Relating the Team Software Process[SM] (TSP[SM]) to the Capability Maturity Model® for Software (SW-CMM®)

With Strategy and Overview by Watts S. Humphrey

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Jim McHale

March 2003

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Team Software Process Initiative

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FOR THE COMMANDER

Christos Scondras
Chief of Programs, XPK

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Table of Contents

List of Figures

List of Tables

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Strategy and Overview by Watts Humphrey

Introduction

The Software Engineering Institute (SEI[SM]) produced this technical report to document its studies of how the Team Software Process[SM] (TSP[SM]) can be used to accelerate Capability Maturity Model® for Software (SW-CMM®-based) process improvement. It also clarifies some common misconceptions about how these two improvement frameworks support each other. These studies are continuing, and report updates will be issued as the TSP process is enhanced to close some of the identified SW-CMM gaps and as this work is extended to cover CMM Integration[SM] (CMMI®).

Some people have the mistaken impression that the TSP should not be introduced until organizations have reached maturity level 2 or higher. It is now clear, however, that the TSP can help organizations at all maturity levels and that the sooner the TSP is introduced the better. Adopting the TSP also can greatly accelerate CMM-based process improvement. For example, SEI studies show that the mean time required for organizations to improve from maturity level 2 to level 3 is 22 months and that the mean time to improve from maturity level 3 to level 4 is 28 months. However, NAVAIR recently announced that its AV-8B Joint Systems Support Activity moved from maturity level 2 to level 4 in only 16 months instead of the expected 50.[1] They attributed this rapid pace of improvement to the organization's prior introduction of the TSP.

Furthermore, the move from level 3 to level 4 is now recognized as the most difficult of all the SW-CMM improvement steps. A common reason is that the process definitions that many organizations develop for maturity level 3 must be reworked to include process measurement when they move to maturity level 4. Because the TSP process includes extensive measures, its use both accelerates the maturity level 3 process definition work and also largely eliminates the need for rewriting these processes when moving to maturity level 4. The move from maturity level 3 to level 4 then need only address the two maturity level 4 key process areas (KPAs).

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[1] NAVAIR News Release ECL200301101, "AV-8B JSSA Team Soars to Level 4," Naval Air Systems Command, Naval Air Warfare Center, Weapons Division, China Lake, CA, January 10, 2003.

The objective of this report is to help process professionals, process managers, project leaders, and organizational management establish process improvement strategies and plans. If you are not now using the TSP, this report will show you why it would be helpful to introduce it in parallel with your CMM improvement efforts. However, if your organization is already using the TSP and if you are planning a CMM-based process improvement effort, this report will help you decide on the most efficient and expeditious way to proceed.

The Improvement Strategy

This report assumes that you have a CMM improvement effort underway and that you are considering TSP introduction. The suggested strategy is to use the TSP to guide the project-centered improvements and to concentrate the CMM improvement effort on the organization-wide responsibilities that are not as completely covered by the TSP. Since the specific steps involved in this improvement strategy depend on the organization's maturity level, the next few sections discuss the improvement strategy for each maturity level.

The Maturity Level 1 to Level 2 Improvement Strategy

As shown in Figure 5 on page 14, the TSP process fully covers more than 70% of the level 2 key practices. Since many of these practices are difficult to institute in organizations that do not already plan their software work, the TSP can provide a great deal of help. During TSP introduction, software professionals are first trained in the Personal Software Process[SM] (PSP[SM]) where they learn to follow a defined process and to measure and plan their personal work. This training helps them to define many of the needed level 2 practices and to guide the improvement team in addressing these practices. The principal technical problem that maturity level 1 organizations have in moving to maturity level 2 is that they do not know how to define, introduce, or perform the required practices. PSP training and the TSP process scripts and practices provide explicit guidance on these topics.

TSP's coverage of the maturity level 2 key process areas is shown in Figure 1 on page 5. Here, the greatest gaps are in Software Quality Assurance (SQA), Software Configuration Management (SCM), and Software Subcontract Management (SSM). Because the TSP does not address any of the SSM key process areas, these topics must be handled by the CMM improvement effort. Of course, this work is needed only if the organization does or plans to do software subcontracting. The suggested strategy for addressing the other maturity level 2 improvement needs is as follows.

First, address the Organization Process Focus (OPF) topics. Even though OPF is a level 3 KPA, it is important to get some resources assigned to the improvement effort and to define what management wants these resources to accomplish. This will establish the responsibili-

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ties of the Software Engineering Process Group (SEPG) and provide its resources. Without these, no improvement effort can succeed.

Since it would be premature to address all aspects of OPF, concentrate on commitments 1, 2, and 3 and on abilities 1, 2, and 3. Regarding ability 3, the PSP engineers' training course could provide the improvement team with a thorough understanding of process principles and practices in only a couple of weeks. However, to take the PSP course, they would have to be competent programmers.

The other principal OPF topics to address are listed on pages 60 and 61. They are activities 2, 3, and 6 and verification 1. The verification effort is required for the improvement effort to have any chance of success. Without management's periodic review and continuing support, any improvement effort will generally founder.

Second, focus on the SCM topics. This is an area where the TSP teams will need early support and assistance. It is therefore a good place to start, both to demonstrate that the CMM effort and the TSP projects can work together and to get the TSP projects' support for the CMM-based improvement effort. If the projects see the CMM work as imposing demands and not providing any added value, they are not likely to cooperate with the SEPG staff. Since a substantial amount of the CMM process improvement work depends on utilizing the knowledge and experience of the TSP teams, close interaction and mutual support are essential.

The areas to address for SCM are described starting on page 50. The principle organizational topics needing attention are ability 4 and verification 4. Regarding the project-level topics, the SEPG should coordinate its work with the TSP teams' support managers. If there are several TSP projects, the SCM process improvement team should include all of the TSP support managers. This SCM improvement team would then establish the SCM requirements; identify any unique team support needs; define the required SCM improvement tasks; and allocate the implementation work among the TSP support managers, the SCM staff (if there is one), and the SEPG staff.

Third, address SQA. This maturity level 2 area has the greatest organization-wide responsibility. However, since it is only lightly covered by the TSP, it will need attention fairly early in the improvement process. The SQA topics are covered starting on page 43. The SQA improvement focus should initially be on the organization-level weaknesses. Here, for example, a CMM assessment could be potentially helpful. Then, when an SQA staff is formed, it should work with the TSP teams to provide whatever quality support and assistance these teams require in the project-centered areas.

Fourth, if required, SSM should be addressed fairly early in the improvement effort. While this is an important area, it is not addressed in this technical report principally because the TSP has no comparable process provisions.

Since these four steps will generally cover the principal maturity level 2 weaknesses, the fifth step should be to review the remaining KPAs with the teams and the various support staff members and managers to see which gaps represent important needs or major risks. If any of these gaps are considered significant, address them next. If not, these topics could be deferred until the organization is preparing for a SW-CMM assessment. The improvement effort should next consider the maturity level 3 needs.

The Maturity Level 2 to Level 3 Improvement Strategy

The major TSP gaps in moving from level 2 to level 3 are shown in Figure 2 on page 8. The principal TSP weaknesses for maturity level 3 are OPF, Organization Process Definition (OPD), and Training Program (TP). In addressing the level 3 improvement needs, the suggested strategy is as follows.

First, ensure that the OPF topics described for maturity level 2 on the previous pages have been put in place (see page 56). If any have not been addressed, handle them before moving on to other topics.

Second, the OPD work should be done in close cooperation with the TSP team process managers (see page 63). The key risk in this work is establishing a large and potentially bureaucratic process. However, if the SEPG improvement effort concentrates on developing the process standards and scripts that the TSP teams need, the effort will almost certainly be appropriate and useful. The major advantage of this strategy is that the TSP teams can act as customers for the OPD effort and can test the products to ensure that they are useful.

Since the TSP teams will have already developed most of the processes they need, the OPD effort can concentrate on adapting the team-defined processes for organization-wide use. Also, where two or more teams have established conflicting or disparate processes, the SEPG staff can work with the TSP process managers to see if their needs can be satisfied with a common organization-wide process definition or if they should continue to use unique team-defined processes. In addition to supporting the teams, the principal OPD effort should focus on organizational policies and standards.

Third, the TP topics should be addressed (see page 68). Since many of the immediate training needs will have been addressed in training and launching the TSP teams, the principal focus of the TP improvement effort should be on establishing the required policies and resources and launching the long-term training program required to meet the teams' and organization's continuing needs.

Since these three steps will generally cover the principal maturity level 3 weaknesses, the fourth step should be to review the remaining KPAs with the teams and the various support staffs and managers to see which gaps represent important needs or major risks. If any of these gaps are considered significant, address them next. If not, these topics should also be deferred until the organization is preparing for a SW-CMM assessment.

However, before deferring any significant amount of improvement work, review all of the deferred items from every maturity level to ensure that nothing important to the teams or to the rest of the organization is deferred. Unless you carefully track these lower-priority improvement items, important improvement steps may be omitted. You are also likely to leave an excessive amount of process clean-up work to be done before the next SW-CMM assessment. The improvement effort should next consider the organization's maturity level 4 needs.

The Maturity Level 3 to Level 4 Improvement Strategy

As shown in Figure 3 on page 9, the TSP fully addresses most of the topics required for maturity level 4. This is largely because, during PSP training, engineers learn to measure their work and to use these data to plan and manage their personal work. The strategy for addressing the maturity level 4 improvement needs is as follows.

First, address the Quantitative Process Management (QPM) needs identified on pages 94 to 98. The only project-level need is for commitment 1, concerning organizational policy. This should be addressed while handling the organizational-level needs for commitments 1 and 2, abilities 1, 2, 3, and 4, activity 7, and verifications 1 and 3.

Next, address the SQM needs on page 100. Here, the project-level items are all fully covered by the TSP except for activity 5, which concerns subcontracting. If the organization does software subcontracting, this topic should be addressed now. The only organizational-level SQM items needing attention are commitment 1 and verification 3. These needs should also be addressed now.

Step 3 of the level 4 improvement actions should be to review all of the deferred items from levels 2 and 3 to see if any now appear more important and should be addressed before starting on the level 5 actions.

The Maturity Level 4 to Level 5 Improvement Strategy

As shown in Figure 4 on page 11, the TSP fully covers about half of the activities for Defect Prevention (DP) and Process Change Management (PCM) but it addresses only a small part of Technology Change Management (TCM). The suggested strategy for addressing the level 5 improvement needs is as follows.

First, deal with the DP items shown on pages 104 to 107. Since a significant number of the defect prevention activities concern organization-wide issues and many of the project-level issues are only partially addressed by the TSP, the CMM improvement effort will need to cover most of the DP commitment, ability, activity, and verification items. The data and practices of the TSP teams should be very helpful in this work but substantial effort is still required to produce and install an organization-wide DP process that builds on the TSP practices and data.

The second maturity level 5 topic to address is PCM. The PCM gaps are listed on pages 114 to 118. Except for abilities 2 and 3 and activity 8, all of the project-level PCM items are covered by the TSP. Since very few of the organization-level items are fully addressed by the TSP, the improvement effort must consider most of the commitment, ability, activity, and validation items. Much of this work can build on the project-level capabilities provided by the TSP.

The third maturity level 5 step is to address TCM. These topics are described on pages 109 to 112. Except for activity 8 and verification 2, none of the TCM items apply at the project level. The TSP fully covers the verification 2 need but only partially addresses activity 8. The TSP fully addresses only one of the organizational-level items. Here again, the SW-CMM improvement effort should examine and handle all of the TCM items. While the TSP provides relatively little guidance for the TCM effort, the TSP process definitions and data are necessary for ability 3 and 4 and measurement 1.

Typical Questions

People have asked many questions about the relationship between the TSP and CMM models. Some of the most common questions are the following.

I have been told that the TSP should not be introduced until an organization is at maturity level 3 or above. Is that correct?

No. The TSP is helpful to organizations at every CMM maturity level. Recent experience demonstrates significant benefits from TSP introduction before or concurrent with the move to CMM maturity level 3.

We have a crash program underway to get to CMM level 3 as fast as possible. Should we attempt to introduce the TSP at the same time?

That depends on your objective. TSP introduction will improve organizational performance faster than anything else you do. If your objective is to reach a maturity level rather than to improve performance, you may wish to defer TSP introduction. However, by concentrating

on achieving a maturity level rather than focusing on performance improvement, you are likely to get disappointing results. A maturity level focus often leads to a bureaucratic process and this generally damages a development organization's performance rather than enhancing it.

We are moving to CMM level 2 and replacing our entire development environment. Senior management would also like to introduce the TSP at the same time. Technical management is resisting. Should we push ahead with the TSP anyway?

Probably not. While some level of change is normal in most organizations, there is a point beyond which change is destructive. At that point, it is usually wise to limit the pace of change to something that people can tolerate. Remember, the organization must continue to operate productively during the change process.

We have been at CMM level 1 for 9 years and have been unable to make significant improvement progress. Would the TSP help us?

It very likely would. Generally, the reason organizations stay stuck at level 1 is that their senior management is unable or unwilling to provide adequate support or to give sufficient priority to the change activities. Since CMM-based improvement must generally be implemented in parallel by most parts of an organization, large, entrenched, or highly bureaucratic groups are often extremely difficult to change. Because a TSP improvement effort can be focused on a relatively concentrated area, it is easier for management to provide the needed focus on process improvement. However, you must still have senior management support or no improvement effort is likely to succeed.

Is TSP introduction always successful or does it sometimes fail?

The TSP is not magic. When TSP introduction efforts have failed, it has been for the same reasons that CMM improvement efforts fail: the management team does not understand or agree with the need to change. At any maturity level, the most common problems are the lack of management support, changes in senior management, or business failures and cutbacks. Generally, when the senior management champions stay in place, both TSP and CMM improvement efforts succeed.

Final Considerations

It should now be clear that the use of the TSP can greatly accelerate CMM-based process improvement. However, several additional points should also be considered in deciding whether and how to combine TSP and CMM improvement efforts.

First, through using the TSP, engineers and engineering teams can see the reasons for many of the high-maturity CMM practices and they will be more likely to cooperate with and support a CMM-based process improvement effort. It is much harder to get the support of engineers who do not have PSP training and TSP experience.

Second, since the objective of any software process improvement effort is to enhance organizational performance and since this will require changes in engineering behavior, any improvement effort should be accompanied by steps that demonstrably change engineering behavior. The PSP and TSP do this.

Third, any improvement effort risks becoming bureaucratic and imposing added demands on the engineers instead of helping them. If, as suggested by this strategy, the SEPG process improvement work treats the TSP teams as its customers, this risk will be greatly reduced.

Fourth, even if all of the above points were not enough, the TSP will substantially improve the performance of the organization's software groups.

Finally, while introducing the TSP can greatly facilitate CMM-based process improvement, this will only hold true if it is properly introduced and used. For example, each TSP team should capitalize on the organization's existing processes and it should work closely with the established quality assurance, process, configuration management, systems, requirements, and test groups. For the TSP effort to succeed, all of the team members and all of the involved management must be properly trained, the improvement activities must be led and coached by an SEI-authorized TSP coach, and the coach must be available to coach and support the team after the launch. Guidance on TSP training and introduction can be found in *Winning with Software: An Executive Strategy.*[2]

[2] Humphrey, Watts S. *Winning with Software: An Executive Strategy*. Reading, MA: Addison Wesley, 2002.

Abstract

Organizations using the Capability Maturity Model for Software® (SW-CMM®) to guide their software process improvement efforts often struggle with implementation details. The Team Software Process℠ (TSP℠) was designed to implement effective, high-maturity processes for project teams. The TSP contains a framework as well as a set of processes, procedures, guidelines, and tools for project teams to use in the production of high-quality software on time and on budget.

Since the SW-CMM describes *what* an organization at a high level of process maturity should be doing, and the TSP describes *how* high-maturity processes are implemented for project teams, the question arises: If all projects in an organization were using the TSP, would the organization exhibit the characteristics of high process maturity, as described in the SW-CMM? To help answer this question, we performed an analysis of the degree to which the SW-CMM is addressed by the TSP. Each key practice described in the SW-CMM was classified as having an organizational or project scope, or both. Then each practice was examined to determine how it was addressed by the TSP. The results presented in this report show that the TSP implements a majority of the key practices of the SW-CMM.

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1 Introduction

The Capability Maturity Model® for Software (SW-CMM®) is an improvement framework that describes the key elements of an effective organizational software process. The SW-CMM describes an evolutionary improvement path from an ad hoc, immature process to a mature, disciplined process [Paulk 95]. It is a descriptive model because it describes the characteristics of an organization at a particular maturity level, and its capabilities for quality, cost, and schedule predictability. The results achieved from CMM-based process improvement are impressive [Herbsleb 94, Lawlis 95], but many organizations struggle to define and implement operational processes for the key practices described in the SW-CMM.

The Team Software Process℠ (TSP℠) is prescriptive, defining a whole product framework of customizable processes and an introduction strategy that includes building management sponsorship, training for managers and engineers, automated tool support, coaching, and mentoring. The TSP is a high-maturity process for project teams. It contains an adaptable set of processes, procedures, guidelines, and tools for project teams to use in the production of high-quality software on time and on budget. A prerequisite for the TSP is the Personal Software Process℠ (PSP℠), which is a high-maturity process for individual software engineers. In terms of product quality and schedule variance, the results from the use of the PSP and the TSP show individuals and teams producing software that is at least what one would expect from a maturity level 5 organization [Ferguson 99, Hayes 97, McAndrews 00].

The SW-CMM and the TSP are complementary by design [Humphrey 98a, 98b, 98c]. After guiding the development of the SW-CMM, Watts Humphrey went on to develop the PSP and TSP to apply CMM principles at the individual and team levels, while addressing common shortcomings in implementing the SW-CMM and going beyond the SW-CMM to more specifically address the work of the engineers [Humphrey 02]. The SW-CMM describes *what* an organization at a particular maturity level should be doing, while the TSP prescribes *how* high-maturity practices can be used at the team level. Since the TSP concentrates on project issues, it does not address the broader organizational aspects of any CMM level. This technical report explores the common elements between the TSP and the Capability Maturity Model for Software V.1.1. It does not discuss TSP practices that have no corresponding CMM practice.

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The purpose of this document is to describe how the TSP addresses each key process area (KPA) of the SW-CMM and to record observations about how the TSP addresses each key practice in the SW-CMM. These observations can serve as one set of inputs in determining how to use the TSP to implement and accelerate CMM-based software process improvement.

The primary audience for this report includes the following:

- organizations currently using the TSP who want to incorporate the additional organizational practices described in the SW-CMM
- organizations that have decided to adopt CMM-based software process improvement and are looking for processes that implement the SW-CMM
- organizations that have started implementing the SW-CMM and are interested in high-maturity team practices

A secondary audience for this report includes the following:

- individuals who are interested in software process improvement
- CMM-Based Appraisal for Internal Process Improvement (CBA IPI) Lead Assessors
- PSP instructors and TSP launch coaches

Familiarity with either the SW-CMM or TSP, and some understanding of the other, would be helpful in understanding this report. Several articles and textbooks describe the TSP and the SW-CMM. Overview information on the SW-CMM is available on the Software Engineering Institute Web site: http://www.sei.cmu.edu/cmm. Articles and papers on the SW-CMM are also available at http://www.sei.cmu.edu/cmm/cmm.articles.html. Information about the TSP is available on the SEI Web site at http://www.sei.cmu.edu/tsp.

2 Methodology

In relating the TSP and the SW-CMM, the first step was to define the fundamental concepts of "organization" and "project" in context of the TSP. The terms "organization" and "project" have specific meaning in the SW-CMM. An *organization* is defined as "a unit within a company or other entity (e.g., a government agency or branch of service) within which many projects are managed as a whole. All projects within an organization share a common top-level manager and common policies." A *project* is defined as "an undertaking requiring concerted effort, which is focused on developing and/or maintaining a specific product. The product may include hardware, software, and other components. Typically a project has its own funding, cost accounting, and delivery schedule" [Paulk 95].

A project, as defined by the SW-CMM, could be composed of more than one TSP team. The TSP process guides projects executed by single teams. An extended version of the TSP guides projects executed by multiple teams. Teams can be software-only TSP teams, multi-disciplinary TSP teams, or a mix of team types in the case of multiple-team projects. This report adopts the SW-CMM definition of project and organization, with the following assumptions:

- The organization is following the standard SEI TSP introduction strategy, as described in Section 8.1.
- The organization has moved beyond TSP pilots to widespread use of the TSP.
- Projects use the TSP as early as possible in the project life cycle.
- Projects use multi-disciplinary TSP teams and/or the multiple-team version of the TSP as necessary.

The next step after documenting the definitions and assumptions was to resolve the differences in scope of the TSP and the SW-CMM. The intent of the SW-CMM is for some key practices of the SW-CMM to be addressed at the organizational level, some at the project level, and some at both levels. The TSP mostly addresses process improvement at the project and individual levels. To resolve this, each key practice of the SW-CMM was examined to determine at what level of the organization, project level or organization level, the SW-CMM intended the key practice to be addressed. Each key practice was classified as being addressed at the organization level, at the project level, or at both the organization and project levels. The detailed methodology and the resulting classification of key practices are presented in Section 9 of this report.

Next, observations were recorded for each key practice of the SW-CMM by citing specific TSP documents: a process script, a form, a specification, a guideline, or a combination. Observations take the form of a direct quote or paraphrase of the text being referenced, a synopsis of a larger piece of a document, or a summary of the collective intent of a set of process elements. Observations also record the degree to which the key practice is addressed by the TSP at the project level and at the organization level according to the following rules:

- A key practice is "not applicable" at the project level if the intent of the SW-CMM is for that key practice to be addressed mainly at the organization level.
- A key practice is "not applicable" at the organization level if the intent of the SW-CMM is for that key practice to be addressed mainly at the project level.
- A key practice is "fully addressed" if the TSP satisfies the intent of that key practice.
- A key practice is "not addressed" if the intent is not satisfied.
- A key practice is "partially addressed" if the degree of satisfaction is anywhere between fully addressed and not addressed.

