and requirements?						
3. Are the results of SQA reviews and audits provided to affected groups and individuals (e.g., those who performed the work and those who are responsible for the work)?						
4. Are issues of noncompliance that are not resolved within the software project addressed by senior management (e.g., deviations from applicable standards)?						
5. Does the project follow a written organizational policy for implementing SQA?						
6. Are adequate resources provided for performing SQA activities (e.g., funding and a designated manager who will receive and act on software noncompliance items)?						

QUESTIONS	Project					
	A	B	C	D	E	F
7. Are measurements used to determine the cost and schedule status of the activities performed for SQA (e.g., work completed, effort and funds expended compared to the plan)?						
8. Are activities for SQA reviewed with senior management on a periodic basis?						
Software Configuration Management (SCM)						
1. Are SCM activities planned for the project?						
2. Has the project identified, controlled, and made available the software work products through the use of software configuration management?						
3. Does the project follow a documented procedure to control changes to configuration items/units?						
4. Are standard reports on software baselines (e.g., software configuration control board minutes and change request summary and status reports) distributed to affected groups and individuals?						
5. Does the project follow a written organizational policy for implementing software configuration management activities?						
6. Are project personnel trained to perform the software configuration management activities for which they are responsible?						
7. Are measurements used to determine the status of activities for software configuration management (e.g., effort and funds expended for software configuration management activities)?						
8. Are periodic audits performed to verify that software baselines conform to the documentation that defines them (e.g., by the SCM group)?						
Organization Process Focus						
1. Are the activities for developing and improving the organization's and project's software processes coordinated across the organization (e.g., via a software engineering process group)?						

QUESTIONS	Project					
	A	B	C	D	E	F
2. Is your organization's software process assessed periodically?						
3. Does your organization follow a documented plan for developing and improving its software process?						
4. Does senior management sponsor the organization's activities for software process development and improvements (e.g., by establishing long-term plans, and by committing resources and funding)?						
5. Do one or more individuals have full-time or part-time responsibility for the organization's software process activities (e.g., a software engineering process group)?						
6. Are measurements used to determine the status of the activities performed to develop and improve the organization's software process (e.g., effort expended for software process assessment and improvement)?						
7. Are the activities performed for developing and improving software processes reviewed periodically with senior management?						
Organization Process Definition						
1. Has your organization developed, and does it maintain, a standard software process?						
2. Does the organization collect, review, and make available information related to the use of the organization's standard software process (e.g., estimates and actual data on software size, effort, and cost; productivity data; and quality measurements)?						
3. Does the organization follow a written policy for both developing and maintaining its standard software process and related process assets (e.g., descriptions of approved software life cycles)?						
4. Do individuals who develop and maintain the organization's standards software process receive the required training to perform these activities?						

QUESTIONS	Project					
	A	B	C	D	E	F
5. Are measurements used to determine the status of the activities performed to define and maintain the organization's standard software process (e.g., status of schedule milestones and the cost of process definition activities)?						
6. Are the activities and work products for developing and maintaining the organization's standard software process subjected to SQA review and audit?						
Training Program						
1. Are training activities planned?						
2. Is training provided for developing the skills and knowledge needed to perform software managerial and technical roles?						
3. Do members of the software engineering group and other software-related groups receive the training necessary to perform their roles?						
4. Does your organization follow a written organizational policy to meet its training needs?						
5. Are adequate resources provided to implement the organization's training program (e.g., funding, software tools, appropriate training facilities)?						
6. Are measurements used to determine the quality of the training program?						
7. Are training program activities reviewed with senior management on a periodic basis?						
Integrated Software Management						
1. Was the project's defined software process developed by tailoring the organization's standard software process?						
2. Is the project planned and managed in accordance with the project's defined software process?						
3. Does the project follow a written organizational policy requiring that the software project be planned and managed using the organization's standard software process.						

QUESTIONS	Project					
	A	B	C	D	E	F
4. Is training required for individuals tasked to tailor the organization's standard software process to define a software process for a new project?						
5. Are measurements used to determine the effectiveness of the integrated software management activities (e.g., frequency, causes and magnitude of replanning efforts)?						
6. Are the activities and work products used to manage the software project subjected to SQA review and audit?						
Software Product Engineering						
1. Are the software work products produced according to the project's defined software process?						
2. Is consistency maintained across software work products (e.g., is the documentation tracing allocated requirements through software requirements, design, code, and test cases maintained)?						
3. Does the project follow a written organizational policy for performing the software engineering activities (e.g., a policy which requires the use of appropriate methods and tools for building and maintaining software products)?						
4. Are adequate resources provided for performing the software engineering tasks (e.g., funding, skilled individuals, and appropriate tools)?						
5. Are measurements used to determine the functionality and quality of the software products (e.g., numbers, types, and severity of defects identified)?						
6. Are the activities and work products for engineering software subjected to SQA reviews and audits (e.g., is required testing performed, are allocated requirements traced through the software requirements, design, code, and test cases)?						

QUESTIONS	Project					
	A	B	C	D	E	F
Intergroup Coordination						
1. On the project, do the software engineering group and other engineering groups collaborate with the customer to establish the system requirements?						
2. Do the engineering groups agree to the commitments as represented in the overall project plan?						
3. Do the engineering groups identify, track, and resolve intergroup issues (e.g., incompatible schedules, technical risks, or system-level problems)?						
4. Is there a written organizational policy that guides the establishment of interdisciplinary engineering teams?						
5. Do the support tools used by different engineering groups enable effective communication and coordination (e.g., compatible word processing systems, database systems, and problem tracking systems)?						
6. Are measures used to determine the status of the intergroup coordination activities (e.g., effort expended by the software engineering group to support other groups)?						
7. Are the activities for intergroup coordination reviewed with the project manager on both a periodic and event-driven basis?						
Peer Reviews						
1. Are peer reviews planned?						
2. Are actions associated with defects that are identified during peer reviews tracked until they are resolved?						
3. Does the project follow a written organizational policy for performing peer reviews?						
4. Do participants of peer reviews receive the training required to perform their roles?						