The detailed methodology and the resulting observations are presented in Section 8.

It is important to understand the context in which these observations were recorded. Observations were recorded for static descriptions of the SW-CMM and the TSP in light of the assumptions listed above. Processes used by organizations and projects to actually perform their work are dynamic instantiations of the process descriptions examined in this paper. It is the dynamic execution of these processes that will show whether the use of the TSP indeed addresses the goals of various KPAs of the SW-CMM.

For readers not interested in the details presented in Sections 8 and 9, summary information about the relationship between the TSP and the SW-CMM at each process maturity level is presented in Sections 3, 4, 5, and 6.

3 TSP and Level 2

The focus of maturity level 2 is on management processes. Requirements are managed to ensure understanding customer commitments, projects are planned and tracked to ensure meeting schedule commitments, and subcontracts are managed to ensure subcontractors meet their commitments. Software Quality Assurance (SQA) provides management with visibility into the processes and procedures being used by projects to meet their commitments. Software Configuration Management (SCM) ensures the integrity of the work products being produced.

At level 2, the TSP provides specific guidance for Software Project Planning (SPP), Software Project Tracking and Oversight (SPTO), Requirements Management (RM), and SQA. The activities constituting effective SCM are mainly enabled and encouraged. Software Subcontract Management (SSM) is outside the scope of the TSP, and is not explicitly addressed, but it is not unusual for an organization using the TSP to start asking their subcontractors for TSP-equivalent project planning, tracking, and quality.

Figure 1 shows the percentage of project key practices addressed by the TSP for each KPA of level 2. For detailed observations on each key practice, see Section 8.

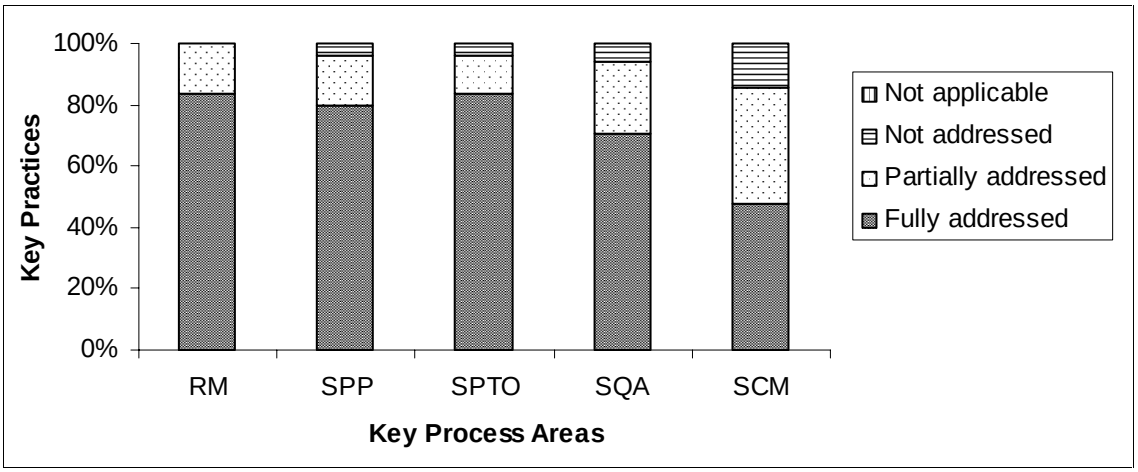

Figure 1: Project Key Practices Profile at Level 2

4 TSP and Level 3

Level 3 builds on level 2 in several ways. At level 2, individual projects in an organization could be practicing different management and engineering processes. At level 3, the projects are expected to tailor a common set of documented and approved organization-wide management and engineering processes. Level 3 also focuses on the software engineering group by addressing engineering processes and on the need for the software engineering group to be involved with other engineering groups. As projects start using a common set of management and engineering processes, these processes can be more effectively instrumented. Thus, an organization's software process database is established at level 3 to collect data on the software processes and products. Finally, level 3 establishes an organizational training program, as well as a peer review process.

Although the TSP focus is on teams and not on organizations, it supports the principal intent of level 3: projects in the organization use a common set of processes to perform software development and maintenance work, and projects share process data and lessons learned. Even if all teams in an organization were using the TSP, there is the need for additional organizational support. An example of the need for organizational support beyond the TSP is evident in the Organization Process Definition (OPD) KPA. TSP teams collect and analyze product and process data. There is the additional need for an organizational function that collects, reviews, and makes this data available for use across the organization, as needed.

At level 3, the TSP provides support for the Organization Process Focus (OPF) and OPD KPAs by improving organizational software process capability and by providing process elements, process architecture, and process and product data to the organization's software process assets. The Integrated Software Management (ISM) KPA is strongly supported because management and engineering activities are integrated into the TSP. Specific guidance is provided for the Peer Review (PR) KPA by way of the TSP inspection process. Software Product Engineering (SPE) activities are strongly supported through the PSP. The Intergroup Coordination (IC) KPA is addressed via the team role managers. The Training Program (TP) KPA is enabled by the TSP in that training needs of projects are identified and planned.

Figure 2 shows the percentage of project key practices addressed by the TSP for each KPA of level 3. For detailed observations on each key practice at level 3, see Section 8.

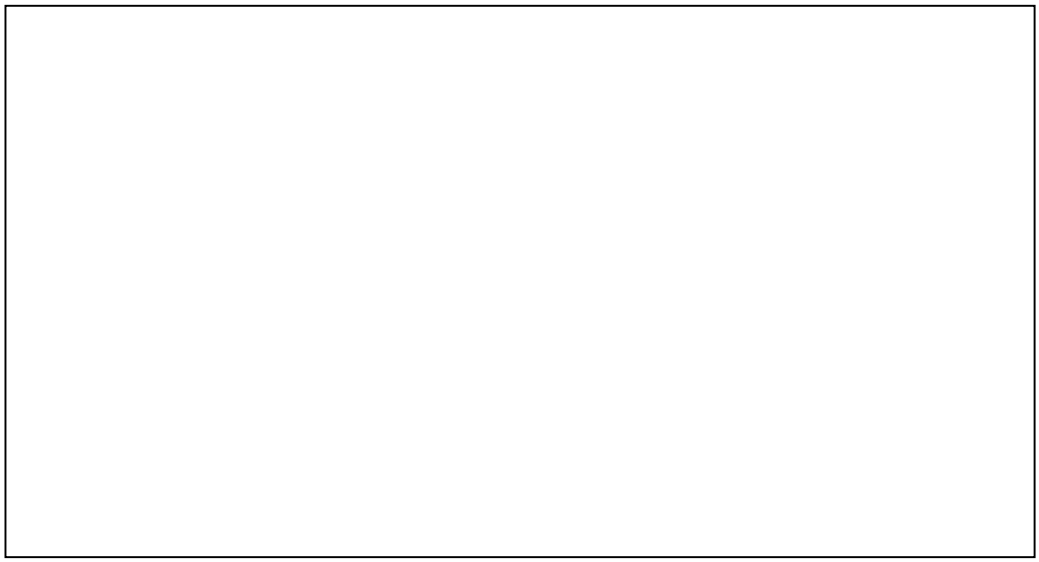

Figure 2: Project Key Practices Profile at Level 3

5 TSP and Level 4

At level 3, defined processes enable the use of process measures. Projects start to collect and use measures for planning and tracking, and an organization's software process database is established. At level 4, projects collect detailed measures for both project processes and product quality. Software product quality and software process capability are quantitatively understood. Measures are used dynamically to manage both project processes and quality.

The Quantitative Process Management (QPM) KPA focuses on understanding and controlling processes used by projects, collecting data on projects' process performance, and where possible, using this data to characterize the performance of the organization's standard software process. The TSP provides direct support for quantitative process management for projects, thus enabling equivalent quantitative analysis across the organization.

The TSP also provides explicit support for the Software Quality Management (SQM) KPA. Product quality is planned, tracked, managed, and understood.

Figure 3 shows the percentage of project key practices addressed by the TSP for each KPA of CMM level 4. For detailed observations on each key practice at level 4, see Section 8.

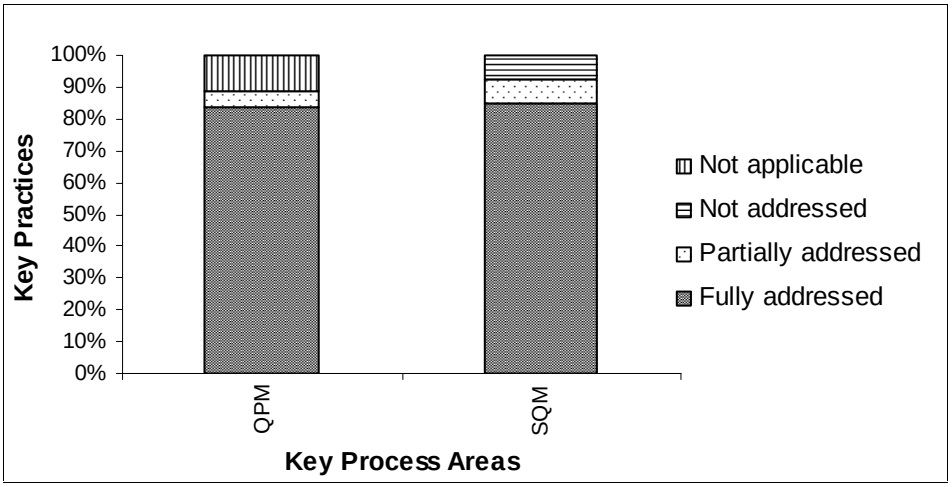

Figure 3: Project Key Practices Profile at Level 4

6 TSP and Level 5

At level 5, the quantitative understanding achieved at level 4 drives a culture of continuous improvement. The Defect Prevention (DP) KPA looks for common causes of defects and attempts to prevent their recurrence. The Process Change Management (PCM) KPA looks to continuously improve the software processes used in the organization in terms of reduced cycle time, productivity gains, or better quality. The Technology Change Management (TCM) KPA specifically examines the potential impact of new technologies on quality and productivity, and transitions appropriate technologies into practice.

The TSP explicitly addresses many of the key practices for the DP and PCM KPAs, and somewhat less of the TCM KPA, again following the pattern of supporting project activities while enabling organizational activities. Figure 4 shows the percentage of project key practices addressed by the TSP for each KPA of level 5. For detailed observations on each key practice at level 5, see Section 8.

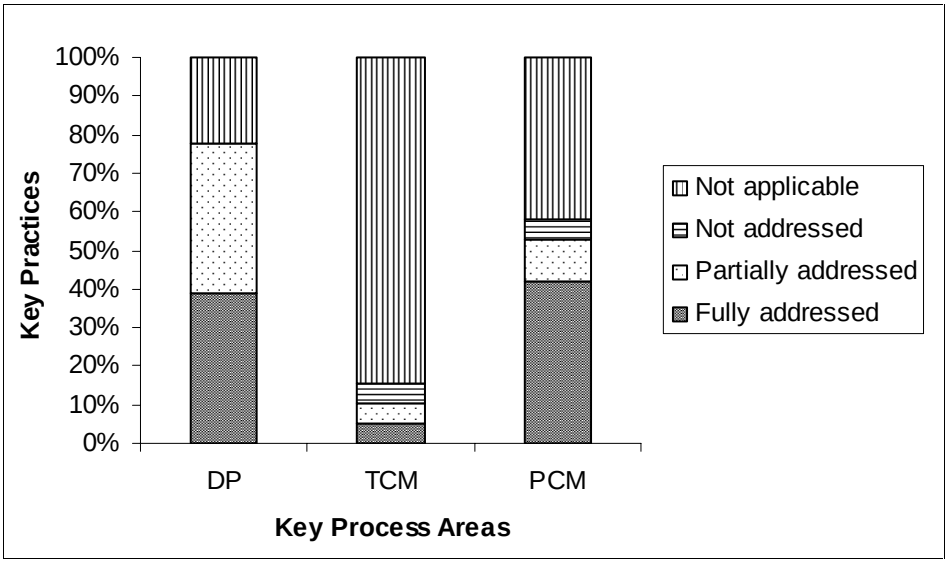

Figure 4: Project Key Practices Profile at Level 5

7 Summary of the Relationship between the TSP and SW-CMM

A potentially useful picture emerges from the project- and organization-level key practice profiles of the TSP across the SW-CMM levels. Of the 294 key practices examined (all KPAs except for SSM at level 2), 139 were classified as project responsibilities, and 70 were classified as organization responsibilities. The 85 practices classified as having both project- and organization-level responsibility provide a starting point for defining an operational interface between TSP projects and a CMM-based improvement program.

Table 1 shows the classification of the key practices by maturity level (see Section 9 for details). Figure 5 shows a summary of the degree to which the TSP addresses key practices classified as either project level, or as both organization and project level. Figure 6 shows the same data for key practices classified as either organization level, or as both project and organization level.

Table 1: Key Practice Classification Summary

	Level 2	Level 3	Level 4	Level 5	All Levels
Project	73%	42%	45%	14%	47%
Organization	0%	37%	6%	50%	24%
Both Project and Organization	27%	21%	48%	36%	29%

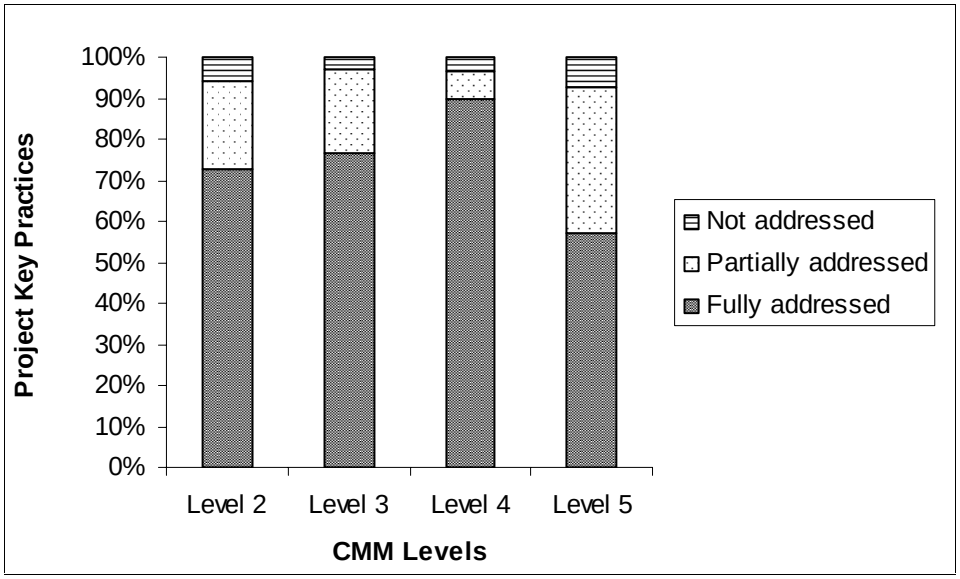

Figure 5: Project Key Practices Profile – Summary

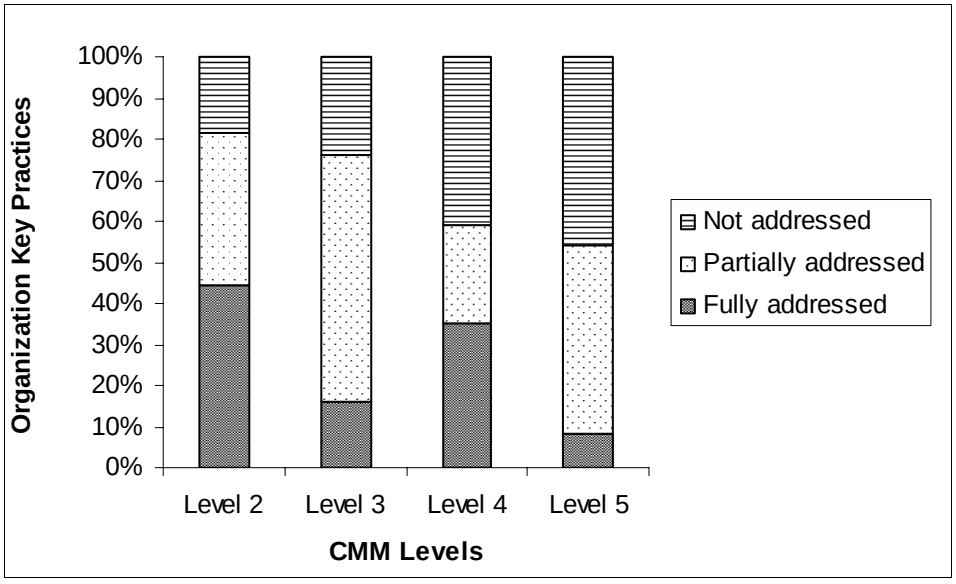

Figure 6: Organization Key Practices Profile – Summary

8 Observations for CMM Key Practices

This section records detailed observations for each KPA of the SW-CMM. First, information about the TSP introduction strategy is provided. Then, the methodology used for recording the observations is described. Next, global observations that apply across most of the KPAs are described. This is followed by a brief description of the process elements of the TSP that are referenced in the observations. Finally, the observations for each KPA are presented.

8.1 The TSP Introduction Strategy

The TSP introduction strategy is designed to create the right circumstances for introducing TSP in an organization. The strategy includes the following:

1. a one-day TSP executive seminar
2. a one-half to one-day executive-planning session
3. four days of training for management in how to lead and coach self-directed TSP teams
4. two weeks of training in the PSP for the software engineers
5. two days of training in a personal process for non-software engineers participating in interdisciplinary TSP teams
6. three- to four-day team launches, with required participation from senior management and customer representatives
7. relaunches, postmortems, and checkpoints

Additional training is required for PSP instructors and TSP launch coaches. The training involves all levels of management: senior executive, middle managers, first-line managers, software engineers, and members of other groups. The TSP is first piloted on two or more teams. Results from the pilots are evaluated, more teams are trained, and the TSP is then rolled out across the organization.

8.2 Methodology for Observations

The methodology used to record the observations for each KPA is as follows:

1. Two tables were created for each KPA of the SW-CMM.
2. In the first table, rows for each goal of the KPA were created. For each goal

a. the first column lists the goal statement from the SW-CMM

b. the second column describes how the TSP addresses the goal. The second column also indicates the degree to which the goal is addressed by the TSP. “Fully addressed” means the TSP fully satisfies the goal, with no significant weaknesses identified. “Not addressed” means the TSP does not address the goal at all, and “Partially addressed” means the goal is addressed to some degree, but no significant weaknesses were identified.

3. In the second table, rows for each key practice of the KPA were created. For each key practice

   a. the first column lists the key practices from the SW-CMM

   b. the “TSP Element” column references the TSP scripts, specifications, forms, or documents that address the key practice

   c. the “Observation” column records one or more comments about how TSP addresses the key practice

   d. the “Project Level” column indicates the degree to which the key practice is addressed at the project level. “Fully addressed” means the TSP fully satisfies the intent of the key practice at the project level. “Not addressed” means the TSP does not satisfy the intent of the key practice at the project level. “Partially addressed” means the key practice is addressed to some degree, but not enough to fully satisfy the intent of the SW-CMM. “Not applicable” means the key practice was classified as an “organization-level” practice in Section 9.

   e. the “Org. Level” column indicates the degree to which the key practice is addressed at the organization level. Though the focus of the TSP is at the project level, it addresses several key practices at the organization level as well. “Fully addressed” means the TSP fully satisfies the intent of the key practice at the organization level. “Not addressed” means the TSP does not satisfy the intent of the key practice at the organization level. “Partially addressed” means the key practice is addressed to some degree, but not enough to fully satisfy the intent of the SW-CMM. “Not applicable” means the key practice was classified as a “project-level” practice in Section 9.

   f. the “Notes” column contains supporting notes for the observation. In particular, this column explains why a key practice is partially addressed.

8.3 Global Observations

The following global observations can be made about how the TSP supports the common features of the SW-CMM. They will not be repeated in the observations for each KPA.

8.3.1 Commitment to Perform

“Where policy statements are used, they generally refer to the project following a written, organizational policy for the practices of that key process area. This is to emphasize the connection between organizational commitment and the projects that are actually performing the work. The subpractices for the policy statement generally summarize activities that are cov-

ered later in the KPA and are particularly suitable to institutionalization via a written policy. In some KPAs (such as Organization Process Focus), the focus of the activities for the KPA is the organization, not the project. In those cases, the policy statement is reworded and refers to the organization following a written policy" [Paulk 95].

Organizational policies must be created at the organization level. At the project level, these policies must be followed and projects must exhibit behaviors consistent with these policies. The TSP does not address creation of organizational policies. However, TSP teams usually exhibit behaviors consistent with such policies, if they exist. The TSP does not fully address any of the key practices in the Commitment to Perform common feature that require a written organization policy. Observations for these key practices in this technical report will address only non-policy issues specified by these practices, if any.

8.3.2 Ability to Perform

"Most key process areas of the SW-CMM contain a key practice that reflects the need for adequate resources and funding for the activities covered by the key process area. These resources and funding generally fall into three categories: access to special skills, adequate funding, and access to tools" [Paulk 95].

The TSP launch process ensures that adequate resources and funding are provided for all project activities. During the launch, the tools and special skills needed are identified. At the conclusion of a launch, the team presents its needs to management. Management approves the team plan, and gives the team the go-ahead to start executing the plan. The Support Manager role is responsible for tools used and needed by the team. This key practice is fully addressed by the TSP whenever resources and funding are needed for project-level activities.

8.3.3 Verifying Implementation

"The Verifying Implementation common feature generally contains key practices that relate to oversight by senior management and project management, as well as specific verification activities that the software quality assurance group or others are expected to perform to verify that the key practices are being performed properly" [Paulk 95].