QUESTIONS	Project					
	A	B	C	D	E	F
5. Are measurements used to determine the status of peer review activities (e.g., number of peer reviews performed, effort expended on peer reviews, and number of work products reviewed compared to the plan)?						
6. Are peer review activities and work products subjected to SQA review and audit (e.g., planned reviews are conducted and follow-up actions are tracked)?						
Quantitative Process Management						
1. Does the project follow a documented plan for conducting quantitative process management?						
2. Is the performance of the project's defined software process controlled quantitatively (e.g., through the use of quantitative analytic methods)?						
3. Is the process capability of the organization's standards software process known in quantitative terms?						
4. Does the project follow a written organizational policy for measuring and controlling the performance of the project's defined software process (e.g., projects plan for how to identify, analyze, and control special causes of variations)?						
5. Are adequate resources provided for quantitative process management activities (e.g., funding, software support tools, and organizational measurement program)?						
6. Are measurements used to determine the status of the quantitative process management activities (e.g., cost of quantitative process management activities and accomplishment of milestones for quantitative process management activities)?						
7. Are the activities for quantitative process management reviewed with the project manager on both a periodic and event-driven basis?						

QUESTIONS	Project					
	A	B	C	D	E	F
Software Quality Management						
1. Are the activities for managing software quality planned for the project?						
2. Does the project use measurable and prioritized goals for managing the quality of its software products (e.g., functionality, reliability, maintainability, and usability)?						
3. Are measurements of quality compared to goals for software product quality to determine if the quality goals are satisfied?						
4. Does the project follow a written organizational policy for managing software quality?						
5. Do members of the software engineering group and other software-related groups receive required training in software quality management (e.g., training in collecting measurement data and benefits of quantitatively managing product quality)?						
6. Are measurements used to determine the status of the activities for managing software quality (e.g., the cost of poor quality)?						
7. Are the activities performed for software quality management reviewed with senior management on a periodic basis?						
Defect Prevention						
1. Are defect prevention activities planned?						
2. Does the project conduct causal analysis meetings to identify common causes of defects?						
3. Once identified, are common causes of defects prioritized and systematically eliminated?						
4. Does the project follow a written organizational policy for defect prevention activities?						

QUESTIONS	Project					
	A	B	C	D	E	F
5. Do members of the software engineering group and other software-related groups receive required training to perform their defect prevention activities (e.g., training in defect prevention methods and the conduct of task kick-off or causal analysis meetings)?						
6. Are measurements used to determine the status of defect prevention activities (e.g., the time and cost for identifying and correcting defects and the number of action items proposed, open, and completed)?						
7. Are the activities and work products for defect prevention subjected to SQA review and audit?						
Technology Change Management						
1. Does the organization follow a plan for managing technology changes?						
2. Are new technologies evaluated to determine their effect on quality and productivity?						
3. Does the organization follow a documented procedure for incorporating new technologies into the organization's standard software process?						
4. Does senior management sponsor the organization's activities for managing technology change (e.g., by establishing long-term plans and commitments for funding, staffing, and other resources)?						
5. Do process data exist to assist in the selection of new technology?						
6. Are measurements used to determine the status of the organization's activities for managing technology change (e.g., the effect of implementing technology changes)?						
7. Are the organization's activities for managing technology change reviewed with senior management on a periodic basis?						

QUESTIONS	Project					
	A	B	C	D	E	F
Process Change Management						
1. Does the organization follow a documented procedure for developing and maintaining plans for software process improvement?						
2. Do people throughout your organization participate in software process improvement activities (e.g., on teams to develop software process improvements)?						
3. Are improvements continually made to the organization's standard software process and the projects' defined software processes?						
4. Does the organization follow a written policy for implementing software process improvements?						
5. Is training in software process improvement required for both management and technical staff?						
6. Are measurements made to determine the status of the activities for software process improvement (e.g., the effect of implementing each process improvement compared to its defined goals)?						
7. Are software process improvement efforts reviewed with senior management on a periodic basis?						

APPENDIX D.
PRESENTATION FOR PRE-PROPOSAL CONFERENCE

Software Capability Evaluation

17 October 1994

SCE Purpose

- **Evaluates an offeror's software development process at a specific organization site**
- **Measures the offeror's process against defined industry accepted standards developed at the Software Engineering Institute**
 - **Capability Maturity Model, Version 1.1(SEI/CMU 93-TR-24)**
 - **Software Capability Evaluation, Version 2.0(SEI/CMU-93-TR-17)**
 - **Software Maturity Questionnaire, Version 1.1 (April, 1994)**
- **Identifies strengths, weaknesses, and process improvement efforts associated with offeror's software development process**

Capability Maturity Model

Maturity Level	Key Process Areas
5 Optimizing	Process Change Management Technology Change Management Defect Prevention
4 Managed	Software Quality Management Quantitative Process Management
3 Defined	Peer Reviews Intergroup Coordination Software Product Engineering Integrated Software Management Training Program Organization Process Definition Organization Process Focus
2 Repeatable	Software Configuration Management Software Quality Assurance Software Subcontract Management Software Project Tracking And Oversight Software Project Planning Requirements Management
1 Initial	"People"