Management Oversight

Senior management oversight (Verification 1) and project management oversight (Verification 2) are integral to the TSP. Management is involved in the team launch, and understands and commits to the team plan. Several status and review meetings and reports are defined in the TSP. These include the following:

- TSP Launch (Script LAU)
- TSP Project Status Report (Specification STATUS)
- TSP Project Summary Report (Specification SUMMARY)
- TSP Management and Customer Status Meeting (Script STATUS)
- TSP Weekly Team Meeting (Script WEEK)
- TSP Quarterly Executive Project Review Checklist (REVCL)
- TSP Plan Review Checklist for Executives (PLANCL)

Observations for Verification 1 and Verification 2 will not repeat this integral oversight process that is built into the TSP.

Software Quality Assurance (SQA)

TSP teams address SQA as it would typically be addressed in high-maturity organizations. Process and product data are analyzed to determine the quality of the work products and the quality of the process used to create the work products. This contrasts with the more work-product-oriented SQA in lower-maturity organizations, where people audit and examine processes and work products to determine their quality.

Humphrey makes the following observation about the changing scope of the SQA function in a high-maturity organization: "…The software professionals and managers will generally do their own quality assurance. They will measure their work, assess trends, and take corrective action." He goes on to say that even at the higher maturity levels, QA must include tasks such as "statistically sample the software engineering work to ensure it is performed to standard, sample the data to assure that it represents the work being done, and analyze the data and alert management to any out-of-line trends or conditions" [Humphrey 89].

TSP teams fulfill this view of SQA. TSP teams are self-managed and are responsible for both their product and process quality. TSP teams use data to assure quality. The Quality Manager on a TSP team has overall responsibility for both process and product quality. Role managers monitor the quality for their particular areas of responsibilities. They try to resolve non-compliance issues with team members and the Team Leader. In addition, the TSP checkpoint process ensures the team is following its processes and procedures. An authorized TSP launch coach, who typically is not a team member, conducts TSP checkpoints. Checkpoint findings are discussed with the team and the Team Leader.

Observations for SQA oversight (Verification 3) address the software quality assurance activities performed by a TSP team. TSP teams perform quality assurance functions, regardless of the existence of an external SQA group. Where an independent SQA group exists, the TSP

suggests that the team's Quality Manager work cooperatively with the SQA group in overseeing the team's product and process quality.

8.4 Process Elements of the TSP

The TSP includes more than 70 process elements to guide the work of TSP teams. Process scripts define processes ranging from project planning processes to project postmortem processes. Forms define data gathering and analysis for various processes and procedures. Examples include the team inspection data recording form and the product size summary data recording form. Checklists, specifications, and standards are included to support project processes and procedures. Examples are the quarterly project review checklist for executives or the management status report specification.

The following process elements of the TSP are referenced in the "TSP Element" column of the observation tables.

8.4.1 TSP Scripts

All TSP scripts are listed in the following table. After the first two, the scripts are listed in the alphabetical order of their abbreviated names.

Table 2: TSP Scripts

Script Abbreviation	Script Name
DEV	Overall Development and Enhancement Process
MAINT	Overall Maintenance and Enhancement Process
ANA	Impact Analysis
HLD	High Level Design
IMP	Implementation
IMP6	Unit Test and Test Development (step 6 in script IMP)
INS	Inspection Process (two pages)
LAU	Team Launch
LAU1	Launch Meeting 1 – Launch overview and kick-off
LAU2	Launch Meeting 2 – Roles and goals
LAU3	Launch Meeting 3 – Strategy, process, support
LAU4	Launch Meeting 4 – Overall team plan
LAU5	Launch Meeting 5 – Quality plan
LAU6	Launch Meeting 6 – Detailed next-phase plans
LAU7	Launch Meeting 7 – Risk assessment
LAU8	Launch Meeting 8 – Management meeting preparation

Script Abbreviation	Script Name
LAU9	Launch Meeting 9 – Wrap-up management meeting
LAUPM	Launch Postmortem Meeting – Postmortem on the launch
MTG	General Meeting Process
PM	Project Postmortem
REL	Team Relaunch
REL1	Relaunch Meeting 1 – Status and management update
REQ	Requirements
STATUS	Management and Customer Status Meeting
TEST	Release Test
TEST1	Product Build (step 1 in script TEST)
TEST2	Integration (step 2 in script TEST)
TEST3	System Test (step 3 in script TEST)
TESTD	Test Defect Handling
WEEK	Weekly Team Meeting

8.4.2 TSP Forms

All of the TSP forms and instructions for the forms are listed here in the alphabetical order of their abbreviations.

Table 3: TSP Forms

Form Abbreviation	Form and Instructions Name
DEFECT	Defect Reporting Form
GOAL	Team Goals
INS	Inspection Report
INV	Process Inventory
ITL	Issue/Risk Tracking Log
LOGD	Defect Recording Log
LOGT	Time Recording Log
MTG	Meeting Report Form
PIP	Process Improvement Proposal
ROLE	Team Roles
ROLEMX	Role Assignment Matrix
SCHED	Schedule Planning Template
STRAT	Strategic Planning Form
SUMDI	Defects Injected Summary
SUMDR	Defects Removed Summary
SUMP	Plan Summary Form

Form Abbreviation	Form and Instructions Name
SUMQ	Quality Summary Form
SUMS	Program Size Summary
SUMT	Development Time Summary Form
SUMTASK	Task Plan Summary
TASK	Task Planning Template
TESTLOG	Test Log
WEEK	Weekly Status Report

8.4.3 TSP Role Specifications

The role specifications provide guidance for people who fill each role, and list each role's principal duties and responsibilities.

Table 4: TSP Role Specifications

Role	Descriptions
Team member	General responsibilities of team members
Customer Interface Manager	Customer Interface Manager responsibilities
Design Manager	Design Manager responsibilities
Implementation Manager	Implementation Manager responsibilities
Planning Manager	Planning Manager responsibilities
Process Manager	Process Manager responsibilities
Quality Manager	Quality Manager responsibilities
Support Manager	Support Manager responsibilities
Test Manager	Test Manager responsibilities
Meeting	Meeting roles and responsibilities
Inspection	Inspection roles and responsibilities
Team Leader	Team Leader responsibilities

8.4.4 TSP Checklists, Specifications, and Standards

The TSP checklists, specifications, and standards are listed in alphabetical order.

Table 5: TSP Checklists, Specifications, and Standards

Item Abbreviation	Checklist, Specification, or Standard
NOTEBOOK	The specification for the project notebook
PLAN	Planning standard – standard planning factors
PLANCL	Plan assessment checklist for executives
PREPL	Launch preparation checklist
PREPR	Relaunch preparation checklist
QUAL	Quality standard – standard quality plan factors
REVCL	Quarterly project review checklist for executives
STATUS	Management status report specification
SUMMARY	Project summary report specification

8.4.5 Other Sources of Information

Other sources of information in the "TSP Element" column include the following:

- the Personal Software Process, as defined in *A Discipline for Software Engineering* [Humphrey 95]
- the executive review process, as defined in *Winning with Software: An Executive Survival Strategy* [Humphrey 02]
- the roles of TSP launch coach and Team Leader, as defined in *Leading and Coaching Disciplined Teams* [Humphrey, in press]
- PSP and TSP training materials used in the TSP introduction strategy
- the TSP prototype tool, which facilitates planning, tracking, data collection, and data analysis for TSP teams
- TSP and PSP measures, such as Process Quality Index (PQI), defined in the PSP and TSP textbooks
- TSP data analysis charts, such as the TSP quality profile described in TSP textbooks

8.5 Requirements Management Observations

"The purpose of Requirements Management is to establish a common understanding between the customer and the software project of the customer's requirements that will be addressed by the software project" [Paulk 95].

TSP projects plan requirements management and definition activities during a requirements launch. In the launch, the requirements team

- meets with management and customer representatives to understand project and product objectives
- defines team goals
- selects team roles, including the role of Customer Interface Manager, who is the liaison between the team and the customer representative, and is responsible for requirements change management
- produces detailed, load-balanced individual team member and overall team plans for requirements activities
- identifies risks for requirements definition and management
- gets commitment from management and customer representatives to proceed with the plan

After the launch, the team has a detailed plan that every team member is committed to, and that marketing and management have approved. The team now follows the TSP requirements process to

- study the requirements to identify errors or clarify requirements
- hold meetings with customers and/or marketing to elicit requirements
- where needed, use prototypes or simulations
- document requirements
- produce user manual outline

- define tests to verify requirements
- inspect requirement phase work products (requirements specifications, test definitions, user manual outlines and drafts)
- baseline requirements

The responsibility to manage changes to requirements is assigned to the Customer Interface Manager. The Customer Interface Manager leads the team in estimating and documenting the impact of every requirements change and works with the Configuration Control Board (CCB) to get approval for changes to requirements.

The TSP does not include procedures for managing changes to requirements. The TSP assumes that teams will use existing requirements change management procedures. In the absence of existing processes, defining and implementing a requirements change management procedure becomes a team task, which is planned and tracked just like any other team task in the TSP.

The observations for Requirements Management assume that the requirements team is using the TSP.

Requirements Management Goal	Observation
Goal 1 System requirements allocated to software are controlled to establish a baseline for software engineering and management use.	TSP teams baseline their requirements. The TSP does not include procedures for requirements change management. This goal is partially addressed by the TSP.
Goal 2 Software plans, products, and activities are kept consistent with the system requirements allocated to software.	As teams develop plans and products, they are reviewed against the requirements. This goal is partially addressed by the TSP.

Requirements Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for managing the system requirements allocated to software.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 For each project, responsibility is established for analyzing the system requirements and allocating them to hardware, software, and other system components.	LAU3, and Customer Interface Manager role specification	The team plans the analysis and allocation of system requirements to software during launch meeting 3 (LAU3). Also during this meeting, the team plans how to manage the changes to requirements. The Customer Interface Manager's principal responsibilities include managing changes to requirements.	Fully addressed	Not applicable	The organization must establish a systems engineering group to analyze and allocate system requirements. The TSP team refines and uses these allocated requirements. The systems engineering group could use the TSP for planning and tracking its own work.
Ability 2 The allocated requirements are documented.	LAU, REQ, ANA, Test Manager, and Customer Interface Manager role specifications	The non-technical requirements (products to be delivered, delivery dates, milestones, etc.) are documented when the team produces a plan during a TSP launch (LAU). The technical requirements are documented in the system requirements specification (SRS) and the engineering requirements specification (ERS), called for in the REQ and ANA scripts. The REQ script calls for acceptance criteria (system test plan). The Test Manager "supports the Customer Interface Manager in getting acceptance test criteria defined and agreed to by the customer during the requirements phase" (Test Manager and Customer Interface Manager role specifications).	Fully addressed	Not applicable	

Requirements Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 3 Adequate resources and funding are provided for managing the allocated requirements.	Customer Interface Manager role specification	In addition to the global observation in Section 8.3, the Customer Interface Manager is responsible for the evolution and development of product requirements.	Fully addressed	Fully addressed	
Ability 4 Members of the software engineering group and other software-related groups are trained to perform their requirements management activities.	LAU3, Team Member, and Team Leader role specifications	In launch meeting 3 (LAU3), team members plan their role responsibilities. Team member role responsibilities include identifying and planning training needs. Team Leader role responsibilities include identifying and planning the training needs of team members.	Fully addressed	Not applicable	
Activity 1 The software engineering group reviews the allocated requirements before they are incorporated into the software project.	LAU, REQ, and ANA	The TSP requirements phase includes a launch and inspections. TSP teams receive, review, and plan requirements during the launch. The REQ and ANA scripts guide the requirements phase activities and call for review with systems, marketing, and the customer. Relaunches and risk analysis are built in. Significant changes to requirements can result in a relaunch.	Fully addressed	Not applicable	

Requirements Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 2 The software engineering group uses the allocated requirements as the basis for the software plans, work products, and activities.	LAU, REL, REQ, ANA, DEV, and MAINT	During a requirements phase launch, TSP teams produce an overall project plan and a detailed next-phase plan (LAU) to develop, document, review, validate, and control software requirements based on allocated requirements (REQ, ANA). After the requirements launch, the team's work is guided by scripts DEV or MAINT. Each step in these scripts ensures that the work done is based on the agreed-upon requirements.	Fully addressed	Not applicable	
Activity 3 Changes to the allocated requirements are reviewed and incorporated into the software project.	REQ, ANA, Customer Interface Manager, Support Manager, and Team Leader role specifications	Requirements are baselined (REQ, ANA). One of the main responsibilities of the Customer Interface Manager is to manage requirements changes. The Customer Interface Manager "leads the team in estimating and documenting impact of every requirements change." One of the Support Manager's responsibilities is change control, including "reviews all changes to controlled products," "evaluates each change for impact and benefit," and "recommends to the team which changes to make."	Partially addressed	Not applicable	The TSP does not explicitly specify a change control process or procedures.
Measurement 1 Measurements are made and used to determine the status of the activities for managing allocated requirements.	TASK, WEEK, LOGT, LOGD, and INS	Some of the measurements defined for the requirements activities include time in requirements phase, defects injected during requirements phase, requirements time in phase ratios, requirements review and inspection rates, requirements defects injection rate, requirements inspection defects removal rates, and requirements inspections phase yields.	Fully addressed	Not applicable	

Requirements Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Verification 1 The activities for managing the allocated requirements are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	An organization or a project may decide on how the available data is to be reported and reviewed.
Verification 2 The activities for managing the allocated requirements are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for managing the allocated requirements and reports the results.		The Quality Manager has overall responsibility for process and product quality. The Customer Interface Manager's principle responsibility is requirements management. Also, see global observations in Section 8.3.	Fully addressed	Partially addressed	

8.6 Software Project Planning Observations

"The purpose of Software Project Planning is to establish reasonable plans for performing the software engineering and for managing the software project" [Paulk 95].

The TSP provides detailed, specific guidance for software project planning. Teams spend several days to plan (launch) or replan (relaunch) each phase or cycle of the project. Detailed scripts, forms, templates, procedures, and guidelines guide team launches and relaunches. A launch is comprised of nine launch meetings, followed by a launch postmortem and any required team training in TSP processes and procedures. Dur-

ing the first launch meeting, the team meets with management and marketing to understand business and product goals. In the following seven meetings, the team defines, develops, and documents

- quantitative team goals
- team member roles
- development strategy
- list of the project's planned products
- conceptual design and size estimates for the planned products
- overall project schedule
- quantitative quality plan
- detailed next-phase plans for each engineer
- a balanced overall team next-phase plan
- the project's key risks

During the final launch meeting, the team meets with management and marketing to present their plan. The team asks for management approval to proceed with the plan.

A launch produces detailed, operational plans that guide individual team members in their day-to-day work, but the principal launch product is a motivated and committed team. Since the team members estimate, plan, and balance their own workloads, the team members believe in and take ownership of the plan. The commitment process is inherent in the TSP: coming out of the launch is a plan to which management, marketing, and the team have agreed and committed.

Software Project Planning Goal	Observation
Goal 1 Software estimates are documented for use in planning and tracking the software project.	TSP teams document and track software estimates using defined estimation processes. This goal is fully addressed by the TSP.
Goal 2 Software project activities and commitments are planned and documented.	TSP teams use the TSP launch process to plan and document project activities and commitments. This goal is fully addressed by the TSP.
Goal 3 Affected groups and individuals agree to their commitments related to the software project.	The role managers handle commitments from other groups and individuals. Management and marketing review the plan during a launch. The organization must determine how software engineering groups participate on proposal teams, include other groups in project planning, and make commitments to people external to the organization. This goal is partially addressed by the TSP.

Software Project Planning Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 A project software manager is designated to be responsible for negotiating commitments and developing the project's software development plan.	Role specifications, LAU1, and LAU9	The Team Leader, along with the Planning Manager, the Customer Interface Manager, and each team member, is responsible for negotiating commitments and developing the project's software development plan. Commitments are negotiated explicitly during launch meetings 1 (LAU1) and 9 (LAU 9).	Fully addressed	Fully addressed	The team as a whole is responsible for negotiating commitments.

Software Project Planning Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 2 The project follows a written organizational policy for planning a software project.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 A documented and approved statement of work exists for the software project.	LAU, PREPL, PM, PLANCL, and REVCL	The outputs of a TSP launch (LAU) include scope of the work, technical goals and objectives, identification of customers and end users, assigned responsibilities, and constraints and goals. This plan is presented to management for approval.	Fully addressed	Not applicable	
Ability 2 Responsibilities for developing the software development plan are assigned.	LAU and role specifications	The Team Leader and Planning Manager, along with the team, are responsible for developing the software development plan (SDP).	Fully addressed	Not applicable	
Ability 3 Adequate resources and funding are provided for planning the software project.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 4 The software managers, software engineers, and other individuals involved in the software project planning are trained in the software estimating and planning procedures applicable to their areas of responsibility.	PREPR and PREPL	The launch and relaunch preparation scripts (PREPR and PREPL) ensure that all participants are trained in TSP estimating and planning procedures.	Fully addressed	Not applicable	Additional training beyond the TSP may be needed for project planning.

Software Project Planning Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 1 The software engineering group participates on the project proposal team.	LAU	There are two subpractices to this key practice. Subpractice 1 requires the software engineering group's involvement in the proposal preparation and submission effort. This is outside the scope of the TSP, although the TSP could be used to create the proposal. The second subpractice calls for the software engineering group to review the project's proposed commitments. The TSP team does this during the launch.	Partially addressed	Partially addressed	The organization must decide who participates on the proposal team and what process is used to create the proposal. The TSP could be used to make software size, resource, schedule, and quality estimates for use in a proposal.
Activity 2 Software project planning is initiated in the early stages of, and in parallel with, the overall project planning.	LAU	The TSP does not explicitly state that software project planning be initiated in parallel with overall project planning. However, one of the assumptions made for these observations is that the TSP is used as early as possible in the project life cycle (Section 2, page 3). Based on this assumption, the TSP fully addresses this key practice.	Fully addressed	Not applicable	
Activity 3 The software engineering group participates with other affected groups in the overall project planning throughout the project's life.	LAU and role specifications	TSP team members participate in all project planning activities. Team members fulfilling their role responsibilities interact with other affected groups in the overall project planning activities. Management participates in launches.	Partially addressed	Not applicable	Participation of affected groups is not required in the team launch.

Software Project Planning Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 4 Software project commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.	Team Leader role specification, STATUS, WEEK, REVCL, and PLANCL	The team commitment is to the plan. The team reviews any new commitments during the weekly team meeting (WEEK). New commitments are planned for and reviewed with management, as appropriate. The Team Leader presents plan status to management on a periodic and event-driven basis (STATUS).	Fully addressed	Not applicable	
Activity 5 A software life cycle with predefined stages of manageable size is identified or defined.	LAU	The team defines and documents a development strategy during the launch. The team defines the phases and the order of work to be done.	Fully addressed	Not applicable	
Activity 6 The project's software development plan is developed according to a documented procedure.	LAU	The project plan is developed according to the procedures defined in the TSP launch scripts.	Fully addressed	Not applicable	
Activity 7 The plan for the software project is documented.	LAU, NOTEBOOK, and TSP prototype tool	The output of a TSP launch is the documented software project plan. The plan is documented in the TSP tool and TSP forms, and saved in the project notebook.	Fully addressed	Not applicable	The software development plan may need to satisfy customer- or organization-imposed standards.
Activity 8 Software work products that are needed to establish and maintain control of the software project are identified.	LAU3 and Support Manager role specification	The team develops a configuration management plan, which identifies software work products to be managed and controlled at each phase (LAU3). The Support Manager is responsible for the team's configuration management system.	Fully addressed	Not applicable	

Software Project Planning Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 9 Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure.	LAU and PSP	The top-down plan and the bottom-up plan include size estimation performed according to procedures documented in TSP and PSP scripts.	Fully addressed	Not applicable	
Activity 10 Estimates for the software project's effort and costs are derived according to a documented procedure.	LAU and PSP	Software project effort is derived from procedures documented in TSP and PSP scripts.	Partially addressed	Not applicable	The TSP does not explicitly address cost estimation.
Activity 11 Estimates for the project's critical computer resources are derived according to a documented procedure.		There are no documented procedures in the TSP for estimating critical computer resources.	Not addressed	Not applicable	
Activity 12 The project's software schedule is derived according to a documented procedure.	LAU and PSP	The software schedule is derived according to procedures documented in TSP and PSP scripts.	Fully addressed	Not applicable	
Activity 13 The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.	LAU7, LAU9, and WEEK	Risks are identified, evaluated, assigned, and presented to management during the launch (LAU7 and LAU9). Risks are tracked weekly during the team meeting (WEEK).	Fully addressed	Not applicable	

Software Project Planning Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 14 Plans for the project's software engineering facilities and support tools are prepared.	Support Manager role specification and LAU3	The Support Manager leads the team in planning for the project's software engineering facilities and support tools. The Support Plan is created in launch meeting 3 (LAU3).	Fully addressed	Not applicable	
Activity 15 Software planning data are recorded.	LAU and NOTEBOOK	Planning data are recorded for both product and process during the launch (LAU). Planning data for tasks, schedule, effort, quality, risks, and goals are recorded (NOTEBOOK).	Fully addressed	Not applicable	
Measurement 1 Measurements are made and used to determine the status of the software planning activities.	TASK, LOGT, and STATUS	Time spent in all phases is tracked, including planning (LOGT and TASK). Data on other planning activities (plan vs. actual) are also tracked (STATUS).	Fully addressed	Not applicable	
Verification 1 The activities for software project planning are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The activities for software project planning are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for software project planning, and reports the results.		The Planning Manager has the overall responsibility to help the team and team members run a well-planned and tracked project. Also, see global observations in Section 8.3.	Fully addressed	Partially addressed	

8.7 Software Project Tracking and Oversight Observations

"The purpose of Software Project Tracking and Oversight is to provide adequate visibility into actual progress so that management can take effective actions when the software project's performance deviates significantly from the software plans" [Paulk 95].