SCE Proposal Requirement

- Offerors asked to provide POC and site location
 - Site of where most of the integration will occur
 - Site where most of the critical software will be developed
- Documentation to be submitted with proposal
 - Project Profiles for 4-6 projects
 - SEI Maturity Questionnaire responses for each project
 - Software Process Improvement Plan
- Criteria for projects selection
 - Similar in scope to BM/C3 (e.g., domain, size, process)
 - From the same organization developing BM/C3 software
 - No "code-word" classified projects
- SCE documentation to be appended to proposal
(not part of proposal page limit)

Initial Site Visit Coordination

- **SCE team pre-coordination activities for site visit**
 - **Provide at least 2-day notice prior to site visit**
 - **Identify projects, interview candidates, schedule**
 - **List of general documentation to have available at start of SCE (e.g., Project A's Software Development Plan, SQA Plan)**
- **Preparation instructions for offeror's Overview presentation**
 - **Description of organizational software development process (e.g., standards, policies, procedures)**
 - **Organization structure (project and organization level)**
 - **Relationship of supporting departments (e.g., SQA, training, SCM, process improvement)**
 - **Software process improvement plans and recent accomplishments**
 - **Limited to 1-2 hours on first day of SCE**

General SCE Site Visit Agenda

- **Day 1:**
 - **SCE introductory briefing by government team**
 - **Overview briefing by offeror**
 - **Interview: program managers**
- **Day 2:**
 - **Documentation review**
 - **Exploratory interviews (e.g., SCM, SQA, Standards)**
 - **Detailed documentation review**
- **Day 3:**
 - **Consolidation interviews**
 - **Report writing**

Focus of Interviews

Inputs

Questionnaires
Key issues
Probing questions
Basic documentation
Supporting documentation

Objectives

Validate responses
Investigate key issues
Request process substantiation
Establish preliminary findings

“Non-attribution”

SCE Results

- **Define risks for key process areas relative to the defined level (3)**
 - **Strengths of offeror’s practices**
 - **Weaknesses of offeror’s practices**
 - **Process improvement activities**
- **Evaluate offeror’s Maturity Questionnaire responses**
- **Assess offeror’s Software Process Improvement Plan (if available)**
- **Results presented at “Disappointed Offerors Debrief”**

APPENDIX E.
SCE TEAM ENTRANCE BRIEFING

Software Capability Evaluation (SCE) Team Entry Brief

<Name, SCE Team Lead>
<Organization name>

Conducted at the request of the Ballistic Missile Defense Office (BMDO)

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Purpose and Agenda

Purpose

- Introduce SCE Team
- Describe Team Process

AGENDA

Introduction of SCE Team Members

SCE Description/Purpose

Team Process and Ground Rules

Generic Site Visit Schedule

Findings Report

Summary

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The SCE Team

Team
Leader

<Name, Organization>

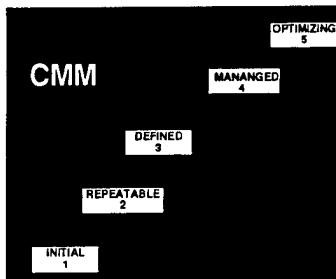
Team
Members

<Name, Organization>
<Name, Organization>
<Name, Organization>
<Name, Organization>

UNCLASSIFIED

SCE Description

CMM Based Evaluation



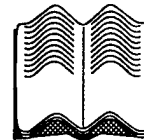
4-6 Person Trained Evaluation Team

Interviews
Document Reviews



Findings

Strengths
Weaknesses
Process Improvement Efforts



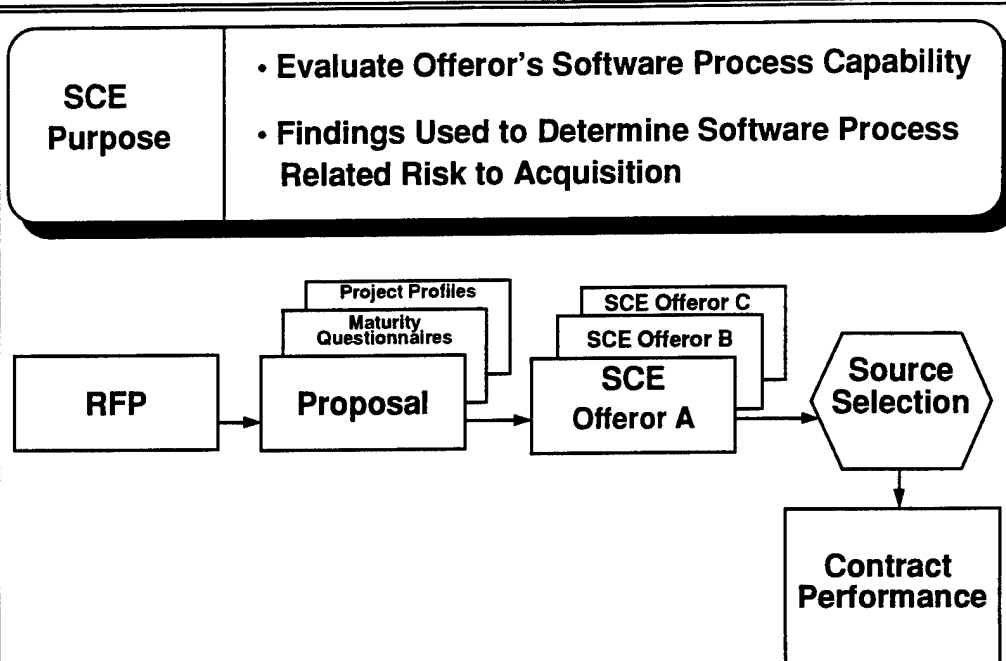
Findings Report

“A method for independently evaluating the software process of an organization to gain insight into its software development capability.”