Project tracking in the TSP is based on the following principles:

- Precise project tracking requires detailed plans and accurate data.
- Accurate data is best collected and tracked by the people who perform the work, namely the software engineers.
- Accurate data must be a byproduct of the process used by the software engineers to perform their work.
- Software engineers have to be trained in disciplined methods to consistently track and collect data on their work.

During a TSP launch, detailed plans are created for each individual and for the project as a whole. Individual plans contain tasks that have been broken down to the granularity of eight to ten hours per task. Individual task plans contain at least one task starting and/or ending each week. When tasks are planned and tracked to this level of granularity, project status is never more than a week out of date. Individuals track their plans daily. Teams track plans at least weekly. Dynamic replanning and load rebalancing takes place during weekly meetings and at the individual level. Major replanning occurs during team relaunches.

Software Project Tracking and Oversight Goal	Observation
Goal 1 Actual results and performances are tracked against the software plans.	A TSP team tracks actual results and performance against plans on a weekly basis. Team members track progress against individual plans on a daily basis. This goal is fully addressed by the TSP.
Goal 2 Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the software plans.	TSP teams make small adjustments to plans dynamically on a weekly basis to minimize deviation between actual results and the plan. When the deviation is significant, the teams go through a relaunch to replan their work. This goal is fully addressed by the TSP.

Software Project Tracking and Oversight Goal	Observation
Goal 3 Changes to software commitments are agreed to by the affected groups and individuals.	The TSP Team Leader and Customer Interface Manager roles communicate changes to software commitments among management, customer, and team members. This goal is fully addressed by the TSP.

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 A project software manager is designated to be responsible for the project's software activities and results.	Role specifications	The Team Leader is designated as the project software manager with overall responsibility. Each role description charges the individual team members with being responsible for their own activities. On TSP multi-teams, the team of Team Leaders and the lead of the Team Leader team are responsible for the overall project.	Fully addressed	Fully addressed	
Commitment 2 The project follows a written organizational policy for managing the software project.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 A software development plan for the software project is documented and approved.	NOTEBOOK and LAU	The software development plan created in the launch is documented and is approved by management (LAU). The plan is documented in the team notebook (NOTEBOOK).	Fully addressed	Not applicable	Teams may have to modify the SDP created during a TSP launch to conform to organization or customer standards.

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 2 The project software manager explicitly assigns responsibility for software work products and activities.	LAU and WEEK	During a TSP launch (LAU), the team cooperatively distributes tasks and other planned activities among specific team members. During weekly team meetings (WEEK), the team members make sure that the work is balanced among team members. Rebalancing takes place as needed.	Fully addressed	Not applicable	This is an alternate practice because the team, not the project manager, assigns responsibility for work products and activities.
Ability 3 Adequate resources and funding are provided for tracking the software project.		The TSP launch produces an adequately staffed and resourced project, including assignments for tracking the project (mainly the Team Leader and Planning Manager, but the entire team contributes). See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 4 The software managers are trained in managing the technical and personnel aspects of the software project.	PREPR, PREPL, and LAU	The launch and relaunch preparation scripts (PREPL and PREPR) include training in TSP project planning, tracking, and team building for all levels of management. The launch (LAU) gives all team members an opportunity to participate in planning a project under the mentorship of a launch coach.	Fully addressed	Not applicable	Additional training in project management and managing personnel may be required to satisfy organization requirements.
Ability 5 First-line software managers receive orientation in the technical aspects of the software project.	LAU, PREPR, PREPL	The Team Leader participates fully in the launch process (LAU) and the preparations for the launch (PREPL or PREPR). This provides detailed exposure to technical aspects of the project. The Team Leader knows the conceptual design of the product, the technical tasks to be performed, the technical risks, and all other technical aspects of the project.	Fully addressed	Not applicable	

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 1 A documented software development plan is used for tracking the software activities and communicating status.	LAU, WEEK, STATUS, MTG, STATUS, PLANCL, REVCL, and NOTEBOOK	The launch process (LAU) produces this plan (NOTEBOOK). Weekly meetings track status against the plan (WEEK). Management reports and meetings ensure that management is aware of project status (STATUS, PLANCL, and REVCL).	Fully addressed	Not applicable	
Activity 2 The project's software development plan is revised according to a documented procedure.	REL, LAU6, role specifications, and WEEK	Teams replan at the end of a phase or a cycle, when plans don't reflect activities, when requirements change, or when resources change (REL). The team workload is balanced in launch meeting 6 (LAU6). Minor replanning occurs as needed in response to changing conditions, usually under the direction of specific role managers (WEEK and role specifications).	Fully addressed	Not applicable	
Activity 3 Software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.	Role specifications, STATUS, and REVCL	The Team Leader communicates with senior management according to the STATUS specification. Executives review the project periodically (REVCL).	Fully addressed	Fully addressed	
Activity 4 Approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups.	Role specifications, WEEK, MTG form	The Team Leader communicates changes specified by management to the team (WEEK, MTG). The Customer Interface Manager communicates changes specified by the customer to the team.	Partially addressed	Partially addressed	The TSP does not explicitly address other software-related groups, although role manager responsibilities include communication with other groups.

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 5 The size of the software work products (or size of the changes to the software work products) is tracked, and corrective actions are taken as necessary.	SUMS, Role specifications, WEEK, and NOTEBOOK	Software sizes, both estimated and actual, are recorded on SUMS. Role managers and team members report problems during weekly team meetings (WEEK). Plans are adjusted to reflect deviations in size. Role managers track the size of work products related to their roles. Results of corrective actions are reflected in the NOTEBOOK.	Fully addressed	Not applicable	
Activity 6 The project's software effort and costs are tracked, and corrective actions are taken as necessary.	WEEK, role specifications, and STATUS	Weekly meetings document software effort and any corrective actions assigned/performed by team members (WEEK). The Team Leader reports any unresolved problems to management (STATUS). Results of corrective actions are reflected in the NOTEBOOK.	Partially addressed	Not applicable	The TSP does not address tracking of other costs beside effort.
Activity 7 The project's critical computer resources are tracked, and corrective actions are taken as necessary.		The TSP does not explicitly address tracking of critical computer resources.	Not addressed	Not applicable	
Activity 8 The project's software schedule is tracked, and corrective actions are taken as necessary.	WEEK, role specifications, STATUS, and NOTEBOOK	The Planning Manager leads in identifying schedule problems. The weekly team meeting documents status and any decisions, actions, or results (WEEK). The Team Leader reports any unresolved problems to management (STATUS). Results of corrective actions are reflected in the NOTEBOOK.	Fully addressed	Not applicable	

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 9 Software engineering technical activities are tracked, and corrective actions are taken as necessary.	TASK, WEEK, role specifications, STATUS, and NOTEBOOK	Team members track individual technical activities (TASK). The Design and Implementation Managers track overall technical activities. Technical issues are discussed in the weekly team meeting (WEEK). The Team Leader reports any unresolved problems to management (STATUS). Results of corrective actions are reflected in the NOTEBOOK.	Fully addressed	Not applicable	
Activity 10 The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked.	WEEK, STATUS, NOTEBOOK, and IRTL	Risks are tracked at every weekly meeting (WEEK and IRTL) and reported to management (STATUS). Results of corrective actions are reflected in the NOTEBOOK.	Fully addressed	Not applicable	
Activity 11 Actual measurement data and replanning data for the software project are recorded.	LOGT, LOGD, SUMS, TASK, WEEK, MTG, NOTEBOOK, and SUMMARY	Team members record actual data on a daily basis (LOGT, LOGD, SUMS, and TASK). Team member data is consolidated weekly to get the team's actual data (WEEK, MTG, NOTEBOOK, and SUMMARY).	Fully addressed	Not applicable	
Activity 12 The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.	WEEK, MTG, NOTEBOOK, role specifications, REVCL, PM, and REL	The project team meets weekly (WEEK). The Team Leader is responsible for reporting status against plan outside the team (STATUS). Detailed management review is conducted quarterly (REVCL). Status is also reviewed during phase postmortems and during team relaunches (REL).	Fully addressed	Not applicable	

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 13 Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.	STATUS, PM, SUMMARY, PLANCL, and REVCL	Periodic reviews are conducted according to STATUS. Projects are summarized according to SUMMARY. Quarterly executive reviews are conducted according to REVCL. Plans produced during launches are reviewed according to PLANCL. Phase or cycle data is collected and analyzed during a phase or cycle postmortem (PM).	Fully addressed	Not applicable	
Measurement 1 Measurements are made and used to determine the status of the software tracking and oversight activities.	WEEK and NOTEBOOK	Changes to size estimates, effort estimates, and schedule are recorded weekly.	Fully addressed	Not applicable	
Verification 1 The activities for software project and tracking are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The activities for software project tracking and oversight are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	

Software Project Tracking and Oversight Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for software project tracking and oversight and reports the results.		The Planning Manager is responsible for tracking project status, resolving issues with team members, and elevating unresolved issues to the Team Leader. Also, see global observations in Section 8.3.	Fully addressed	Partially addressed	

8.8 Software Subcontract Management

"The purpose of Software Subcontract Management is to select qualified software subcontractors and manage them effectively" [Paulk 95].

The TSP does not address the Software Subcontract Management (SSM) KPA. Requiring subcontractors to have detailed plans, detailed measures, frequent data-based reviews, and quality levels similar to those produced by the TSP is one method to ensure receiving quality products on time and within cost.

8.9 Software Quality Assurance Observations

"The purpose of Software Quality Assurance is to provide management with appropriate visibility into the process being used by the software project and of the products being built" [Paulk 95].

Adherence to process and product quality is addressed in multiple ways in the TSP. TSP teams are self-directed, and are responsible for both their product and process quality. TSP teams use data to assure quality. The Quality Manager role on a TSP team has overall responsibility for both process and product quality. Other role managers monitor quality for their particular areas of responsibilities. Role managers try to resolve non-compliance issues with team members and the Team Leader.

Objectivity is built in because process and product quality are tracked through data. Objectivity is also promoted through the TSP checkpoint process. An SEI-authorized TSP launch coach periodically conducts the TSP checkpoint. The launch coach is usually not a team member. During this one- to two-day checkpoint, the launch coach analyzes team data. The coach also meets with team members, the Team Leader, and management to determine process fidelity to the team's processes, and to determine the quality of products being produced. The Team Leader is advised to work with the role managers to understand and determine how to fix issues identified in checkpoints. The Team Leader, role managers, and other team members are then advised to create an action plan to address issues identified during a checkpoint, and review the plan with management.

Note that the SW-CMM does not require independent SQA, just objective SQA. The TSP addresses the requirement for objectivity by the pervasive use of data to monitor product and process quality, and by the independent checkpoint process. The TSP does not address escalation of non-compliance issues to senior management.

An organization must decide how it wants to address the SQA function: either an external group conducts SQA, or the TSP teams do so, or a combination of both. Regardless of the existence of an external SQA group, all TSP teams, led by the team Quality Manager, perform some SQA functions, such as planning and tracking process and product quality, analyzing team data for trends, and taking corrective actions.

The observations for this KPA assume that the TSP team is working in an organization with no external SQA group. If the organization includes an independent SQA group, and that group is not using the TSP, then these observations may not be valid. Note that the TSP encourages the use of an external SQA group with independent audit and escalation processes. Humphrey discusses how TSP teams can coordinate and work with external SQA groups.[3]

[3] This information comes from a draft version of *Leading and Coaching Disciplined Teams Using the Team Software Process*[SM] *(TSP*[SM]*)* written by Watts Humphrey.

Software Quality Assurance Goal	Observation
Goal 1 Software quality assurance activities are planned.	Teams create a quality plan during the team launch. This goal is fully addressed by the TSP.
Goal 2 Adherence of software products and activities to the applicable standards, procedures, and requirements is verified objectively.	TSP teams analyze product and process data to objectively verify product and process quality. Adherence to standards is verified during inspections. The TSP checkpoint process is also used for objective verification. This goal is fully addressed by the TSP.
Goal 3 Affected groups and individuals are informed of software quality assurance activities and results.	The team collectively plans and tracks its quality assurance activities. It collects data, analyzes them, and takes corrective action as needed. The team shares status of its activities with management and with the customer. This goal is fully addressed by the TSP.
Goal 4 Noncompliance issues that cannot be resolved within the software project are addressed by senior management.	TSP teams resolve any noncompliance issues identified by the Quality Manager, the Team Leader, any team member, or during a TSP checkpoint. There is no escalation process defined in the TSP. This goal is partially addressed by the TSP.

Software Quality Assurance Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for implementing software quality assurance (SQA).		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 A group that is responsible for coordinating and implementing SQA for the project (i.e., the SQA group) exists.	Quality Manager and Team Member role specifications	The team, led by the Quality Manager and other role managers, is responsible for its own software quality assurance activities.	Fully addressed	Partially addressed	The organization may also include an SQA group independent of TSP teams.
Ability 2 Adequate resources and funding are provided for performing the SQA activities.		There is built-in support in the TSP for all team members to plan, manage, and track personal quality, and for the Team Leader and Quality Manager to track team quality. See global observations in Section 8.3.	Fully addressed	Partially addressed	Funding for an SQA group not using the TSP is outside the scope of the TSP.

Software Quality Assurance Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 3 Members of the SQA group are trained to perform their SQA activities.	PREPL, PREPR, and LAU	TSP team members, as well as managers, are trained in how to plan, manage, and track product and process quality (PREPL and PREPR). The TSP places a lot of emphasis on quality from the beginning. Key metrics are defined to track quality from day one of the project. During a launch (LAU), the team identifies and plans for any specific training needs. Management approves the plan, including the training needs identified in the plan.	Fully addressed	Partially addressed	If the organization has an SQA group not using the TSP, training for this is outside the scope of the TSP.
Ability 4 The members of the software project receive orientation on the role, responsibilities, authority, and value of the SQA group.	PREPR, PREPL, LAU, Team Leader, Quality Manager, and Team Member role descriptions	The TSP team members, as well as managers, are trained in how to plan, manage, and track project quality.	Partially addressed	Not applicable	The TSP does not address other members of the software project, unless these groups are members of TSP teams.
Activity 1 An SQA plan is prepared for the software project according to a documented procedure.	Role specifications, LAU, SUMQ, and TASK	A quality plan is created during the team launch (LAU and SUMQ). The team collects metrics and tracks against this plan weekly. The Quality Manager and the Team Leader focus on quality. Personal reviews, team inspections, and TSP checkpoints are planned (TASK).	Fully addressed	Not applicable	
Activity 2 The SQA group's activities are performed in accordance with the SQA plan.	SUMQ, TASK, and WEEK	The team performs its activities according to its quality plan and task plan. Quality tasks are recorded and tracked on form TASK. Quality metrics are tracked on form SUMQ. The Quality Manager reports on quality activities during role reports of weekly meetings (WEEK).	Fully addressed	Not applicable	

Software Quality Assurance Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 3 The SQA group participates in the preparation and review of the project's software development plan, standards, and procedures.	LAU and INS	Since the team is responsible for quality, and the team creates the project plan (LAU), this is implied. Standards and procedures developed by the team and inspected (INS) by the team.	Fully addressed	Not applicable	
Activity 4 The SQA group reviews the software engineering activities to verify compliance.	Role specifications, LAU, WEEK, INS, and SUMQ	Since the team performs both engineering and quality assurance activities (LAU and WEEK), and the Quality Manager reviews quality metrics and activities weekly (WEEK and INS), this is implied.	Fully addressed	Not applicable	
Activity 5 The SQA group audits designated software work products to verify compliance.		Although the TSP calls for a periodic checkpoint, audits of designated software work products to verify compliance are not specified.	Not addressed	Not applicable	
Activity 6 The SQA group periodically reports the results of its activities to the software engineering group.	Quality Manager role specification, and WEEK	The team performs both engineering and quality assurance activities. The Quality Manager reports weekly on the quality of the team products and processes.	Fully addressed	Not applicable	
Activity 7 Deviations identified in the software activities and software work products are documented and handled according to a documented procedure.	Role specifications, WEEK, and INS	The standard method of handling deviations is to address them during the role reports in the weekly team meetings (WEEK), and during team inspections (INS).	Partially addressed	Not applicable	Escalation of noncompliance issues to senior management is not addressed by the TSP.

Software Quality Assurance Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 8 The SQA group conducts periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate.	STATUS	The team reviews its status with the customer (STATUS).	Partially addressed	Not applicable	Reviews with customer SQA are not explicitly specified in the TSP.
Measurement 1 Measurements are made and used to determine the cost and schedule status of the SQA activities.	LOGT, LOGD, TASK, and PM	Teams track time spent in quality activities (LOGT and TASK), and log defects identified (LOGD). Specific postmortem activities are also planned and tracked (PM).	Fully addressed	Not applicable	
Verification 1 The SQA activities are reviewed with senior management on a periodic basis.		The team reviews its quality status with management. See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The SQA activities are reviewed with the project manager on both a periodic and event-driven basis.		The team reviews its quality status with management. See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 Experts independent of the SQA group periodically review the activities and software work products of the project's SQA group.	TSP checkpoint	An authorized TSP launch coach usually performs the TSP checkpoint. The launch coach is not a team member.	Fully addressed	Not applicable	

8.10 Software Configuration Management Observations

"The purpose of Software Configuration Management is to establish and maintain the integrity of the products of the software project throughout the project's software life cycle" [Paulk 95].

The Software Configuration Management (SCM) KPA addresses the need for projects to control the configuration of their work products. The products placed under configuration management may include both customer deliverable products and non-deliverable products. Projects plan their SCM activities, identify the work products to be placed under configuration management, define methods to control changes to the identified work products, and ensure that the status and content of software baselines are reported.

During a TSP launch, teams identify and plan for any missing project processes or procedures. Specific guidance is provided to ensure that change control and change management procedures are defined. The TSP relies on a configuration management system through all phases of a project life cycle. Teams identify work products to be baselined during the launch. Process scripts for requirements, high-level design, implementation, and test activities identify work products to be baselined and/or put under change control. Membership in the Configuration Control Board (CCB) is determined during the launch. The Support Manager role on the team has the responsibility for configuration management and for change control, and has a leadership role on the CCB. The Support Manger is expected to be familiar with the configuration management system, or is given the responsibility for becoming familiar with it. The Support Manager is also responsible for making sure that the team members know how to use the configuration management system.

The TSP does not include procedures for change control, configuration management, build and release, or baseline audits. Teams are expected to plan to develop these procedures if they do not already exist in their organization. If TSP teams operate in an organization where SCM processes and procedures exist, they plan on using these processes or procedures. Otherwise, their plan includes definition and deployment of SCM processes. The TSPi [Humphrey 00] includes processes for change control and configuration management. Most TSP teams use or modify these processes in the absence of existing SCM processes.

The observations for this KPA assume that the TSP team is responsible for its own software configuration management. If the teams are working in an organization where an external SCM group exists, and that group is not using the TSP, these observations may not be valid.

Software Configuration Management Goal	Observation
Goal 1 Software configuration management activities are planned.	Teams plan configuration management activities during the team launch. This goal is fully addressed by the TSP.
Goal 2 Selected software work products are identified, controlled, and available.	Items to be baselined are identified during the launch, and are controlled during phase or cycle activities. The TSP does not include actual change control procedures. This goal is partially addressed by the TSP.
Goal 3 Changes to identified software work products are controlled.	The TSP requires that changes to identified software work products are controlled. The TSP does not include actual change control procedures. This goal is partially addressed by the TSP.
Goal 4 Affected groups and individuals are informed of the status and content of software baselines.	This goal is not addressed by the TSP.

Software Configuration Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for implementing software configuration management (SCM).		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 A board having the authority for managing the project's software baselines (e.g., a software configuration control board – SCCB) exists or is established.	LAU3 and role specifications	The launch coach leads the team in identifying membership of CCB (LAU3). The Support Manager is the suggested role for CCB chair (role specification). Other roles suggested for participation in the CCB are Design Manager, Team Leader, and Customer Interface Manager.	Fully addressed	Not applicable	
Ability 2 A group that is responsible for coordinating and implementing SCM for the project (e.g., the SCM group) exists.	LAU3 and Support Manager role specification	Team identifies any needed process and tool support, specifically for configuration management during the launch (LAU3). The Support Manager role is specifically charged with change control and configuration management on the project. The team is responsible for SCM.	Fully addressed	Not applicable	
Ability 3 Adequate resources and funding are provided for performing the SCM activities.		See global observations in Section 8.3.	Fully addressed	Fully addressed	

Software Configuration Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 4 Members of the SCM group are trained in the objectives, procedures, and methods for performing their SCM activities.	Team Leader and Support Manager role specifications	The Team Leader is responsible for ensuring that team members are adequately trained to do their jobs. The Support Manager is specifically responsible for ensuring adequate training for configuration management tasks.	Fully addressed	Partially addressed	If the organization has A SCM group not using the TSP, training for this group beyond the scope of the TSP.
Ability 5 Members of the software engineering group and other software-related groups are trained to perform their SCM activities.	Support Manager role specification	The Support Manager ensures that team members are familiar with support tools and, if necessary, are trained in their use.	Fully addressed	Not applicable	
Activity 1 A SCM plan is prepared for each software project according to a documented procedure.	LAU3	During a launch, the team creates a process plan that addresses change control and change management procedures (LAU3). The team also creates a support plan, which addresses configuration management.	Partially addressed	Not applicable	The TSP does not include a documented procedure for preparing A SCM plan.
Activity 2 A documented and approved SCM plan is used as the basis for performing the SCM activities.	WEEK and TASK	The team performs its activities according to its plan. Tasks are recorded and tracked on form TASK and reported on form WEEK.	Partially addressed	Not applicable	The TSP does not explicitly address approval of the SCM plan.
Activity 3 A configuration management library system is established as a repository for the software baselines.	Support Manager role specification, and LAU3	"The Support Manager obtains and manages the team's configuration management system" and "maintains a protected master copy of all controlled items." The support plan includes tools, facilities, and resources for configuration management (LAU3).	Fully addressed	Not applicable	

Software Configuration Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 4 The software work products to be placed under configuration management are identified.	LAU3, DEV, MAINT, HLD, and IMP	Items to be baselined are identified during the launch (LAU3). Phase scripts also identify what work products should be baselined, and when (DEV, MAINT, HLD, and IMP).	Fully addressed	Not applicable	
Activity 5 Change requests and problem reports for all configuration items/units are initiated, recorded, reviewed, approved, and tracked according to a documented procedure.	Support Manager role specification, LAU3, and LAU4	The TSP does not contain a change control process. TSP teams plan on creating this process if it does not exist at the organization level (LAU3). The Support Manager role is responsible for SCM procedures and processes (LAU4 and role specification).	Partially addressed	Not applicable	The TSP does not include a documented procedure for handling change requests and problem reports.
Activity 6 Changes to baselines are controlled according to a documented procedure.	LAU3, LAU4, REQ, HLD, IMP, and TEST	During a launch (LAU3 and LAU4), TSP teams plan on defining change control and change management procedures (referenced by the phase scripts), if they do not exist.	Partially addressed	Not applicable	The TSP does not include a procedure for controlling changes to the baseline.
Activity 7 Products from the software baseline library are created and their release is controlled according to a documented procedure.	TEST	The TEST scripts call for making a build plan and releasing the product(s) according to the plan.	Partially addressed	Not applicable	The TSP does not include a documented procedure for building and releasing products.
Activity 8 The status of configuration items/units is recorded according to a documented procedure.	Support Manager role specification	The Support Manager responsibilities include configuration status.	Partially addressed	Not applicable	The TSP does not include a documented procedure for recording configuration status.

Software Configuration Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 9 Standard reports documenting the SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals.		The TSP does not address SCM status reports.	Not addressed	Not applicable	
Activity 10 Software baseline audits are conducted according to a documented procedure.			Not addressed	Not applicable	
Measurement 1 Measurements are made and used to determine the status of the SCM activities.	TASK and WEEK	TSP teams use measurements to track the status of all activities in their plans (TASK). Once A SCM plan has been developed, the team will track estimated versus actual effort on SCM activities and completion of any milestones associated with SCM activities (WEEK).	Partially addressed	Not applicable	As noted previously, the TSP asks teams to develop A SCM plan but does not specify procedures to do so.
Verification 1 The SCM activities are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The SCM activities are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	

Software Configuration Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Verification 3 The SCM group periodically audits software baselines to verify that they conform to the documentation that defines them.		The TSP does not address audits of software baselines.	Not addressed	Not applicable	
Verification 4 The software quality assurance group reviews and/or audits the activities and work products for SCM and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.11 Organization Process Focus Observations

"The purpose of Organization Process Focus is to establish the organizational responsibility for software process activities that improve the organization's overall software process capability" [Paulk 95].

OPF calls for the organization to establish a group that is responsible for long-term process improvement efforts. This group is most commonly referred to as the Software Engineering Process Group (SEPG). The SEPG is responsible for planning, developing, and maintaining the software processes to be used by projects in the organization. Specifically, the SEPG is responsible for developing and maintaining the organization's process improvement plan, the organization's standard software process (OSSP) and other software process assets, the organization's software process database (OSPD), and for training the organization in the use of the OSSP.

If all projects in an organization are using the TSP, and the organization has adopted the standard TSP introduction strategy, then the goals of coordinating and planning software process improvement activities are largely addressed at the project level. However, some process improvement activities at the organization level are not addressed by the TSP. Some examples of such activities would be organization-wide con-

figuration management, subcontract management, training program, cross-project data analysis, and technology change management. Overall, the focus of this KPA is at the organization level, not at the project level. The TSP mainly enables the key practices of this KPA.

Specifically, the TSP supports an organization-wide SEPG in the following ways:

- The Process Manager role on teams using the TSP is the natural project liaison to the SEPG.
- During a TSP launch, teams identify the processes that they will need to guide the work they will perform. If organizational processes already exist, the teams use them. However, if the processes do not exist, the teams plan to develop these processes themselves or they provide requirements to the SEPG to develop these processes. The people who will immediately use a process specify the requirements for that process. This promotes ownership and commitment to the process once it has been developed.

The TSP introduction strategy includes training for executives, managers, software developers, and everyone else who will be participating in or managing a TSP team. Since most projects in the organization will be using the TSP, training in the TSP addresses a majority of the process training requirements for the organization.

Organization Process Focus Goal	Observations
Goal 1 Software process development and improvement activities are coordinated across the organization.	The TSP provides the main process elements and architecture of the OSSP. The TSP introduction strategy coordinates some process development and improvement activities across the organization. To fully satisfy this goal, other process improvement activities besides the TSP would have to be coordinated across the organization. The entire KPA is an organizational issue. The organization has to decide who besides the TSP Process Managers and TSP launch coaches will be responsible for coordinating, planning, and developing organizational processes. This goal is partially addressed by the TSP.
Goal 2 The strengths and weaknesses of the software processes used are identified relative to a process standard.	The TSP does not address software process assessments.

Goal 3 Organization-level process development and improvement activities are planned.	The TSP introduction strategy includes planning for introduction of the TSP into an organization. TSP teams plan to build the process elements needed by the teams. TSP teams also plan to address Process Improvement Proposals (PIPs) generated throughout the project life cycle, and specifically during the postmortem of the project. Although the introduction and adoption of the TSP is planned, other software process development and improvement activities across the organization may be beyond the scope of the TSP. This goal is partially addressed by the TSP.

Organization Process Focus Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The organization follows a written organizational policy for coordinating software process development and improvement activities across the organization.		See global observations in Section 8.3.	Not applicable	Not addressed	
Commitment 2 Senior management sponsors the organization's activities for software process development and improvement.	TSP introduction strategy, PREPL, PREPR, and LAU	Senior management is required to participate in a TSP executive seminar and planning workshop, other management training, launches, and project reviews. Substantial investment in training the software engineers and supporting staff is required to introduce the TSP.	Not applicable	Partially addressed	The TSP relies on management sponsorship for process improvement areas not fully addressed by the TSP (SCM, SQA, SSM, training program, etc.).
Commitment 3 Senior management oversees the organization's activities for software process development and improvement.	LAU, STATUS, and REVCL	Management involvement in the introduction, launch, status tracking, and project reviews is required. All involve process improvement.	Not applicable	Partially addressed	

Organization Process Focus Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 1 A group that is responsible for the organization's software process activities exists.	Process Manager role specification, and LAU3	TSP teams have a Process Manager role that fulfills some of the functions of the SEPG (LAU3). TSP multi-teams have a Process Manager team, comprised of Process Managers from each of the sub-teams. This Process Manager team is responsible for the overall process needs of the multi-team project.	Not applicable	Partially addressed	The organization must decide how to organize a group responsible for the organization's software process improvement activities, supported by TSP team Process Managers and launch coaches.
Ability 2 Adequate resources and funding are provided for the organization's software process activities.	LAU, PM, DEV, and MAINT	TSP projects plan for resources and funding for project-level process activities, including any requirements the organization has for the projects.	Not applicable	Partially addressed	Resources and funding for process activities beyond the project are not addressed by the TSP.
Ability 3 Members of the group responsible for the organization's software process activities receive required training to perform these activities.	TSP introduction strategy, PREPL, and PREPR	The TSP introduction strategy includes extensive training in the TSP and the PSP for all levels of an organization.	Not applicable	Partially addressed	Training beyond the TSP and the PSP is not addressed.
Ability 4 Members of the software engineering group and other software-related groups receive orientation on the organization's software process activities and their roles in those activities.	TSP introduction strategy, PREPL, PREPR, and LAU	The TSP introduction strategy ensures training and orientation for all levels of an organization (executive, management, and team member). The launches, relaunches, and checkpoints ensure that project teams and management are kept up to date with project software process activities.	Not applicable	Partially addressed	The TSP does not address orientation in non-TSP processes.
Activity 1 The software process is assessed periodically, and action plans are developed to address the assessment findings.		The TSP does not address software process assessments.	Not applicable	Not addressed	

Organization Process Focus Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 2 The organization develops and maintains a plan for its software process development and improvement activities.	TSP introduction strategy, PREPL, PREPR, LAU, and PM	The TSP introduction strategy includes a planning phase for introducing and monitoring the TSP in an organization. This plan does not address non-TSP-related activities. Project teams plan for their own process development and improvement activities during team launches and postmortems.	Not applicable	Partially addressed	The TSP does not address process improvement plans beyond the project level.
Activity 3 The organization's and projects' activities for developing and improving their software processes are coordinated at the organization level.	TSP introduction strategy, PREPL, PREPR, and LAU	TSP introduction and usage is coordinated at the organization level.	Not applicable	Partially addressed	Coordination beyond the introduction of TSP is not addressed at the organization level.
Activity 4 The use of the organization's software process database is coordinated at the organizational level.	SUMP, SUMS, and SUMQ	The TSP defines common measures and coordinates them at the project level.	Not applicable	Partially addressed	The TSP does not address an organization-level process database. TSP teams use defined and measured processes that generate metrics to populate an organization's software process improvement database. Since all TSP teams use the same planning and tracking metrics, the use of common metrics across projects is greatly simplified.
Activity 5 New processes, methods, and tools in limited use in the organization are monitored, evaluated, and, where appropriate, transferred to other parts of the organization.	Role specifications	TSP multi-teams share and transfer new processes, methods, and tools. Each role manager team is responsible for doing this for its particular area of concern.	Not applicable	Partially addressed	Parts of the organization beyond the project level are not addressed.

Organization Process Focus Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 6 Training for the organization's and projects' software processes is coordinated across the organization.	TSP introduction strategy, PREPL, PREPR, and LAU	The TSP introduction strategy plans, tracks, and implements training in the TSP for all levels of an organization: executive, management, software engineers, and other software related groups (PREPL and PREPR). During a launch, teams plan for the training that they require for doing their work (LAU).	Not applicable	Partially addressed	Coordination of training across the organization beyond the PSP and the TSP is not addressed.
Activity 7 The groups involved in implementing the software processes are informed of the organization's and projects' activities for software process development and improvement.	PREPL, PREPR, LAU, role specifications, WEEK, and PM	Teams plan, track, and improve their process activities so they are well informed. The Process Managers also report weekly on role activities thus informing the team on the status of process activities.	Partially addressed	Partially addressed	There may be groups in the organization involved in implementing processes that don't use the TSP (e.g., SQA, SCM, SEPG, and training group). Informing these groups is beyond the scope of the TSP.
Measurement 1 Measurements are made and used to determine the status of the organization's process development and improvement activities.	PM	During the team postmortem (PM), the team determines the status of process improvement activities. Teams plan their process development activities and then track the plan.	Not applicable	Partially addressed	Projects measure the status of their process development and improvement activities. These measures can serve as an input to measure the status of the organization's process development and improvement activities. But, the organization-level measures are not fully supported.
Verification 1 The activities for software process development and improvement are reviewed with senior management on a periodic basis.	STATUS, LAU, and REVCL	The TSP calls for periodic review of project status with management. The status includes metrics and narrative for project processes as well as product quality.	Not applicable	Partially addressed	See notes for Measurement 1.

8.12 Organization Process Definition Observations

"The purpose of Organization Process Definition is to develop and maintain a usable set of software process assets that improve process performance across the projects and provide a basis for cumulative, long-term benefits to the organization" [Paulk 95].

OPD calls for development of a standard software process to be tailored and used by projects across the organization. OPD also calls for information on the use of the process to be collected from projects and made available for use across the organization.

When organizations adopt the TSP they participate in PSP and TSP training for all levels of the organization. The training includes procedures and standards to be used in the development of process descriptions (scripts), role specifications, and standards. Most organizations adopting the TSP also adopt the TSP standards for developing, maintaining, and documenting process elements. The TSP and the PSP also include a broad category of processes. (See Section 8.4.) Since TSP projects use these processes, the processes by default become part of the organization's standard software process (OSSP).

Projects using the TSP define the set of processes that they will use to do their work. During a launch, TSP teams list each type of product that they have to produce (code, documentation, test software, requirements, etc.). For each type of product that they have to produce, the teams first determine if an organizational process exists that they can use as is, or one that can be tailored to conform to TSP criteria for a quality process. If an organizational process does not exist, the teams use existing TSP processes, define processes during the launch, or plan to define the processes after the launch. Projects using the TSP collect and analyze a standard set of project planning, product quality, and process quality metrics.

Organization Process Definition Goal	Observation
Goal 1 A standard software process for the organization is developed and maintained.	Project teams develop and maintain their own processes, which are supplied to a large degree by the TSP. The organization's standard software process will include other processes besides the ones developed at the project level. Examples include subcontract management, change control, training program, and engineering processes. These are not addressed by the TSP. This goal is partially addressed by the TSP.

Goal 2 Information related to the use of the organization's standard software process by the software projects is collected, reviewed, and made available.	Projects collect, review, and use metrics and other information related to the use of their processes. An organization-level function that makes this information available for use by projects across the organization is beyond the scope of the TSP. This goal is partially addressed by the TSP.

Organization Process Definition Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The organization follows a written policy for developing and maintaining a standard software process and related process assets.		See global observations in Section 8.3.	Not applicable	Not addressed	
Ability 1 Adequate resources and funding are provided for developing and maintaining the organization's standard software process and related process assets.	At least 30 scripts, 23 forms, and 6 standards for the team (see Section 8.4) are supplied by the TSP. More scripts, standards, and forms are available in the PSP, TSP-M, TSP-D, and TSP-F.	The TSP supplies a majority of the content of the Organization's Standard Software Process (OSSP). TSP teams plan and develop processes needed by the team to perform their work. Management approves the plan, thus providing resources and funding. These processes are also candidate process elements for the OSSP.	Not applicable	Partially addressed	This key practice requires resources and funding for an organization-level function that is beyond the scope of the TSP.
Ability 2 The individuals who develop and maintain the organization's standard software process and related process assets receive required training to perform these activities.	TSP introduction strategy, PREPL, and PREPR	The organization receives training in the PSP, including training in process development.	Not applicable	Partially addressed	Training for processes developed at the organization level by teams who may not be using the TSP is beyond the scope of the TSP.

Organization Process Definition Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 1 The organization's standard software process is developed and maintained according to a documented procedure.	All TSP and PSP process elements, and PIP	All processes on TSP teams are developed using a common standard, and are revised based on Process Improvement Proposals.	Not applicable	Partially addressed	Processes developed by organization-level teams not using the TSP are beyond the scope of the TSP. It should be noted that the TSP addresses Activity 1 and Activity 2 of this KPA differently than described in the SW-CMM. Projects in an organization adopt the TSP as their standard process. They abstract it to the organization level where needed. They adopt the TSP documentation standards for developing scripts; thus, the organization standard becomes the TSP standard.
Activity 2 The organization's standard software process is documented according to established organization standards.	All TSP and PSP process elements	All TSP scripts follow a standard: Purpose, Entry Criteria, General Comments, Steps, and Exit Criteria.	Not applicable	Not addressed	Organizational standards are beyond the scope of the TSP, although the organization may choose to adopt the TSP standard. (See note for Activity 1.)
Activity 3 Descriptions of software life cycles that are approved for use by the projects are documented and maintained.	LAU	Teams determine the product development strategy, based on business needs and customer needs presented to them by senior management and customer representatives during the launch. If the customers require the team to use a particular life-cycle model, the team plan reflects the life-cycle model. Once the team has planned a development strategy, it is presented to management and customer representatives for approval.	Not applicable	Fully addressed	The TSP handles the issue of life cycles differently than this key practice describes (see observation). However, the intent is satisfied in that projects use the life cycle that best fits their needs, and that both their customer and their management approve.

Organization Process Definition Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 4 Guidelines and criteria for the projects' tailoring of the organization's standard software process are developed and maintained.	LAU3	The TSP launch includes a tailoring process, during which a team develops the defined process that it will be using to do its work. Specifically, during launch meeting 3, the team defines a development process and documents it. The LAU3 script provides guidelines for developing and documenting the project development process.	Not applicable	Partially addressed	The organization may need guidelines and criteria for tailoring the organization's standard software process that are not included in the TSP.
Activity 5 The organization's software process database is established and maintained.	DEFECT, INS, LOGD, LOGT, SCHED, SUMP, SUMQ, SUMS, SUMT, TSP prototype tool, TSP and PSP measures defined in *A Discipline for Software Engineering*, as well as the *Launch Coach Guidebook* manuscript, all role specifications	Team members log and track process and product quality data, as well as schedule data, on a continuous basis. Personal data is consolidated into team data. This helps to track team performance, and helps to filter sensitive personal data. The TSP defines and provides the measures input into the OPD. It also defines the measures extracted from an OPD to be used by projects for planning purposes. This set of measures is defined in the TSP planning and quality guidelines. The Quality Manager, Process Manager, Planning Manager, and Team Leader roles track the team's data to ensure validity, accuracy, completeness, and consistency.	Not applicable	Partially addressed	The mechanics or responsibility for ensuring that team data are categorized, reviewed, and added to the OPD are not addressed by the TSP.
Activity 6 A library of software process-related documentation is established and maintained.	NOTEBOOK, STATUS, SUMMARY, TSP and PSP process elements	The TSP provides a variety of project artifacts to be included in an organization's process related library.	Not applicable	Partially addressed	The TSP does not address collection of, review of, or control of assets submitted to the library.

Organization Process Definition Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Measurement 1 Measurements are made and used to determine the status of the organization's process definition activities.	LAU, DEV, and MAINT	Projects measure their process development activities.	Not applicable	Not addressed	Measurements in addition to those made at the project level are beyond the scope of the TSP.
Verification 1 The software quality assurance group reviews and/or audits the organization's activities and work products for developing and maintaining the organization's standard software process and related process assets and reports the results.	WEEK, Quality Manager role specification, and STATUS	The team members, the Team Leader, and the Quality Manager review process development and maintenance activities.	Not applicable	Not addressed	Reviews and audits of organization-level activities are beyond the scope of the TSP.

8.13 Training Program Observations

"The purpose of the Training Program key process area is to develop the skills and knowledge of individuals so they can perform their roles effectively and efficiently" [Paulk 95].

The Training Program KPA calls for an organizational group responsible for training, and for identifying training needs for the organization, projects, and individuals. The process area mainly covers practices for the group that performs the training function, with a single practice directing projects to evaluate current and future skill needs and to determine how these skills will be obtained, and one unelaborated practice on a training waiver procedure that can reasonably be interpreted as having both organizational and project scope.

When organizations adopt the TSP, training is specified for all levels of the management chain, down to the practicing developers, including non-software personnel. However, TSP introduction does not specify organization-specific non-TSP training, so this process area in general

can only be partially addressed by widespread adoption of the TSP. Most project-level training practices of the TSP are recognized in specific institutionalization features (Abilities) in the other KPAs.

Training Program Goal	Observation
Goal 1 Training activities are planned.	The standard TSP introduction strategy provides a framework, sequence, and criteria for appropriate PSP and/or TSP training for senior, middle, and first-line managers, as well as for software engineers and non-software technical personnel working on TSP teams. This goal is partially addressed by the TSP.
Goal 2 Training for developing the skills and knowledge needed to perform software management and technical roles is provided.	PSP and/or TSP training is provided as part of the standard TSP introduction strategy. This goal is partially addressed by the TSP.
Goal 3 Individuals in the software engineering group and software-related groups receive the training necessary to perform their roles.	All members of TSP teams, as well as the entire management chain up to the sponsoring manager, receive training as part of the standard TSP introduction strategy. This goal is partially addressed by the TSP.

Training Program Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The organization follows a written policy for meeting its training needs.		See global observations in Section 8.3.	Not applicable	Not addressed	
Ability 1 A group responsible for fulfilling the training needs of the organization exists.		The TSP Team Leader is responsible for ensuring that team members are appropriately trained for their work on the team. Team members "arrange for and get the education and training needed to do superior work."	Not applicable	Partially addressed	The TSP requires that the PSP and TSP training needs of the organization be addressed. The TSP introduction strategy includes identification of resources required for training. But an organization-level group for training besides the TSP is not addressed.
Ability 2 Adequate resources and funding are provided for implementing the training program.	PREPL, PREPR, PSP and TSP training materials, and TSP launch plans	TSP team launch plans include planned time for individuals to attend needed training. Organizational introduction follows the TSP introduction strategy using SEI-created materials.	Not applicable	Partially addressed	Adequate resources and funding are provided for PSP and TSP training. The training program as a whole is not addressed.
Ability 3 Members of the training group have the necessary skills and knowledge to perform their training activities.	PREPL and PREPR	The TSP introduction strategy calls for the implementing organization to have its own people trained and authorized by the SEI to teach the PSP and to launch and coach TSP teams.	Not applicable	Partially addressed	The PSP trainers and TSP launch coaches have the necessary skills and knowledge for training and coaching in PSP and the TSP. Other skills are not addressed.
Ability 4 Software managers receive orientation on the training program.	PREPL, PREPR, and executive and management training	As part of the executive and management training specified by the introduction strategy, all levels of management are exposed to the scope and nature of PSP/TSP training for the entire organization.	Not applicable	Partially addressed	Managers receive orientation in PSP and TSP training and coaching. Other training is not addressed.