SCE Method Description, V2.0, SEI/CMU-94-TR-06

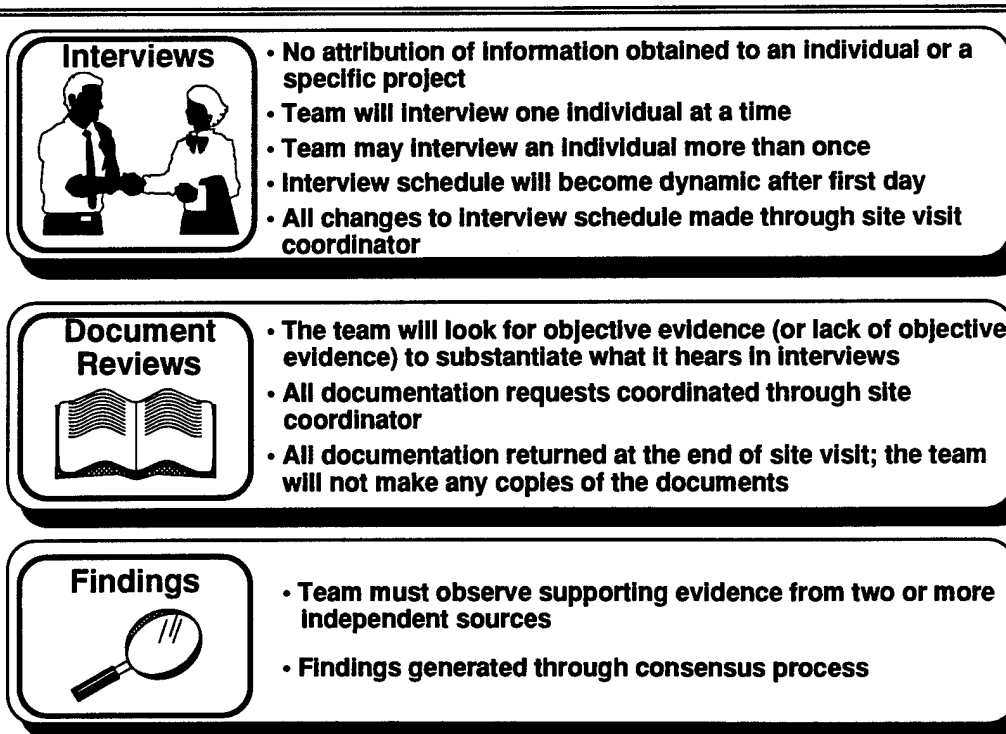
UNCLASSIFIED

SCE Purpose



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Team Process and Ground Rules



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Generic Site Visit Schedule

DAY ONE

8:30 - 9:00	Team Entry Briefing
9:00 - 10:00	Contractor Entrance Briefing
10:00 - 1:30	Document Review
1:30 - 5:30	Interviews and Lunch
5:30 - 7:30	Team Caucus and Document Review

DAY TWO

8:30 - 12:00	Interviews
12:00 - 2:00	Document Review and Lunch
2:00 - 5:00	Interviews
5:00 - 7:30	Team Caucus and Document Review

DAY THREE

7:30 - 9:00	Document Review
9:00 - 10:30	Team Meeting
10:30 - 12:30	Consolidation Interviews
12:30 - 1:30	Additional Document Reviews/Lunch
1:30 - 5:00	Preparation of Findings

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Target Process Capability

Level 5 KPAs

Technology Change Management

Level 3 KPAs

Peer Reviews
Intergroup Coordination
Software Product Engineering
Integrated Software Management
Training Program
Organization Process Definition
Organization Process Focus

Level 2 KPAs

Software Configuration Management
Software Quality Assurance
Software Subcontract Management
Software Project Tracking and Oversight
Software Project Planning
Requirements Management

Processes Are Specified in Terms of CMM Key Process Areas (KPAs)

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Findings Report

Summary Findings

- KPA acceptability criteria tailored for acquisition
- Summary of findings at KPA level

Detailed Findings

- Generated for each KPA in target process capability
- Strengths/weaknesses/ noted improvement activities

Findings Report

Findings Summary

Acceptable:

KPAs

Could benefit from improvement:

KPAs

KPA Name

KPA Summary Statement

Strengths:

Weaknesses:

Noted Improvement Activities:

TEAM
CONSENSUS

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Summary

Findings not presented during site visit
Summary level findings available for review
after contract award

POC for SCE Results: LTC James McKenna, BMDO

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APPENDIX F.
NOTICE TO CONTRACTOR



Date

MEMORANDUM FOR BMC3 Offeror's SCE Point of Contact

FROM: Beth Springsteen

SUBJECT: Software Capability Evaluation Site Visit

The BMC3 Software Capability Evaluation (SCE) will be conducted at _____ over the course of three days next week, Tuesday through Thursday, _____. Following is a list of information that should be prepared for the SCE site visit.

Security Clearance: If the evaluation team needs to have a security clearance on file at your facility, please send my secretary the appropriate information (i.e., fax number of security office, phone number of security office). This is for convenience on the part of the evaluation team so that they may go to the rest rooms and enter and exit the building as needed. My secretary's name is Libby Gonzalez: Fax number is (703) 845-6848, phone number is (703) 845-6612.

Interview Room: The SCE team will need a closed meeting room capable of handling at least eight people during the site visit. The room should also contain two tablets on easels with markers. The team will also need access to a copier machine and phone.