Training Program Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 1 Each software project develops and maintains a training plan that specifies its training needs.	LAU4, PM, Team Leader, and team member roles	In launch meeting 4, teams specifically set aside time for all project-related training in the schedule. Postmortem meetings call for identifying needed training to improve the team's processes. The Team Leader is responsible for the training needs of the team. Team members "arrange for and get the education and training needed to do superior work."	Fully addressed	Not applicable	
Activity 2 The organization's training plan is developed and revised according to a documented procedure.	TSP introduction strategy, and TSP launch plans	The TSP introduction strategy provides training requirements for PSP and TSP and a generic plan to meet those requirements, including specific guidelines. Team launch plans identify training needs.	Not applicable	Partially addressed	A training plan for PSP and TSP training and coaching is developed. Other organization-level training is not addressed.
Activity 3 The training for the organization is performed in accordance with the organization's training plan.	TSP introduction strategy, PREPL, and PREPR	Performance of the training follows the introduction strategy and is monitored by following the appropriate launch preparation checklist.	Not applicable	Partially addressed	PSP and TSP training and coaching is performed according to the plan. Other training is not addressed.
Activity 4 Training courses prepared at the organization level are developed and maintained according to organization standards.	SEI training materials for PSP and TSP courses in the introduction strategy	SEI training materials for PSP and TSP are available to authorized instructors and launch coaches, and represent a *de facto* organization standard for these training courses.	Not applicable	Partially addressed	The TSP does not address organizational standards for training besides the materials included for PSP and TSP training.
Activity 5 A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform in their designated roles.	Team Leader and team member roles	The TSP Team Leader and each individual team member are responsible for using such organizational guidelines to assess whether or not the individual possesses the necessary knowledge and skills.	Partially addressed	Not addressed	The waiver procedure is an organizational product, which would be applied at the project level, based on Team Leader and team member judgments.

Training Program Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 6 Records of training are maintained.	PREPL and PREPR	The preparation scripts require reporting of training status for the team(s) being launched.	Not applicable	Partially addressed	Records of PSP and TSP training and coaching are maintained. Other training is not addressed.
Measurement 1 Measurements are made and used to determine the status of the training program activities.	PREPL and PREPR	The preparation scripts require reporting of training status for the team(s) being launched.	Not applicable	Partially addressed	Measurements for training status other than for the PSP and TSP are not addressed.
Measurement 2 Measurements are made and used to determine the quality of the training program.	PSP class data	Aggregate PSP class data are typically reported to management and interpreted by an authorized PSP instructor in terms of class performance and training effectiveness.	Not applicable	Partially addressed	Measurements for training quality other than the PSP and TSP are not addressed.
Verification 1 The training programs activities are reviewed with senior management on a periodic basis.	TSP introduction strategy	Introduction activity status, especially PSP training status, is typically reviewed with the sponsoring senior manager.	Not applicable	Partially addressed	Review of activities for training other than the PSP and the TSP are not addressed.
Verification 2 The training program is independently evaluated for consistency with, and relevance to, the organization's needs.			Not applicable	Not addressed	Such an evaluation is beyond the scope of the TSP.
Verification 3 The training program activities and work products are reviewed and/or audited and the results are reported.	PREPL and PREPR	Launch preparation scripts call for reviewing the status of PSP and TSP training activities.	Not applicable	Not addressed	Reviews and audits of organization-level activities are beyond the scope of the TSP.

8.14 Integrated Software Management Observations

"The purpose of Integrated Software Management is to integrate the software engineering and management activities into a coherent, defined software process that is tailored from the organization's standard software process and related process assets, which are described in Organization Process Definition" [Paulk 95].

The TSP planning process integrates software engineering and management processes to support the Integrated Software Management KPA. TSP plans reflect management processes such as earned value planning and tracking, risk management, team goal management, and team management roles. The plans also reflect engineering processes such as requirements, design, code, test, personal reviews, and team inspections. The most important way in which TSP integrates management and engineering processes is that the metrics generated by engineers as a byproduct of using the TSP are the same metrics that are used to manage TSP projects. Planning for TSP projects takes place mainly during the TSP launch. Dynamic planning takes place as needed at the individual level and at the team level. Major replanning takes place during a relaunch.

Team members plan their own work. During a TSP launch, the team

- meets with management and marketing to understand business and product goals
- defines measurable team goals
- defines team roles
- determines a list of types of products to be produced
- ensures that processes or plans exist to develop processes for each type of product
- produces a conceptual design for the product
- estimates size for all product types
- creates an earned value plan
- creates a CM plan, support plan, process plan, and quality plan

- creates individual plans for each team member, and performs load balancing
- consolidates individual plans into a team-level plan
- conducts a risk analysis
- presents their plan to management and gets management commitment to the plan

Individual team member plans produced during the launch guide the day-to-day work of each team member. Plans are updated as needed. Teams meet weekly to consolidate, track, and manage according to the plan.

Integrated Software Management Goal	Observation
Goal 1 The project's defined software process is a tailored version of the organization's standard software process.	Projects either tailor the OSSP to meet TSP quality criteria or use a combination of processes from the OSSP and the TSP. This goal is fully addressed by the TSP.
Goal 2 The project is planned and managed according to the project's defined software process.	During a TSP launch, the team defines the project's development process, using guidelines provided in the TSP. Then, the team plans and tracks its work using this defined development process. This goal is fully addressed by the TSP.

Integrated Software Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy requiring that the software project be planned and managed using the organization's standard software process and related process assets.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 Adequate resources and funding are provided for managing the software project using the project's defined software process.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 2 The individuals responsible for developing the project's defined software process receive required training in how to tailor the organization's standard software process and use the related process assets.	LAU3	The team follows the tailoring guidelines provided in the launch script and supplemented by any organizational tailoring guidelines. An authorized launch coach who has been trained in the launch process facilitates a TSP launch.	Partially addressed	Partially addressed	The TSP does not address specific training in using other organizational processes besides the TSP.
Ability 3 The software managers receive required training in managing the technical, administrative, and personnel aspects of the software project based on the project's defined software process.	TSP introduction strategy, PREPL, and PREPR	Managers are trained in how to work with TSP teams. Methods, procedures, processes, and measures are included in the training.	Partially addressed	Partially addressed	The TSP does not address training in performance management, or training in organization business processes. Both are specific to particular organizations, and thus are outside the scope of the TSP.

Integrated Software Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 1 The project's defined software process is developed by tailoring the organization's standard software process according to a documented procedure.	LAU3	The team tailors the TSP and/or any organization processes needed to best address their business and customer needs using the TSP launch process.	Fully addressed	Not applicable	
Activity 2 Each project's defined software process is revised according to a documented procedure.	PIP, PM, and SUMMARY	Teams conduct postmortems (PM) to gather, analyze, and record phase or project data. Changes to a project's process quality parameters (SUMMARY) are made based on lessons learned. Process Improvement Proposals (PIPs) are generated and submitted.	Fully addressed	Not applicable	
Activity 3 The project's software development plan, which describes the use of the project's defined software process, is developed and revised according to a documented procedure.	LAU	The project's SDP is developed during a launch, using the launch scripts and supporting forms and standards.	Fully addressed	Not applicable	
Activity 4 The software project is managed in accordance with the project's defined process.	LAU, DEV, MAINT, WEEK, STATUS, and SUMMARY	The TSP includes scripts and forms for gathering, analyzing, and reporting project data; for estimating, planning, and tracking key tasks; for replanning; for collecting lessons learned; and for identifying skills and training needed by team members.	Fully addressed	Not applicable	

Integrated Software Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 5 The organization's software process database is used for software planning and estimating.	LAU3, LAU4, PSP, and planning and quality guidelines	The TSP includes size estimation during the planning process for various work products (LAU3). PSP estimation skills are assumed. Planning and quality guidelines are used to plan and track both schedule and quality. Planning and quality guidelines are based on project historical data, or on organization data or on industry standards.	Fully addressed	Not applicable	
Activity 6 The size of the software work products (or size of changes to the software work products) is managed according to a documented procedure.	SUMS, WEEK, Design, Implementation, and Customer Interface Manager role specifications	The size of various work products is estimated and tracked on SUMS. The Design Manager and Implementation Manager focus on and track size issues. Role managers report weekly on their responsibilities (WEEK).	Fully addressed	Not applicable	
Activity 7 The project's software effort and costs are managed according to a documented procedure.	LAU, WEEK, Planning Manager, and Team Leader role specifications	The project's effort is planned during the launch (LAU). Team members track effort in real time (LOGT). The team tracks effort in weekly meetings (WEEK). The Team Leader and Planning Manager focus on managing the team effort.	Partially addressed	Not applicable	The TSP does not plan or track costs.
Activity 8 The project's critical computer resources are managed according to a documented procedure.		There is no documented procedure for managing critical computer resources in the TSP. The Design Manager and Implementation Manager roles focus on and track product performance issues.	Not addressed	Not applicable	

Integrated Software Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 9 The critical dependencies and critical paths of the project's software schedule are managed according to a documented procedure.	LAU6 and WEEK	The launch meeting 6 script (LAU6) calls for resolving critical path conflicts. This implies the existence of a critical path. During launch meeting 6, teams load balance, which involves examining critical paths. Teams also dynamically load-balance during the weekly team meeting (WEEK).	Partially addressed	Not applicable	There is no explicitly documented procedure in the TSP to manage critical dependencies and critical paths.
Activity 10 The project's software risks are identified, assessed, documented, and managed according to a documented procedure.	LAU7, LAU9, WEEK, and *Leading and Coaching Disciplined Teams* manuscript	Risks are identified, assessed, and assigned in launch meeting 7 (LAU7). They are presented to management in the launch management meeting (LAU9). The team tracks risks on a weekly basis (WEEK).	Fully addressed	Not applicable	
Activity 11 Reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate.	STATUS and REVCL	The STATUS specification guides the project in making management status reports. The STATUS script guides the project in planning and conducting periodic management and customer status meetings. Quarterly executive project reviews are conducted (REVCL).	Fully addressed	Not applicable	
Measurement 1 Measurements are made and used to determine the effectiveness of the integrated software management activities.	MTG, WEEK, and SUMMARY	The principal amount of time spent in project planning and tracking activities is the time spent in weekly meetings, launches, and relaunches. This time is tracked in the MTG forms associated with each launch, relaunch, or weekly meeting.	Fully addressed	Not applicable	

Integrated Software Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Verification 1 The activities for managing the software project are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The activities for managing the software project are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for managing the software project and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.15 Software Product Engineering Observations

"The purpose of Software Product Engineering is to consistently perform a well-defined engineering process that integrates all the software engineering activities to produce correct, consistent software products effectively and efficiently" [Paulk 95].

The Software Product Engineering (SPE) KPA addresses the engineering processes used by engineers to produce software products. The TSP and the PSP provide guidelines for quality engineering processes, along with the measures associated with the processes. Examples include time in phase, time-in-phase ratios, personal reviews and team inspections, review rates, phase yields, defects injected, defects removed, analysis of defects found in integrating, system, and acceptance tests. Process scripts provide high-level guidance for engineering activities

(for example, the REQ and ANA scripts for requirements, HLD for high-level design, and IMP for detailed design and implementation). Role managers have specific responsibilities for engineering activities (for example, the Customer Interface Manager is responsible for requirements activities, the Design Manager for design activities, and the Test Manager for test activities).

The TSP does not include specific procedures and tools for engineering practices. For example, the TSP does not include a particular requirements analysis method or a particular design method, or particular testing methods. This level of detail is unique to organizations and projects, and thus is outside the scope of the TSP.

Goal	Observation
Goal 1 The software engineering tasks are defined, integrated, and consistently performed to produce the software.	The TSP defines most software engineering tasks. It does not specify specific tools and methods (i.e., design methodology, code analysis methods). This goal is partially addressed by the TSP.
Goal 2 Software work products are kept consistent with each other.	TSP phase scripts require software work products to be consistent with the previous phase. TSP does not include tools and procedures for ensuring consistency.

Software Product Engineering (SPE)	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for performing the software engineering activities.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 Adequate resources and funding are provided for performing the software engineering tasks.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 2 Members of the software engineering technical staff receive required training to perform their technical assignments.	TSP introduction strategy, LAU, PREPR, PREP, and role specifications	PSP training is required for software engineers prior to the TSP launch. The support plan identifies additional training needs (LAU). The Team Leader role specification assigns responsibility for team member training to the Team Leader. Several other role specifications call out responsibility to assure team member training in particular areas.	Fully addressed	Not addressed	Required training in organizational processed besides the TSP itself are beyond the scope of the TSP.
Ability 3 Members of the software engineering technical staff receive orientation in related software engineering disciplines.	Team Leader role specification, other role specifications, and LAU	The Team Leader role specification assigns responsibility for team member training to the Team Leader. Several other role specifications call out responsibility to assure team member training in particular areas. Role responsibilities are planned during the launch.	Fully addressed	Not applicable	

Software Product Engineering (SPE)	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 4 The project manager and all software managers receive orientation in the technical aspects of the software project.	SUMS, INV, LAU3, and LAU9	During a launch (LAU3), the team produces a conceptual design of the product to be developed and identifies all deliverables and non-deliverable work products (SUMS and INV). The team presents this to management in launch meeting 9 (LAU9).	Fully addressed	Not applicable	
Activity 1 Appropriate software engineering methods and tools are integrated into the project's defined software process.	PSP, LAU3, Process Manager, and other role specifications	The LAU3 script guides the team in developing a custom process and listing of needed support tools and methods, which are then planned for. The Process Manager holds responsibility for following through on processes in general, and other roles have specific process responsibilities to support the plan.	Fully addressed	Not applicable	
Activity 2 The software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process.	LAU, REQ, ANA, and Customer Interface Manager role specification	The activities for planning, developing, maintaining, documenting, testing, reviewing, and controlling requirements are planned during the requirements-phase launch.	Partially addressed	Not applicable	Procedures and methodologies for analyzing requirements are beyond the scope of the TSP, and are specific to an organization.
Activity 3 The software design is developed, maintained, documented, and verified, according to the project's defined software process, to accommodate the software requirements and to form the framework for coding.	LAU, HLD, IMP, PSP, and Design Manager role specification	The activities for high-level design are planned during the HLD-phase launch. The activities for detailed design are planned during the implementation-phase launch. TSP scripts HLD and IMP describe the major activities for creating, documenting, reviewing, and controlling the design. Design strategies, documentation standards, and verification procedures are defined in the PSP.	Fully addressed	Not applicable	Organizations may require specific design procedures and methodologies, such as object-oriented design or Unified Modeling Language (UML).

Software Product Engineering (SPE)	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 4 The software code is developed, maintained, documented, and verified, according to the project's defined software process, to implement the software requirements and software design.	LAU, IMP, PSP, and Design and Implementation Manager role specifications	The activities for developing, maintaining, reviewing, inspecting, and controlling code are planned during the implementation-phase launch. TSP script IMP describes the major activities for coding, inspection, unit test, release, and baseline of software components. Coding standards and personal review procedures are defined in the PSP.	Fully addressed	Not applicable	Organizations may require specific implementation procedures and methodologies (programming languages, coding standards, and counting standards).
Activity 5 Software testing is performed according to the project's defined software process.	LAU, TEST, TEST1, TEST2, TEST3, TESTD, and Test Manager role specification	TSP test activities are planned during the test-phase launch (TEST and LAU). The TSP test scripts include detailed activities for build, integration test, and system test. The team determines test readiness based on component quality. Build plans, integration plans, and system test plans are created. Plans are reviewed.	Fully addressed	Not applicable	Organizations may require specific testing procedures and methodologies (programming languages, coding standards, and counting standards).
Activity 6 Integration testing of the software is planned and performed according to the project's defined software process.	TEST2, TESTD, and Test Manager role specification	Integration testing activities are performed according to TSP script TEST2, and include steps for determining if each component is ready for integration test, creating the integration test plan, reviewing the plan, developing the test package, verifying the test package, performing the tests, and recording integration test defects. Script TESTD handles test defects.	Fully addressed	Not applicable	Organizations may require specific testing procedures and methodologies (programming languages, coding standards, and counting standards).

Software Product Engineering (SPE)	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 7 System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.	TEST3, TESTD, and Test Manager role specification	System testing activities are performed according to TSP script TEST3, and include steps for determining if each component is ready for the system, creating the system test plan, reviewing the plan, developing the test package, verifying the test package, performing the tests, and recording the results. Script TESTD handles test defects.	Fully addressed	Not applicable	Organizations may require specific testing procedures and methodologies (programming languages, coding standards, and counting standards).
Activity 8 The documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process.	REQ, LAU3, and Customer Interface and Implementation Manager role specifications	The REQ script calls for production and review of a user manual. LAU3 calls for a defined process to produce each identified product. The Customer Interface Manager is responsible for customer documentation. The Implementation Manager is responsible for standards used to produce the product and its documentation.	Fully addressed	Not applicable	
Activity 9 Data on defects identified in peer reviews and testing are collected and analyzed according to the project's defined software process.	INS and TESTD	The TSP collects data from team inspections (INS). Each defect found in build, integration, or system test is handled according to script TESTD.	Fully addressed	Not applicable	
Activity 10 Consistency is maintained across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures.	REQ, ANA, DEV, MAINT, HLD, IMP, TEST, INS, and role specifications	Each TSP script for each software life-cycle phase includes activities to ensure that consistency is maintained with the previous phase(s). During an inspection, teams check for consistency between work products from the current phase and work products from previous phases.	Fully addressed	Not applicable	

Software Product Engineering (SPE)	TSP Element	Observation	Project Level	Org. Level	Notes
Measurement 1 Measurements are made and used to determine the functionality and quality of the software products.	LOGD, DEFECT, and TESTD	The TSP includes detailed measures on product quality, including defect density, defect removal profiles, defect injection, and defect removal rates.	Fully addressed	Not applicable	
Measurement 2 Measurements are made and used to determine the status of the software product engineering activities.	ANA and Customer Interface Manager role specification	The ANA script covers estimating and documenting the effects of proposed requirements changes. The Customer Interface role tracks such changes and reports them to the team.	Fully addressed	Not applicable	
Verification 1 The activities for software product engineering are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The activities for software product engineering are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for software product engineering and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.16 Intergroup Coordination Observations

"The purpose of Intergroup Coordination is to establish a means for the software engineering group to participate actively with the other engineering groups so the project is better able to satisfy the customer's needs effectively and efficiently" [Paulk 95].

Intergroup coordination is addressed in several ways by the TSP. First, the role managers on a TSP team are the natural liaisons to other engineering groups.

Table 6: Intergroup Coordination With Role Managers

Team role	Responsible for coordination with
Team Leader	Management
Customer Interface Manager	Requirements group, marketing, the customer, other Customer Interface Managers
Process Manager	Software Engineering Process Group, other process managers
Quality Manager	Software Quality Assurance group, other quality managers.
Support Manager	Software Configuration Management group, IT group, other support managers
Design Manager	Documentation group, other design managers
Test Manager	Test Group, other test managers
Implementation Manager	Other implementation managers
Planning Manager	Other planning managers

On projects using multiple teams, intergroup coordination involves not only coordination with external groups such as SQA or SCM, but also coordination among the project teams. Role manager teams are responsible for coordination across all project teams. For example, the Planning Managers from all project teams form the Planning Manager role team. This team is responsible for coordinating all project planning and tracking activities across all teams working on the project. Another example is the Quality Manager role team. This team is formed of all the Quality Managers from each team working on the project. The Quality Manager role team is responsible for the overall process and product quality of the project.

The TSP also supports integrated product teams. Representatives from the SQA, SCM, or testing groups may become team members of an integrated product team, thus promoting intergroup coordination. Requirements teams may also include software engineers and representatives from the testing group, also promoting intergroup coordination.

Observations for this KPA assume that projects are using TSP for multiple teams as well as interdisciplinary teams where needed (see Section 2).

Intergroup Coordination Goal	Observation
Goal 1 The customer's requirements are agreed to by all affected groups.	All affected groups are represented on multi-disciplinary TSP teams. TSP teams agree to customer requirements. This goal is fully addressed by the TSP.
Goal 2 The commitments between the engineering groups are agreed to by the affected groups.	All affected groups are represented on multi-disciplinary TSP teams. TSP teams agree to commitments. This goal is fully addressed by the TSP.
Goal 3 The engineering groups identify, track, and resolve intergroup issues.	TSP teams track and resolve intergroup issues via the team role managers.

Intergroup Coordination Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for establishing interdisciplinary engineering teams.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 Adequate resources and funding are provided for coordinating the software engineering activities with other engineering groups.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 2 The support tools used by the different engineering groups are compatible to enable effective communication and coordination.	Support Manager role specification	All TSP teams use the same tool for planning and tracking individual and team plans. Projects using the TSP develop a support plan that would address the need for common tools across different teams.	Fully addressed	Not applicable	
Ability 3 All managers in the organization receive required training in teamwork.	PREPL and LAU	The Team Leader and all involved managers and executives are required to have completed TSP training, which includes teamwork issues (PREPL). Launches are an explicit exercise in team building and team working (LAU3).	Partially addressed	Partially addressed	Training beyond the TSP is not addressed.