Site Visit Schedule: Attached is a generic schedule for the three-day site visit. Identified are typical titles of the individuals who will be scheduled for interviews at this time. The interviewees are in a standard order but this can be altered in order to accommodate their schedules. However, keep the allocated length of the interview as identified.

Entrance Briefing: At 8:30 on the first day, the BMC3 SCE team will give a brief introduction to the site visit activities. In addition, each offeror is requested to provide a brief introduction of his or her software development process and organization. Provide five copies of the presentation material to the SCE team. This presentation should not exceed one hour and should include the following:

- Overview of organization structure (selected project and organizational level groups that support the projects)
- Responsibilities of organizational-level groups which support the software-intensive projects (e.g., groups responsible for software process improvement, software quality assurance, software configuration management, training program, development of software policies and standards, software technology change management)
- Overview of organization's software development process (e.g., standards, policies, and procedures)

Document Request: Attached is a list of documents to have available when the SCE team arrives on site (these may be placed in the interview room). In addition, documents that were referenced in response to the Maturity Questionnaire should be made available at the beginning of the site visit. These references should be organized by each selected project and by question in the Maturity Questionnaire. Other documents will be requested during the course of interviews as necessary.

Interview Candidates: Attached is a list of the interview candidates selected from the organization charts which were submitted with the proposals. Since the offeror's job titles may be unique to that organization and misinterpreted by the SCE team, please provide input in the event there may be a mismatch. In the left column is the generic title that the SCE team is using to characterize typical project responsibilities. To the right is the selected interview candidate with their job title as it appears in the organization chart. The SCE team has made some assumptions that these responsibilities match (e.g., software quality assurance vs. product assurance). Coordinate with the SCE team at the beginning of the site visit to ensure it interviews the most appropriate candidate.

In addition, several job titles were not easily identified in the offeror's organization charts that the SCE team would like to interview. These are typically the departments that may exist at the organizational level rather than the project level. If such individuals or groups exist, please identify and schedule those responsible for managing a) software process improvement across projects, b) software configuration management across projects, and c) software quality assurance across projects.

The interview schedule and the interview candidates may change during the course of the site visit.

Attachments:

- Generic Site Visit Schedule
- General Document List
- Interview Candidates

Generic Site Visit Schedule

Day One:

- 7:30-8:30 SCE team arrives on site
- 8:30-9:00 SCE team introduction briefing to contractor
- 9:00-10:00 Contractor entrance briefing
- 10:00-12:30 Documentation review
- 12:30-1:30 Lunch
- 1:30-5:30 Interviews
 - Hrs 1.25 Software manager (project 1)
 - 0.25 Break
 - 0.50 Project manager (project 1)
 - 0.25 Break
 - 1.00 Manager of software process improvement
 - 0.25 Break
 - 0.50 SQA manager
- 5:30-7:30 End-of-day caucus
- 7:30+ Document review at hotel

Day Two:

- 7:30-8:30 Document review
- 8:30-12:00 Interviews
 - Hrs 0.50 SQA (project 2)
 - 0.25 Break
 - 0.50 Subcontractor software manager (project 2)
 - 0.25 Break
 - 0.50 System engineer (Project 1)
 - 0.25 Break
 - 0.50 SCM manager
 - 0.25 Break
 - 0.50 Test Engineer (project 2)
- 12:00-2:00 Document review with lunch
- 2:00-5:00 Interviews
 - Hrs 0.75 Developer/Group lead (project 2)
 - 0.25 Break
 - 1.25 Software manager (project2)
 - 0.25 Break
 - 0.50 SCM (project 1)

Generic Site Visit Schedule (cont.)

Day Three:

- 7:30-9:00 Document review
- 9:00-10:30 Team meeting/consolidation plan
- 10:30-12:30 Interviews
 - Hrs 0.50 Developer/Group lead (project 1)
 - 0.50 Software manager (project 3)
 - 0.25 Break
 - 0.75 other
- 12:30-1:30 Additional documentation review with lunch
- 1:30-5:00 Preparation of findings

General Document List

(Provided documents exist and are being used)

1. Division-level documents (generally apply across all projects)
 - Software process improvement plan
 - Software policy, standards, and procedures (2 copies)
 - Generic software development plan
 - Software quality assurance procedures/plan
 - Software configuration management procedures/plan
2. Project documents (for all projects selected for review by SCE team)
 - Program management plan
 - Software development plan
 - SCM plan
 - SQA plan
 - Software test procedures
 - Software standards and procedures manual
 - Sample software development folder

Interview Candidates

Project 1: (name)

- Project manager: _____
- Software manager: _____
- Project software configuration manager: _____
- System engineer: _____
- Developer/Group lead: _____

Project 2: (name)

- Software manager: _____
- Manager of software subcontractor: _____
- Project software quality assurance: _____
- Software test engineer: _____
- Developer/Group lead: _____

Project 3: (name)

- Software manager: _____

Organization-wide department heads:

- Manager of software process improvement: _____
- Manager of software quality assurance: _____
- Manager of software configuration management: _____

APPENDIX G.
INTERVIEW INTRODUCTION

The following points should be covered by the team leads at the initiation of each interview [Ragan 1994]:

- Introduce yourself and set a friendly tone (there is typically not time to introduce the entire team). Explain that the team is trying to gain an understanding of the organization's software process and the interviewee's roles and responsibilities in the organization.
- Put the interviewee at ease by emphasizing that the interview process is non-attribution and that the sources of data gathered during the interviews will remain anonymous.
- Explain that several team members will be asking questions, and that interruptions may occur. Ask that the interviewee not be offended by interruptions since interruptions may be required to meet the interview objectives in the allotted time.
- If the interviewee does not know the answer to a question, ask him or her to identify the appropriate person to ask (or document to review).
- Let the interviewee know the team will probably be requesting to see documentation that will help the team's understanding of the processes described. Ask the interviewee to deliver all requested documentation to the organization's SCE point of contact, and let him or her know the documentation will be returned once the team has completed its evaluation.
- Tell the interviewee that you appreciate his or her time, assistance, and cooperation.
- Be sure to thank the interviewee at the end of the interview and review the list of documents that were requested and recorded by the SCE document tracker.

APPENDIX H.
DOCUMENT TRACKING FORM

APPENDIX I.
SAMPLE FINDINGS

This appendix contains sample findings for levels 2-3 KPAs and Technology Change Management.

1. Software Project Planning

1.1 Sample Strengths

- a. Software development plans are developed according to a documented procedure (e.g., project standards and procedures, division-level Standard Software Development Process, Model Software Development Plan).
- b. Software size, effort, schedule, cost, and computer resources estimates are developed in accordance with documented procedures (e.g., Procedure for Estimating Software Sizing and Timing, Procedure for Estimating Software Cost and Schedule, Software Cost Estimating Guidebook).
- c. Software group participates in planning activities associated with the proposal team (e.g., SOW, WBS, SDP).
- d. Long-term historical data are used in developing software estimates.

1.2 Sample Weaknesses

- a. Little evidence is available that project-level software development plans are reviewed, managed, or controlled.

2. Requirements Management

2.1 Sample Strengths

- a. Requirements and changes to requirements are documented, reviewed, and consistently controlled (e.g., ECPs incorporated via CCB-controlled STRs).
- b. Traceability tools are used for managing allocated requirements and related tests (e.g., TRACER requirements traceability tool).
- c. Software engineering group is actively involved in allocation of system requirements to software.

2.2 Sample Weaknesses

- a. Projects lack guidance for selecting COTS software to satisfactory requirements.
- b. Instances occur of inefficient and potentially error-prone requirements traceability methods (i.e., both automated and manual within same project).
- c. Projects lack guidance for selecting COTS software to satisfy requirements.

3. Software Project Tracking and Oversight

3.1 Sample Strengths

- a. Cost/schedule status is tracked through periodic reports (e.g., earned value).
- b. Risks, sizes, efforts, costs, schedules are tracked against plans (e.g., gant charts, fowler charts, activity networks, C/SCSC, rate charts).
- c. Project status is reviewed weekly with task managers and monthly with senior management (e.g., weekly status meetings, tracking book reviews, highlights).
- d. Problems are documented (e.g., open/closed STRs) and tracked to closure.
- e. Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the software plans.

3.2 Sample Weaknesses

- a. No evidence is found of software development plan revisions.
- b. Limited use is made of metrics to identify need for corrective actions and revisions to plans.
- c. Process for action item identification and tracking to closure is extremely informal (e.g., issues identified through internal status meetings with PM, APM, SPMs—no minutes, no action item lists).
- d. Instances occur of schedule milestones being defined by management without input from those responsible for executing the task.

4. Software Subcontract Management

4.1 Sample Strengths

- a. Subcontractor technical and management personnel actively participate in project meetings that address status, risk, and technical issues.
- b. Subcontractor software engineering capability is evaluated prior to subcontractor selection.
- c. Subcontractor software effort is monitored against software development plan prepared by subcontractor.
- d. Documented procedures exist for planning subcontract work and for selecting and monitoring subcontractor.
- e. SOW detailing commitments regarding deliverables, standards, statusing mechanisms, and other relevant items are agreed to by both parties.

4.2 Sample Weaknesses

- a. Verification of subcontractor compliance with project-specific selection criteria is not evident.
- b. Procedures are insufficient used to verify organization's capability to select qualified subcontractors and monitor subcontractor efforts effectively (when subcontracted effort is not co-located).

- c. Organization has never selected or managed a software development subcontractor; therefore, no evaluation of this KPA was possible.

5. Software Quality Assurance

5.1 Sample Strengths

- a. Audits of software products and processes are scheduled and conducted throughout the life-cycle (e.g., walkthroughs, audits).
- b. Results of product and process evaluations are communicated to responsible engineers, project managers, and quality manager.
- c. Organizational-level SQA procedures, practices, and standards exist and are augmented as needed on individual projects.

5.2 Sample Weaknesses

- a. No mechanism exists to determine if audits are representative and sufficient.
- b. SQA personnel are also performing some line activities (e.g., SCM, testing).
- c. No feedback mechanism exists for improving software quality process.

6. Software Configuration Management

6.1 Sample Strengths

- a. Changes to baselines and the release of software products built from the software baseline library are systematically controlled.
- b. Configuration control of requirements, design, software, and associated documentation is well defined.
- c. Tools support multiple levels of software configuration management control tied to development stages for software libraries.
- d. CCBs are established to manage formal and informal baselines (e.g., Software CCB and Program CCB).
- e. Formal mechanism is in place for tracking problem reports.
- f. Regression testing is performed as applicable after incorporation of corrections to code.

6.2 Sample Weaknesses

- a. Insufficient documentation exists of software development library, roles, and responsibilities
- b. Regression testing is not performed and reported.
- c. Traceability between requirements, design, and code is inadequate.
- d. No organization-wide policies and procedures exist for developmental SCM practices.
- e. No feedback mechanism exists to track and refine SCM practices.