Intergroup Coordination Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 4 All task leaders in each engineering group receive orientation in the processes, methods, and standards used by the other engineering groups.	PREPR and PREPL	All levels of management above the team members involved in the TSP receive management training in the TSP. Projects develop a process plan and a support plan, so they know what processes, methods, and standards are being used by all project groups.	Fully addressed	Not applicable	
Ability 5 The members of the engineering groups receive orientation in working as a team.	LAU, WEEK, and team member role description	The TSP launch and team-working processes are designed specifically to help and support the team in working together.	Fully addressed	Not applicable	
Activity 1 The software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements.	Product Discussion Guidelines for Launch meeting 1, REQ, ANA, and Team Leader and Customer Interface Manager role specifications	The Team Leader and Customer Interface Manager have the responsibility to do this but have no specific guidance. For multi-team launches and activities, specific meetings coordinate planning for these efforts.	Fully addressed	Not applicable	
Activity 2 Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues.	Product Discussion Guidelines, LAU1, and role specifications	The team seeks management guidance in meeting 1 (LAU1) regarding early and overlapping involvement of other groups. Team roles are responsible for coordinating with other engineering groups.	Fully addressed	Not applicable	

Intergroup Coordination Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 3 A documented plan is used to communicate intergroup commitments and to coordinate and track the work performed.	STATUS and TSP prototype tool	TSP multi-teams communicate subteam commitments. Members of integrated product teams document their commitments in their TSP plans.	Partially addressed	Not applicable	There is no separate documented plan in the TSP for intergroup commitments. All commitments are included in the team plan, including intergroup commitments.
Activity 4 Critical dependencies between engineering groups are identified, negotiated, and tracked according to a documented procedure.	LAU4, LAU6, LAU7, ITL, and WEEK	Critical dependencies of all types are often addressed in meetings 4 and 6 (LAU4 and LAU6). Multi-teams track dependencies between subteams. Risk assessment also tends to identify critical dependencies (LAU7), and if these are not of low priority or low impact, the risks are tracked. Dependencies between groups are also tracked during weekly meetings (WEEK).	Partially addressed	Not applicable	There are no specific documented procedures in the TSP for identifying, negotiating, and tracking critical dependencies between engineering groups.
Activity 5 Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs.	REQ, ANA, and role specifications	System requirements are reviewed by the software team as part of defining software requirements (REQ and ANA). Role managers are responsible for ensuring work products needed for their areas of responsibility are of sufficient quality to meet their needs.	Fully addressed	Not applicable	
Activity 6 Intergroup issues not resolvable by the individual representatives of the project engineering groups are handled according to a documented procedure.	Team Leader role specification, STATUS, and REVCL	The Team Leader presents status, risks and other issues to management regularly (STATUS and REVCL).	Not addressed	Not applicable	There are no documented procedures in the TSP to address this key practice.

Intergroup Coordination Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 7 Representatives of the project engineering groups conduct periodic technical reviews and interchanges.	Role manager specifications, and WEEK	TSP multi-teams meet and conduct reviews and exchanges. Team members participate in team inspections. Risks and issues are reviewed weekly (WEEK).	Fully addressed	Not applicable	
Measurement 1 Measurements are made and used to determine the status of the intergroup coordination activities.	LAU3 and WEEK	Role managers report weekly on their role activities and may include time logged (WEEK). LAU3 script calls explicitly for planning (and by implication and tracking) role manager tasks.	Fully addressed	Not applicable	
Verification 1 The activities for intergroup coordination are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The activities for intergroup coordination are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for intergroup coordination and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.17 Peer Review Observations

"The purpose of Peer Reviews is to remove defects from the software work products early and efficiently. An important corollary effect is to develop better understanding of the software work products and of defects that might be prevented" [Paulk 95].

One of the basic quality principles of the TSP is to remove defects as early as possible. The TSP inspection process, along with the structured personal design and code reviews of the PSP, address early defect removal. Team members are trained in how to conduct personal reviews and team inspections. The Quality Manager role on the team serves as moderator for most team inspections. Personal reviews and team inspections are planned during the team launch. Team members track and fix defects identified in personal reviews. Defects identified in inspections are assigned to the appropriate team member, are tracked, and fixed. Remaining defects are predicted.

Peer Review Goal	Observation
Goal 1 Peer review activities are planned.	Team inspections are planned. This goal is fully addressed by the TSP.
Goal 2 Defects in the software work products are identified and removed.	The inspections identify defects, which are subsequently removed. This goal is fully addressed by the TSP.

Peer Review Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for performing peer reviews.		See global observations in Section 8.3.	Partially addressed	Not addressed	

Peer Review Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 1 Adequate resources and funding are provided for performing peer reviews on each software work product to be reviewed.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 2 Peer review leaders receive required training in how to lead peer reviews.	LAU, Quality Manager role specification, and INS	The Quality Manager ensures that a qualified moderator is available to lead team inspections (INS) or personally acts as inspection moderator. Training needs are identified during the launch (LAU).	Fully addressed	Fully addressed	
Ability 3 Reviewers who participate in peer reviews receive required training in the objectives, principles, and methods of peer reviews.	PREPL, Quality Manager role specification, INS, and PSP	Team members are required to be PSP-trained. New teams/team members receive required training in inspections at the post-launch briefing.	Fully addressed	Fully addressed	
Activity 1 Peer reviews are planned and the plans are documented.	LAU	Team inspections are planned during the launch.	Fully addressed	Not applicable	
Activity 2 Peer reviews are performed according to a documented procedure.	INS, PSP	Teams follow the personal review process defined in the PSP and the inspection process (INS) defined in the TSP.	Fully addressed	Not applicable	
Activity 3 Data on the conduct and results of the peer reviews are recorded.	INS	Inspection data is recorded on the inspection form.	Fully addressed	Not applicable	

Peer Review Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Measurement 1 Measurements are made and used to determine the status of the peer review activities.	WEEK and Quality Manager role specification	Quality Manager reports to the team weekly on inspection activities.	Fully addressed	Not applicable	
Verification 1 The software quality assurance group reviews and/or audits the activities and work products for peer reviews and reports the results.	INS, LOGD, SUMQ, and Quality Manager role specification	TSP does not explicitly call for SQA involvement. The quality manager is charged with maintaining the team's focus on quality, including checking that INS and LOGD forms (usually via the SUMQ) have been completed on work accomplished to date.	Fully addressed	Partially addressed	

8.18 Quantitative Process Management Observations

"The purpose of Quantitative Process Management is to control the process performance of the software project quantitatively. Software process performance represents the actual results achieved from following a software process" [Paulk 95].

TSP projects measure, analyze, and manage the processes that they use. Team members are introduced to quantitative process management during PSP training. Team members learn how to measure, analyze, understand, and improve their personal processes such as size estimation, effort estimation, and personal reviews. Team members use statistical techniques for quantitative process management (QPM), including flow charts, scatter diagrams, histograms, Pareto analysis, run (trend) charts, correlation, linear regression, and prediction intervals.

During a team launch, the team first defines the processes that it will use to perform its work. Then, the team creates a quality plan that includes process measures that are monitored and controlled during the project. Teams measure, analyze, and manage size and effort estimation

processes, process yields, reviews, and inspections. The Process Quality Index (PQI) is a composite measure for the overall development process.[4]

Teams use this plan to guide their day-to-day work. Measures are collected and analyzed frequently to understand the performance of the processes being used. Plans and processes are adjusted based on this analysis. Regular status reviews include key process quality indicators. Sensitivity to personal data is addressed through all levels of the organization via PSP and TSP training for engineers, managers, and executives.

During the project postmortem, the team performs an in-depth analysis of the performance of its processes. Process Improvement Proposals (PIPs) are generated throughout the project life cycle, but especially during the postmortem. The Process Manager role on the team is responsible for ensuring the appropriate disposition of the PIPs.

The TSP quality and planning guidelines provide the data definition and values for process planning and tracking. An example of a quality guideline is the time-in-phase ratio between design and design review. Another example is the review rate for code reviews. The values for the planning and quality guidelines may be based on past project history, may be provided by other similar projects in the organization, or may be provided by the SEI (based on data collected from TSP teams).

TSP defines operational measures, as well as the methods that use these measures, to manage project processes. But the scope of the TSP is the project, and not the organization. The TSP does not address using the project's process performance data to characterize the process capability of the organization, although it enables the organization's ability to do so.

[4] This information comes from a draft version of *Leading and Coaching Disciplined Teams Using the Team Software Process*[SM] *(TSP*[SM]*)* written by Watts Humphrey.

Quantitative Process Management Goal	Observation
Goal 1 The quantitative process management activities are planned.	The quantitative process management activities are planned in the TSP. This goal is fully addressed by the TSP.
Goal 2 The process performance of the project's defined software process is controlled quantitatively.	The process performance is quantitatively managed. Processes being quantitatively managed include size estimation, effort estimation, inspections, and defect removal. This goal is fully addressed by the TSP.
Goal 3 The process capability of the organization's standard software process is known in quantitative terms.	The process capability is known in quantitative terms at the project level. Knowledge of the process capability at the organization level is beyond the scope of the TSP. This goal is partially addressed by the TSP.

Quantitative Process Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for measuring and quantitatively controlling the performance of the project's defined software process.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Commitment 2 The organization follows a written policy for analyzing the process capability of the organization's standard software process.		See global observations in Section 8.3.	Not applicable	Not addressed	

Quantitative Process Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 1 A group that is responsible for coordinating the quantitative process management activities for the organization exists.	Role specifications, LAU, PM, and WEEK	All team members, especially the Process Manager and Quality Manager roles, are responsible for collecting process data, analyzing it, and using it to improve the process. Processes and measures are planned during the launch (LAU), tracked weekly (WEEK), and analyzed frequently, with specific analysis during the postmortem (PM).	Not applicable	Not addressed	Projects using the TSP enable coordination across the organization but a group responsible for performing this job is beyond the scope of the TSP.
Ability 2 Adequate resources and funding are provided for the quantitative process management activities.		See global observations in Section 8.3.	Fully addressed	Not addressed	Resources and funding for an organization-level group are beyond the scope of the TSP.
Ability 3 Support exists for collecting, recording, and analyzing data for selected process and product measurements.	LOGT, LOGD, SUMP, SUMQ, SUMS, WEEK, and TSP prototype tool	Data collection (LOGT, LOGD, and SUMS) and analysis (SUMP, SUMQ, and WEEK) occur at the individual and project levels.	Fully addressed	Not addressed	Support exists for this key practice at the project level. Support at the organization level for collecting, recording, and analyzing data for selected processes is beyond the scope of the TSP.
Ability 4 The individuals implementing or supporting quantitative process management receive required training to perform these activities.	TSP introduction strategy, PREPR, and PREPL	Training is provided to each TSP team member and throughout the management chain.	Fully addressed	Not addressed	Training for an organization-level QPM group is beyond the scope of the TSP.
Ability 5 The members of the software engineering group and other software-related groups receive orientation on the goals and value of quantitative process management.	TSP introduction strategy, PREPR, PREPL	Training is provided to each TSP team member, and to personnel throughout the management chain.	Fully addressed	Fully addressed	

Quantitative Process Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 1 The software project's plan for quantitative process management is developed according to a documented procedure.	LAU and NOTEBOOK	The project's quantitative plan is developed (LAU) and recorded (NOTEBOOK) according to the procedures documented in the launch scripts.	Fully addressed	Not applicable	
Activity 2 The software project's quantitative process management activities are performed in accordance with the project's quantitative process management plan.	WEEK, STATUS, SUMMARY, LOGT, LOGD, TASK, SCHED, SUMQ, SUMP, TSP prototype tool, and Quality and Process Manager role specifications	TSP team members track daily (LOGT, LOGD, TASK, SUMS), the team tracks weekly (WEEK, SUMP, SUMQ, SCHED), and management monitors status periodically (STATUS). The Quality and Process Managers have specific responsibilities in this regard.	Fully addressed	Not applicable	
Activity 3 The strategy for the data collection and the quantitative analyses to be performed are determined based on the project's defined software process.	LAU, DEV, MAINT, WEEK, STATUS, PM, LOGT, LOGD, TASK, SUMS, and TSP prototype tool	The data collection and process control strategies are built into the PSP and the TSP.	Fully addressed	Not applicable	
Activity 4 The measurement data used to control the project's defined software process quantitatively are collected according to a documented procedure.	LOGT, LOGD, TASK, SUMS, INS, and TSP prototype tool	The PSP and the TSP define measures, procedures, scripts, and forms for both engineers and teams use to collect data.	Fully addressed	Not applicable	

Quantitative Process Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 5 The project's defined software process is analyzed and brought under quantitative control according to a documented procedure.	TSP, PSP, TSP prototype tool, and quality profiles, Process Quality Index	Data analysis activities are well defined. The size and effort estimates are statistically derived from historical data. The size and effort estimation processes are under statistical process control (using prediction intervals and upper and lower limits). Review and inspection processes are managed by analyzing review rates, yields, defect densities, and defect injection and removal profiles. The development process is managed by tracking process yields and the Process Quality Index (PQI). The remaining measures are tracked with actual versus planned values.	Fully addressed	Not applicable	
Activity 6 Reports documenting the results of the software project's quantitative process management activities are prepared and distributed.	WEEK, STATUS, SUMMARY, and REVCL	Reports are regular products of the TSP. Reports are generated for the team members, the team, customers, and management.	Fully addressed	Not applicable	
Activity 7 The process capability baseline for the organization's standard software process is established and maintained according to a documented procedure.	Planning and Quality guidelines, LOGT, LOGD, TASK, SCHED, and PSP	At the project level, the TSP and the PSP provide the data and the methods to determine the capability of project processes.	Fully addressed	Partially addressed	The TSP provides the data and the methods to determine the capability of the OSSP, but it does not provide procedures for establishing and maintaining the OSSP baseline.

Quantitative Process Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Measurement 1 Measurements are made and used to determine the status of the activities for quantitative process management.	PM, WEEK, and Process Manager role specification	TSP teams schedule postmortems (PM) as milestones. Effort for postmortems is planned and tracked. The Process Manager plans role tasks, which include planning and tracking PIPs.	Fully addressed	Fully addressed	Measurements for QPM activities are made both at the project and organization levels.
Verification 1 The activities for software quality management are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Partially addressed	If the organization has a separate group responsible for QPM, and this group is not using the TSP, this key practice may not be fully addressed at the organization level.
Verification 2 The software project's activities for quantitative process management are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for quantitative process management and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.19 Software Quality Management Observations

"The purpose of Software Quality Management is to develop a quantitative understanding of the quality of the project's software products and achieve specific quality goals" [Paulk 95].

Projects using the TSP plan and manage the quality of the products that they produce. Product quality is planned during a team launch or relaunch. Product quality is tracked in real time at the individual level and at the project level. Several in-process measures are defined to track product quality. The principle measure of product quality is defect density, which is measured at several points in the project life cycle.

Software Quality Management Goal	Observation
Goal 1 The project's software quality management activities are planned.	The project's Software Quality Management (SQM) activities are planned. This goal is fully addressed by the TSP.
Goal 2 Measurable goals for software product quality and their priorities are defined.	Measurable goals for software product quality are defined and prioritized during the launch. This goal is fully addressed by the TSP.
Goal 3 Actual progress toward achieving the quality goals for the software products is quantified and managed.	Quality goals are quantified, tracked, and managed. This goal is fully addressed by the TSP.

Software Quality Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The project follows a written organizational policy for managing software quality.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 Adequate resources and funding are provided for managing the quality of the software products.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Ability 2 The individuals implementing and supporting software quality management receive required training to perform their activities.	TSP introduction strategy, PREPR, and PREPL	The team is responsible for software quality management, and they are trained in the PSP and TSP.	Fully addressed	Fully addressed	
Ability 3 The members of the software engineering group and other software-related groups receive required training in software quality management.	TSP introduction strategy, PREPR, and PREPL	Everyone participating in a project launch or working in a TSP team has been trained in quality methods (based on the TSP introduction strategy).	Fully addressed	Fully addressed	
Activity 1 The project's software quality plan is developed and maintained according to a documented procedure.	LAU, NOTEBOOK, SUMS, SUMP, SUMQ, TASK, and GOAL	The plan (SUMS, SUMP, SUMQ, TASK, GOAL, and NOTEBOOK) is developed according to the launch scripts (LAU).	Fully addressed	Not applicable	

Software Quality Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 2 The project's software quality plan is the basis for the project's activities for software quality management.	SUMS, SUMP, SUMQ, TASK, WEEK, STATUS, quality profiles, REVCL, TEST, INS, and TSP prototype tool	Team members use their individual quality plans as a basis for their quality management activities. Individual plans are consolidated into team plans, which are the basis for the team's quality management activities.	Fully addressed	Not applicable	
Activity 3 The project's quantitative quality goals for the software products are defined, monitored, and revised throughout the software life cycle.	LAU, NOTEBOOK script, SUMS, SUMP, SUMQ, GOAL, planning and quality guidelines, PM, and REL	The team defines quantitative quality goals (GOAL) in the launch (LAU), and tracks the goals daily, weekly, and periodically (SUMS, SUMP, and SUMQ). Goals are revised during relaunches (REL), based on actual project data.	Fully addressed	Not applicable	
Activity 4 The quality of the project's software products is measured, analyzed, and compared to the products' quantitative quality goals on an event-driven basis.	WEEK, STATUS, REVCL, PM, REL, TEST, INS, and Quality Manager role specification	Quality data (SUMQ) are analyzed and compared to the plan daily by each team member, weekly by the Quality Manager (WEEK); during status reports and meetings with customer and management (STATUS and REVCL); during phase and cycle postmortems (PM); and during relaunches (REL).	Fully addressed	Not applicable	
Activity 5 The software project's quantitative quality goals for the products are allocated appropriately to the subcontractors delivering software products to the project.		The TSP does not address subcontractors.	Not addressed	Not applicable	
Measurement 1 Measurements are made and used to determine the status of the software quality management activities.	LOGT, LOGD, TASK, SCHED, SUMQ, SUMP, and data analysis charts, and Quality Manager role specification	TSP tracks phase and time in finding and fixing defects (LOGT, LOGD, and TASK). Cost of quality, appraisal to failure ratio, and Process Quality Index are also tracked.	Fully addressed	Not applicable	

Software Quality Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Verification 1 The activities for software quality management are reviewed with senior management on a periodic basis.		See global observations in Section 8.3.	Fully addressed	Fully addressed	
Verification 2 The activities for software quality management are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for software quality management and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.20 Defect Prevention Observations

"The purpose of Defect Prevention is to identify the cause of defects and prevent them from recurring" [Paulk 95].

The TSP addresses defect prevention in several ways. First, defect prevention is addressed at the individual level by the PSP. Individual engineers keep detailed data on each defect they find and/or fix during the product life cycle. For each defect, engineers categorize the defect, record the life-cycle phase in which the defect was injected, the phase in which the defect was removed, the effort expanded in finding and fixing the defect, as well as the defect description. They perform Pareto analyses to determine what category of defects they are injecting most

often, or the category of defects that are most expensive to fix, and devise process changes to eliminate these defects earlier in the product life cycle, or to prevent these defects from occurring at all.

The emphasis of both the PSP and the TSP on design is also a defect prevention strategy. TSP and PSP data show that emphasizing design and design review activities prevents some defects from occurring in later phases.

In the TSP, the team consolidates personal defect data to track the quality of each component of the product. Once the number of defects escaping to the test phases is under control, TSP teams meet to determine the cause for each defect that escapes beyond unit test into integration, system, or acceptance test. The team determines whether other components should be checked for similar defects, and whether changes to processes used to produce the product could have prevented the defect from occurring in the first place. Process Improvements Proposals (PIPs) are submitted for process changes.

Teams also address defects during project postmortems.

The TSP does not address an organization-level team for defect prevention. It also does not contain any procedures to determine the root causes of defects.

Defect Prevention Goal	Observation
Goal 1 Defect prevention activities are planned.	Projects plan defect prevention activities. Defect prevention at the organization level is beyond the scope of the TSP. This goal is partially addressed by the TSP.
Goal 2 Common causes of defects are sought out and identified.	Projects find common causes of defects. The organization level is beyond the scope of the TSP. This goal is partially addressed by the TSP.

Goal 3 Common causes of defects are prioritized and systematically eliminated.	Projects categorize, prioritize, and change processes to prevent defects from reoccurring. The organization level is beyond the scope of the TSP. This goal is partially addressed by the TSP.

Defect Prevention Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The organization follows a written policy for defect prevention activities.		See global observations in Section 8.3.	Not applicable	Not addressed	
Commitment 2 The project follows a written organizational policy for defect prevention activities.		See global observations in Section 8.3.	Partially addressed	Not addressed	
Ability 1 An organization-level team to coordinate defect prevention activities exists.		Organization-level teams are beyond the scope of the TSP.	Not applicable	Not addressed	
Ability 2 A team to coordinate defect prevention activities for the software project exists.	TESTD, PSP, LAU, PM, and role manager specifications	Every team member is involved in defect prevention activities for the team (TESTD, PSP, and LAU), with special involvement by the Quality Manager, the Process Manager, and the Test Manager.	Fully addressed	Not applicable	

Defect Prevention Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 3 Adequate resources and funding are provided for defect prevention activities at the project and organization levels.	LAU	During the launch, the team creates a plan that includes defect prevention activities. Management approves this plan, thus providing resources and funding.	Partially addressed	Not addressed	TSP does not address resources and funding at the organization level.
Ability 4 Members of the software engineering group and other software-related groups receive required training to perform their defect prevention activities.	PREPL, PREPR	Some training in defect prevention activities is covered during TSP training.	Partially addressed	Partially addressed	Groups not using the TSP are not addressed.
Activity 1 The software project develops and maintains a plan for its defect prevention activities.	LAU, PM, TESTD, TASK, and WEEK	TSP teams schedule design activities and postmortems. Defect analysis meetings are scheduled for any defect found after unit test.	Fully addressed	Not applicable	
Activity 2 At the beginning of a software task, the members of the team performing the task meet to prepare for the activities of that task and the related defect prevention activities.	PSP, LAU, INS, HLD, IMP, and PM	During the launch (LAU), TSP teams plan personal reviews (PSP), team inspections (INS), high-level design (HLD), detailed-level design (IMP), and project postmortems (PM).	Partially addressed	Not applicable	The TSP does not explicitly address defect prevention at the beginning of a software task.
Activity 3 Causal analysis meetings are conducted according to a documented procedure.	TESTD, PSP, and MTG	PSP introduces engineers to analyzing and preventing defects. The TSP TESTD script requires causal analysis for all defects found after unit test. All TSP meetings are conducted according to script MTG.	Fully addressed	Not applicable	

Defect Prevention Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 4 Each of the teams assigned to coordinate defect prevention activities meets on a periodic basis to review and coordinate implementation of action proposals from the causal analysis meetings.	WEEK, PIP, PM	All team actions items are tracked during the weekly team meeting (WEEK). Process Improvement Proposals (PIPs) resulting from causal analysis meetings are handled during weekly meetings, during project postmortems (PM), and as needed.	Partially addressed	Not applicable	No specific meetings for action proposals from causal analysis meetings are called for in the TSP.
Activity 5 Defect prevention data are documented and tracked across the teams coordinating defect prevention activities.	TESTD	The TESTD script addresses this project level.	Partially addressed	Not applicable	The TSP is not explicit about how defect prevention data are managed and controlled.
Activity 6 Revisions to the organization's standard software process resulting from defect prevention actions are incorporated according to a documented procedure.		Revisions to the organization's standard software process are beyond the scope of the TSP.	Not applicable	Not addressed	
Activity 7 Revisions to the project's defined software process resulting from defect prevention actions are incorporated according to a documented procedure.	LAU3, TESTD, and PM	Process Manager plans role tasks during launch meeting 3 (LAU3). The Process Manager role includes planning for existing process improvement proposals, some of which are from causal analysis meetings (TESTD) and some from postmortems (PM).	Fully addressed	Not applicable	

Defect Prevention Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 8 Members of the software engineering group and software-related groups receive feedback on the status and results of the organization's and project's defect prevention activities on a periodic basis.	TESTD, SUMQ, and TSP data analysis charts in TSP prototype tool	Team members participate in defect prevention activities (TESTD) so they know the status of these activities.	Partially addressed	Not addressed	The organization level is beyond the scope of the TSP.
Measurement 1 Measurements are made and used to determine the status of the defect prevention activities.	LOGT, LOGD, TASK, SUMQ, SUMP, and TSP data analysis charts in TSP prototype tool, Quality Manager role specification	TSP tracks effort in defect analysis meetings, the defect injection and removal profiles, the number of defects, the effort to find and fix defects, COQ, and A/FR.	Fully addressed	Not addressed	Measurements for the status of defect prevention activities at the organization level are not addressed.
Verification 1 The organization's activities for defect prevention are reviewed with senior management on a periodic basis.			Not applicable	Not addressed	
Verification 2 The software project's activities for defect prevention are reviewed with the project manager on both a periodic and event-driven basis.		See global observations in Section 8.3.	Fully addressed	Not applicable	
Verification 3 The software quality assurance group reviews and/or audits the activities and work products for defect prevention and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.21 Technology Change Management Observations

"The purpose of Technology Change Management is to identify new technologies (i.e., tools, methods, and processes) and track them into the organization in an orderly manner" [Paulk 95].