7. Organization Process Focus

7.1 Sample Strengths

- a. Mechanisms exist to inform software groups at project level of organization-wide process improvements (e.g., SSC Newsletter, change pages, formal training).
- b. A CCB and STRs are used to control updates to the organization software process.
- c. Organization metrics are used to perform process improvement trend analysis.
- d. Self-assessments of the organization-wide software process are conducted to identify strengths and weaknesses (e.g., 1998, 1991, planned in April 1995).
- e. Software process development and improvement activities are coordinated and disseminated across the organization and the projects (i.e., SEPG has broad membership, select business units have SEPGs, VP GM receives monthly SEPG status).

7.2 Sample Weaknesses

- a. Minimal feedback from projects occurs to identify opportunities for process improvements (e.g., Phase II training interviews).
- b. Information related to the use of the organization standard process by the projects is not collected and reviewed by SEPG (e.g., project SDPs not consistently reviewed by SEPG).
- c. Lack of organization metrics used to analyze process improvement needs and to track effectiveness of improvements (e.g., PRA reports collected but not analyzed).

8. Organization Process Definition

8.1 Sample Strengths

- a. A library of software process-related documentation is established, maintained, and populated by the projects (e.g., SDPs, metrics reports, management plans, requirements, designs, and test specifications/materials, source listings, standards).
- b. The organization's standard software process covers the entire software life-cycle and includes the approved engineering methods and techniques, products, and practices/procedures/entry/exit criteria for each life-cycle phase.
- c. Additions and revisions to the organization's software process are reviewed and approved by senior management.

8.2 Sample Weaknesses

- a. Guidance for tailoring the organization's standard process is not documented for project use.
- b. A library of software process-related documentation is established, but it lacks lessons-learned data and is only populated by a small set of projects.

- c. Information related to use of the organization's standard software process by the projects is not routinely collected and reviewed (i.e., process audits immature).
- d. A formal centralized software process database and procedures to collect and make available data on software processes and products do not exist.

9. Training Program

9.1 Sample Strengths

- a. Training program on organizational processes is widely received (e.g., engineering process improvement training Phase 1 and 2).
- b. Organizational training plan exists and specifies required and recommended training for all grade levels within each software discipline.
- c. Training records are located in a central repository and indicate progress towards attending required classes.
- d. Information regarding organization training events is disseminated (e.g., monthly training calendars, electronic mail, bulletins on a quarterly and "as available" basis).

9.2 Sample Weaknesses

- a. Existence of training plans is not apparent for some projects, and those project plans observed are deemed inadequate due to lack of maintenance.
- b. Required training is typically provided only during off hours.
- c. Lack of a centralized repository for training records hampers planning and tracking.
- d. Training for professional development is left to employee's initiatives with some informal input from supervisor.

10. Integrated Software Management

10.1 Sample Strengths

- a. Software risks are identified, assessed, documented, and managed across projects according to documented procedures.
- b. The project's software development process is developed by tailoring the organization's standard software development process to reflect project needs.
- c. Organizational database is used to support software project planning and estimating (e.g., project control database).

10.2 Sample Weaknesses

- a. The current projects' defined software processes are not tailored versions of the current organization's standard software process.
- b. No evidence exists of formalized proactive, risk management processes or procedures.

- c. Organizational database to support software project planning and estimating is immature (e.g., metrics database, data center is not automated and is not always used; it is repository for project-level metrics reports).
- d. Thresholds are not established for parameters; when exceeded, action is required.

11. Software Product Engineering

11.1 Sample Strengths

- a. Acceptability and quality of the software are enhanced by integrated software engineering activities (e.g., requirements, analysis, design, code, and test).
- b. Common methods and tools are defined and used to support software engineering activities (e.g., OOA/OOD, TEAMWORK, RVTM traceability tool, Structured Analysis and Design).
- c. Appropriate methods and tools are used for conducting requirements analysis and design (e.g., Hatley-Pirbhai method for requirements analysis, software through pictures CASE tool, structured analysis and design).

11.2 Sample Weaknesses

- a. No formal process exists for identifying, selecting, and evaluating COTS tools for project use along with reuseable software components.
- b. Automated tools are not used for conducting requirements analysis and design (e.g., requirements traceability, design specification tools).
- c. Software engineering tool selection is customer driven vs. what is appropriate to the task and available resources (e.g., skill base, ease-of-use, availability).

12. Intergroup Coordination

12.1 Sample Strengths

- a. Multi-discipline risk management team provides mechanism for tracking and resolving risks.
- b. Standardized process for review of work products by all affected engineering groups ensures that products meet receiving group's needs.
- c. New policy and procedures for implementation of integrated product development teams encourage integration of customer into all phases of software development process (new procedures not yet institutionalized).
- d. Working groups established to address technical intergroup issues and resulting action items are tracked to closure.
- e. A master schedule identifies intergroup commitments and is used to coordinate and track the work performed.

12.2 Sample Weaknesses

- a. Customer interface is limited and primarily occurs during reviews of contractually deliverable documents and attendance at formal reviews (e.g., PDR, CDR).

- b. No mechanism exists for regular communication between disciplines at working level; coordination of activities performed by different engineering groups within project is accomplished at periodic (e.g., weekly) management meetings.
- c. No evidence exists consistent tracking of dependencies between tasks that are performed by different engineering groups.

13. Peer Reviews

13.1 Sample Strengths

- a. Inspection action items are documented, tracked to closure, and signed off.
- b. Statistics on the inspection process are collected, reported to the SEPG, and used to measure inspection ROI and to make inspections more effective.
- c. Peer reviews are scheduled and conducted for 100% of software design, code, and test products for development projects.
- d. Policy and procedures exist to support the walkthrough process at all phases of the software life cycle (requirements, design, code).

13.2 Sample Weaknesses

- a. Most code peer reviews are desk reviews performed by one peer. This decreases the opportunities for synergistic problem detection and for developing widespread understanding of software work products, and increases the potential for rote, rubber-stamp peer review efforts.
- b. Organizational standard procedure for performing peer reviews is not documented.
- c. Rigor of tracking action items to closure varies across projects.
- d. Structured peer review process not uniformly applied to software products other than PDL and code.

14. Technology Change Management

14.1 Sample Strengths

- a. Selected software techniques are being evaluated (e.g. software environment, object-oriented technology, CASE tools, reuse, domain analysis).
- b. Responsibilities and resources are assigned for evaluating new software tools and technologies (e.g., working and departments).
- c. Technology planning committee and core technology teams are established at division level to manage engineering technology change activities, including software.
- d. Regular technology transfer forums are conducted by SEPG to provide information on state-of-the-art software technologies/methodologies (e.g., several sessions held on COTS).
- e. Organization's standard process defines detailed process, criteria, and checklists to be used for evaluation and selection of COTS.

14.2 Sample Weaknesses

- a. No formal organizational plan exists which captures process for evaluation and infusion of new technologies into the organization's standard process.
- b. Software technology database containing status of new tools and technologies has been recently established but is not yet populated or used by projects.
- c. No evidence exists of expertise available to support project's implementation of advance software technologies and tools.

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LIST OF ACRONYMS

BE	Brilliant Eyes
BMC3	Battle Management Command, Control, and Communications
BMD	Ballistic Missile Defense
BMDO	Ballistic Missile Defense Organization
BP	Brilliant Pebbles
CASE	Computer-Assisted Software Engineering
CBA-IPI	Capability Maturity Model (CMM) Based Appraisal - Internal Process Improvement
CCB	Configuration Control Board
CDR	Critical Design Review
CMM	Capability Maturity Model
CMU	Carnegie Mellon University
COTS	Commercial-off-the-shelf
C/SCSC	Cost/Schedule Control Systems Criteria
Dem/Val	Demonstration/Validation
DoD	Department of Defense
EMD	Engineering Manufacturing and Development
ECP	Engineering Change Proposal
FAR	Federal Acquisition Regulation
FFRDC	Federally Funded Research and Development Center
GBI	Ground Based Interceptor
GBR	Ground Based Radar
IC	Intergroup Coordination
IDA	Institute for Defense Analyses
IFPP	Instructions for Preparation of Proposals
IRAD	Internal Research and Development
ISM	Integrated Software Management
KPA	Key Process Area
KSLOC	Thousand Source Lines of Code

MIS	Management Information System
MMI	Man-Machine Interface
MQ	Maturity Questionnaire
NTBIC	National Test Bed Integration Contractor
NTF	National Test Facility
OPD	Organization Process Definition
OPF	Organization Process Focus
PDL	Process Design Language
PDR	Preliminary Design Review
PIC	Procurement Integrity Certificate
PM	Program Manager
PMM	Process Maturity Model
PO	Program Office
POC	Point of Contact
PR	Peer Reviews
RM	Requirements Management
RFP	Request for Proposal
ROI	Return on Investment
SCE	Software Capability Evaluation
SCI	Sensitive Compartmented Intelligence
SCM	Software Configuration Management
SDC/CR	Software Development Capability/Capacity Review
SDP	Software Development Plan
SE&I	Systems Engineering and Integration
SEI	Software Engineering Institute
SEPG	Software Engineering Process Group
SOW	Statement of Work
SPA	Software Process Assessment
SPE	Software Product Engineering
SPIP	Software Process Improvement Plan
SPP	Software Project Planning
SPR	Software Productivity Research
SPTO	Software Project Tracking and Oversight
SQA	Software Quality Assurance
SSA	Source Selection Authority

SSEB	Source Selection Evaluation Board
SSM	Software Subcontract Management
SSPM	Software Standards and Procedures Manual
SSEB	Source Selection Evaluation Board
STR	Software Trouble Report
TP	Training Program
TBD	To Be Determined
TCM	Technology Change Management
TSM	Trusted Software Methodology
THAAD	Theatre High Altitude Area Defense
WBS	Work Breakdown Structure

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE July 1995		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE Conducting Software Capability Evaluations: 1995			5. FUNDING NUMBERS DASW01-94-C-0054 Task Order T-R2-597.2	
6. AUTHOR(S) Beth E. Springsteen, Dennis W. Fife				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Institute for Defense Analyses (IDA) 1801 N. Beauregard St. Alexandria, VA 22311-1772			8. PERFORMING ORGANIZATION REPORT NUMBER IDA Paper P-3105	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) BMDO/DB The Pentagon, Room 1E149 Washington, DC 20301-7100			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, unlimited distribution: October 23, 1995.			12b. DISTRIBUTION CODE 2A	
13. ABSTRACT (Maximum 200 words) This document presents the results of an ongoing study to assess and recommend procedures for conducting a Software Capability Evaluation (SCE) for the Ballistic Missile Defense (BMD) program. BMD is using the SCE methodology of the Software Engineering Institute (SEI) to evaluate contractors during the source selection process and to monitor contractors after the award has been granted. SEI provides basic procedures in its SCE training course, but during the course of conducting more than 14 SCEs, IDA found that additional procedures and information were necessary to improve the effectiveness of the BMD SCE teams. This document provides lessons learned, findings, and recommended procedures and techniques, based on the BMD team's experiences in 1995, and should be used to supplement SEI's training material and reports.				
14. SUBJECT TERMS Software Evaluations, Request for Proposal (RFP), Ballistic Missile Defense (BMD), Software Life Cycle, Capability Maturity Model (CMM).			15. NUMBER OF PAGES 136	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT SAR	