Most key practices of this KPA are organization-level key practices. The TSP handles technology change management at the project level only. The TSP does not distinguish technology change management (TCM) from process change management. Both involve piloting changes, defining measures, tracking measures, and wider deployment of changes based on quantitative analysis of results.

Technology Change Management Goal	Observation
Goal 1 Incorporation of technology changes is planned.	Technology changes are planned at the project level, but not at the organization level. This goal is partially satisfied by the TSP.
Goal 2 New technologies are evaluated to determine their effect on quality and productivity.	New technologies are evaluated at the project level, but not at the organization level. This goal is partially satisfied by the TSP.
Goal 3 Appropriate new technologies are transferred into normal practice across the organization.	The TSP does not address transferring new technologies across the organization. This goal is partially satisfied by the TSP.

Technology Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The organization follows a written policy for improving its technology capability.		See global observations in Section 8.3.	Not applicable	Not addressed	
Commitment 2 Senior management sponsors the organization's activities for technology change management.	PREPL, PREPR, and LAU	TSP projects that are introducing new technologies will have senior management involvement and sponsorship during the launch.	Not applicable	Not addressed	
Commitment 3 Senior management oversees the organization's technology change management activities.		TSP projects introducing new technologies will have senior management oversight.	Not applicable	Not addressed	
Ability 1 A group responsible for the organization's technology change management activities exists.	Role specifications	The role manager teams for a TSP multi-team fulfill some of the responsibility for TCM.	Not applicable	Not addressed	
Ability 2 Adequate resources and funding are provided to establish and staff a group responsible for the organization's technology change management activities.		Resources and funding for an organization-level group are the responsibility of the organization.	Not applicable	Not addressed	

Technology Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 3 Support exists for collecting and analyzing data needed to evaluate technology changes.	LOGT, LOGD, TASK, SCHED, SUMQ, SUMP, data analysis charts in the TSP prototype tool, and roles specifications	The TSP prototype tool provides automated support for collecting and analyzing data needed to evaluate technology changes. The tool automates the data collection specified in various TSP data collection forms.	Not applicable	Fully addressed	
Ability 4 Appropriate data on the software processes and software work products are available to support analyses performed to evaluate and select technology changes.	LOGT, LOGD, TASK, SCHED, SUMS, SUMQ, SUMP, data analysis charts in TSP prototype tool, and roles specifications	All team members collect data (LOGT, LOGD, TASK, and SUMS) that can be used to evaluate technology changes.	Not applicable	Fully addressed	
Ability 5 Members of the group responsible for the organization's technology change management activities receive required training to perform these activities.		Training for the organization's TCM activities are beyond the scope of the TSP.	Not applicable	Not addressed	
Activity 1 The organization develops and maintains a plan for technology change management.	LAU	TSP projects plan and manage all changes, which can include technology changes that specifically affect the project.	Not applicable	Partially addressed	A specific organization-level plan is not addressed.
Activity 2 The group responsible for the organization's technology change management activities works with the software projects in identifying areas of technology change.	LAU	During a launch, TSP projects meet with management and marketing to understand business and product goals. If identification of technology changes is a business or product goal, the TSP team will plan and track this work.	Not applicable	Partially addressed	The organization-level group responsible for TCM is outside the scope of the TSP.

Technology Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 3 Software managers and technical staff are kept informed of new technologies.	Role manager specifications	Depending on the technology being changed, TSP role managers are the natural liaison to the organization's TCM group. Role managers keep other team members, including the Team Leader, up to date with the status of their activities.	Not applicable	Partially addressed	
Activity 4 The group responsible for the organization's technology change management systematically analyzes the organization's standard software process to identify areas that need or could benefit from new technology.		The TSP does not address analysis of the organization's standard software process.	Not applicable	Not addressed	
Activity 5 Technologies are selected and acquired for the organization and software projects according to a documented procedure.		TSP does not address selection and acquisition of technologies.	Not addressed	Not addressed	
Activity 6 Pilot efforts for improving technology are conducted, where appropriate, before a new technology is introduced into normal practice.	LAU1 and LAU2	TSP does not specifically address piloting new technologies. However, if a TSP project has a goal to pilot a new technology (LAU1 and LAU2), the team will plan it, collect data on it, and analyze the data, just as it would with any other project requirement.	Not applicable	Partially addressed	

Technology Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 7 Appropriate new technologies are incorporated into the organization's standard software process according to a documented procedure.		The TSP does not address incorporating new technologies in the OSSP.	Not applicable	Not addressed	
Activity 8 Appropriate new technologies are incorporated into the projects' defined software processes according to a documented procedure.	LAU3	During launch meeting 3 teams identify any new technologies needed for the project to be successful.	Partially addressed	Partially addressed	There is no documented procedure in the TSP to incorporate new technologies.
Measurement 1 Measurements are made and used to determine the status of the organization's activities for technology change management.	TASK, SUMQ, and SUMP	TSP provides project-level measures to determine the status of technology change management activities.	Not applicable	Partially addressed	Project-level measures are provided to support organizational measures but no other support is provided at the organization level.
Verification 1 The organization's activities for technology change management are reviewed with senior management on a periodic basis.	REVCL	If TSP projects use new technologies, they are reviewed at the quarterly executive review.	Not applicable	Not addressed	
Verification 2 The software quality assurance group reviews and/or audits the activities and work products for technology change management and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

8.22 Process Change Management Observations

"The purpose of Process Change Management is to continually improve the software processes used in the organization with the intent of improving software quality, increasing productivity, and decreasing the cycle time for product development" [Paulk 95].

Each team member collects data on individual processes, analyzes process data during individual postmortems, submits individual process improvement proposals, plans and implements process changes, and measures the impact of the changes. TSP teams perform the same activities at the team level. The Process Manager role on TSP teams has specific responsibilities for process change management.

Process Change Management Goal	Observation
Goal 1 Continuous process improvement is planned.	Continuous process improvement is planned at the project level. The organization level is not addressed by the TSP. This goal is partially addressed by the TSP.
Goal 2 Participation in the organization's software process improvement activities is organization wide.	All TSP teams are involved with process improvement. The organization level is not addressed by the TSP. This goal is partially addressed by the TSP.
Goal 3 The organization's standard software process and the projects' defined software processes are improved continuously.	The projects' defined software processes are continuously improved. Continuous improvement of the OSSP is outside the scope of the TSP. This goal is partially addressed by the TSP.

Process Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Commitment 1 The organization follows a written policy for implementing software process improvements.		See global observations in Section 8.3.	Not applicable	Not addressed	
Commitment 2 Senior management sponsors the organization's activities for software process improvement.	TSP introduction strategy, REVCL, PREPR, PREPL, and LAU	Senior management sponsors TSP, which includes continuous process improvement.	Not applicable	Partially addressed	Senior management sponsorship beyond TSP is not addressed.
Ability 1 Adequate resources and funding are provided for software process improvement activities.	PM, TESTD, LAU, and STATUS	During postmortems (PM), causal analysis meetings (TESTD), and on a continuous basis, teams identify process improvement opportunities. They plan on implementing them during a launch or a relaunch (LAU), or as needed. Plans and changes to plans are reviewed with management (STATUS). Management provides resources and funding (LAU).	Fully addressed	Partially addressed	Resources and funding beyond the project level are not addressed by the TSP.
Ability 2 Software managers receive required training in software process improvement.	TSP introduction strategy, PREPL, and PREPR	All managers receive training in TSP during the introduction strategy, which includes training in software process improvement.	Partially addressed	Partially addressed	

Process Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Ability 3 The managers and technical staff of the software engineering group and other software-related groups receive required training in software process improvement.	TSP introduction strategy, PREPL, and PREPR	All managers and technical staff receive training during the introduction strategy that includes how to improve software processes.	Partially addressed	Partially addressed	The organization may specify training beyond that provided by the TSP.
Ability 4 Senior management receives required training in software process improvement.	TSP introduction strategy, PREPL, and PREPR	Senior management receives training during the introduction strategy that briefly addresses software process improvement.	Not applicable	Partially addressed	The organization may specify training beyond that provided by the TSP.
Activity 1 A software process improvement program is established which empowers the members of the organization to improve the processes of the organization.	PREPL, PREPR, PM, PIPs, and role specifications	Any TSP team member can submit a Process Improvement Proposal (PIP) and is trained in how to do this. Role managers with specific responsibilities submit PIPs in their area of responsibility.	Not applicable	Fully addressed	
Activity 2 The group responsible for the organization's software process activities (e.g., software engineering process group) coordinates the software process improvement activities.	LAU and Process Manager role specification	Process managers are responsible for coordinating process improvement activities at the project level.	Not applicable	Not addressed	Activities of an organization-level group are beyond the scope of the TSP.
Activity 3 The organization develops and maintains a plan for software process improvement according to a documented procedure.	TSP introduction strategy, PREPL, and PREPR	An organization-level plan must be prepared that instantiates the generic TSP introduction strategy for a particular organization.	Not applicable	Partially addressed	Addressing software process improvement beyond the TSP at the organization level is beyond the scope of the TSP.

Process Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 4 The software process improvement activities are performed in accordance with the software process improvement plan.	LAU	TSP teams plan any software process improvement activities required by the organization.	Not applicable	Partially addressed	The organization's plan for software process improvement activities may include organization-level activities, which are beyond the scope of the TSP.
Activity 5 Software process improvement proposals are handled according to a documented procedure.	LAU, Process Manager role description, and PM	PIPs are generated at personal and team levels throughout the project life cycle, and especially during personal and team postmortem (PM) phases. Process managers plan their role tasks during the launch, which includes planning for implementing PIPs.	Not applicable	Partially addressed	Procedures for handling PIPs at the organization level are beyond the scope of the TSP.
Activity 6 Members of the organization actively participate in teams to develop software process improvements for assigned process areas.	PM, Team Leader, and role manager specifications	The entire TSP team participates in software process improvement activities including postmortems (PM). The Process Manager, in conjunction with the team leader and other role managers, assigns responsibilities for specific process areas.	Fully addressed	Partially addressed	Other groups in the organization (SQA, SCM, or SEPG) may not be using the TSP. These groups are not addressed by the TSP.
Activity 7 Where appropriate, the software process improvements are installed on a pilot basis to determine their benefits and effectiveness before they are introduced into normal practice.	TSP	While implementing PIPs, TSP teams pilot new processes or changes to processes.	Fully addressed	Not addressed	Introduction of successfully piloted changes across the organization is beyond the scope of the TSP.

Process Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Activity 8 When the decision is made to transfer a software process improvement into normal practice, the improvement is implemented according to a documented procedure.		There is no documented procedure to address this in the TSP.	Not addressed	Not addressed	
Activity 9 Records of software process improvement activities are maintained.	PIPs, TASK, WEEK, STATUS, and LOGD	TSP teams maintain records of all software process improvement activities.	Fully addressed	Partially addressed	Other groups in the organization (SQA, SCM, or SEPG) may not be using the TSP. These groups are not addressed by the TSP.
Activity 10 Software managers and technical staff receive feedback on the status and results of the software process improvement activities on an event-driven basis.	WEEK, STATUS, and REVCL	All project activities are reviewed with all team members weekly (WEEK), and with management on a periodic basis (STATUS and REVCL).	Fully addressed	Fully addressed	
Measurement 1 Measurements are made and used to determine the status of the software process improvement activities.	PIPs, TSP quality profile, and TSP process quality indicator (PQI)	TSP teams measure the quality of the processes they use (quality profile and PQI), as well as changes to processes (PIP).	Fully addressed	Partially addressed	Other groups in the organization (SQA, SCM, or SEPG) may not be using the TSP. These groups are not addressed by the TSP.
Verification 1 The activities for software process improvement are reviewed with senior management on a periodic basis.	REVCL	The quarterly executive review includes all activities, including software process improvement activities.	Fully addressed	Partially addressed	Other groups in the organization (SQA, SCM, or SEPG) may not be using the TSP. These groups are not addressed by the TSP.

Process Change Management Key Practice	TSP Element	Observation	Project Level	Org. Level	Notes
Verification 2 The software quality assurance group reviews and/or audits the activities and work products for software process improvement and reports the results.		See global observations in Section 8.3.	Fully addressed	Partially addressed	

9 Classification of CMM Key Practices

The scope of the TSP is the mainly the project, whereas the scope of the SW-CMM covers both the organization and the projects in an organization. To record observations about how the TSP addresses key practices of the SW-CMM, each key practice of the SW-CMM was classified to determine at what level of the organization the SW-CMM intends the key practice to be addressed.

A classification of "Project" means the intent of the SW-CMM is for the project to be responsible for addressing the key practice. A classification of "Organization" means the intent is for the organization to be responsible for addressing the key practice. A classification of "Project and Organization" means both the organization and project are responsible for addressing the key practice.

Classifying a key practice as a project-level key practice does not mean that the organization has no role to play. Organizations must support projects in all their activities. Classifying a key practice as a project-level key practice means that the project has the principle responsibility of addressing that key practice, using organizational support as needed.

Similarly, classifying a key practice as an organization-level key practice does not mean that the projects have no role to play. Classifying a key practice as an organization-level key practice means that the organization has the principle responsibility of addressing that key practice, using project support as needed.

An example of a key practice that is classified as organization-level is Commitment 1 of the Defect Prevention KPA, which states, "The organization follows a written policy for defect prevention activities." An example of a key practice that is classified as both organization-level and project-level is Commitment 2 of the Defect Prevention KPA, which states, "The project follows a written organizational policy for defect prevention activities." In the former case, the key practice calls for the organization to follow an organizational policy; thus, the intent of the SW-CMM is for that key practice to be addressed at the organization level. In the latter case, the key practice calls for the project to follow an organizational policy; thus, the intent of the SW-CMM is for the key practice to be addressed at both the organization and at the project levels.

An example of a key practice that is classified as project-level is Activity 7 of the Software Project Planning KPA, which states, “The plan for the software project is documented.” It is the project’s responsibility to ensure that the plan is documented, even though the project may use other organizational resources to do this.

Overall, the classifications follow the broad focus of each SW-CMM KPA. KPAs which focus on projects include

- Requirements Management
- Software Project Planning
- Software Project Tracking and Oversight
- Software Quality Assurance
- Software Configuration Management
- Integrated Software Management
- Software Product Engineering
- Intergroup Coordination
- Peer Review
- Software Quality Management

KPAs that focus on both the project and the organization include

- Quantitative Process Management
- Defect Prevention

KPAs that focus on the organization include

- Organization Process Focus
- Organization Process Definition
- Training Program
- Technology Change Management
- Process Change Management

9.1 Methodology for Classification

To classify the key practices, tables were created for each KPA of the SW-CMM. Each row in a KPA table represents one key practice in that KPA. The first column in the table identifies the key practice being classified. Key practices are identified by combining the name of the SW-CMM common feature with the number of the key practice. For example, the first key practice of the Ability to Perform common feature is titled “Ability 1.” The second key prac-

tice of the Commitment to Perform common feature is labeled "Commitment 2." The second column in the table classifies the level at which the SW-CMM intends the key practice to be addressed. The last column in the table contains notes describing the reason for the classification.

9.2 Key Practice Classification for Requirements Management

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for managing the system requirements allocated to software.
Ability 1	Project	The project is responsible for ensuring that for each project, responsibility is established for analyzing the system requirements and allocating them to hardware, software, and other system components.
Ability 2	Project	The project is responsible for ensuring that the allocated requirements are documented.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for managing the allocated requirements.
Ability 4	Project	The project is responsible for ensuring that members of the software engineering group and other software-related groups are trained to perform their requirements management activities.
Activity 1	Project	The project is responsible for ensuring that the software engineering group reviews the allocated requirements before they are incorporated into the software project.
Activity 2	Project	The project is responsible for ensuring that the software engineering group uses the allocated requirements as the basis for the software plans, work products, and activities.
Activity 3	Project	The project is responsible for ensuring that changes to the allocated requirements are reviewed and incorporated into the software project.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the activities for managing allocated requirements.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for managing the allocated requirements are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for managing the allocated requirements are reviewed with the project manager on both a periodic and event-driven basis.

Key Practice	Classification	Notes
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for managing the allocated requirements and reports the results.

9.3 Key Practice Classification for Software Project Planning

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that a project software manager is designated to be responsible for negotiating commitments and developing the project's software development plan.
Commitment 2	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for planning a software project.
Ability 1	Project	The project is responsible for ensuring that a documented and approved statement of work exists for the software project.
Ability 2	Project	The project is responsible for ensuring that responsibilities for developing the software development plan are assigned.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for planning the software project.
Ability 4	Project	The project is responsible for ensuring that the software managers, software engineers, and other individuals involved in the software project planning are trained in the software estimating and planning procedures applicable to their areas of responsibility.
Activity 1	Project and Organization	Both the organization and the project are responsible for ensuring that the software engineering group participates on the project proposal team.
Activity 2	Project	The overall project is responsible for ensuring that software project planning is initiated in the early stages of, and in parallel with, the overall project planning.
Activity 3	Project	The project is responsible for ensuring that the software engineering group participates with other affected groups in the overall project planning throughout the project's life.
Activity 4	Project	The project is responsible for ensuring that software project commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.
Activity 5	Project	The project is responsible for ensuring that a software life cycle with predefined stages of manageable size is identified or defined.

Key Practice	Classification	Notes
Activity 6	Project	The project is responsible for ensuring that the project's software development plan is developed according to a documented procedure.
Activity 7	Project	The project is responsible for ensuring that the plan for the software project is documented.
Activity 8	Project	The project is responsible for ensuring that software work products that are needed to establish and maintain control of the software project are identified.
Activity 9	Project	The project is responsible for ensuring that estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure.
Activity 10	Project	The project is responsible for ensuring that estimates for the software project's effort and costs are derived according to a documented procedure.
Activity 11	Project	The project is responsible for ensuring that estimates for the project's critical computer resources are derived according to a documented procedure.
Activity 12	Project	The project is responsible for ensuring that the project's software schedule is derived according to a documented procedure.
Activity 13	Project	The project is responsible for ensuring that the software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.
Activity 14	Project	The project is responsible for ensuring that plans for the project's software engineering facilities and support tools are prepared.
Activity 15	Project	The project is responsible for ensuring that software planning data are recorded.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the software planning activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for software project planning are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for software project planning are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for software project planning and reports the results.

9.4 Key Practice Classification for Software Project Tracking and Oversight

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that a project software manager is designated to be responsible for the project's software activities and results.
Commitment 2	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for managing the software project.
Ability 1	Project	The project is responsible for ensuring that a software development plan for the software project is documented and approved.
Ability 2	Project	The project is responsible for ensuring that the project software manager explicitly assigns responsibility for software work products and activities.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for tracking the software project.
Ability 4	Project	The project is responsible for ensuring that the software managers are trained in managing the technical and personnel aspects of the software project.
Ability 5	Project	The project is responsible for ensuring that first-line software managers receive orientation in the technical aspects of the software project.
Activity 1	Project	The project is responsible for ensuring that a documented software development plan is used for tracking the software activities and communicating status.
Activity 2	Project	The project is responsible for ensuring that the project's software development plan is revised according to a documented procedure.
Activity 3	Project and Organization	Both the organization and the project are responsible for ensuring that software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.
Activity 4	Project and Organization	Both the organization and the project are responsible for ensuring that approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups.
Activity 5	Project	The project is responsible for ensuring that the size of the software work products (or size of the changes to the software work products) is tracked and corrective actions are taken as necessary.
Activity 6	Project	The project is responsible for ensuring that the project's software effort and costs are tracked and corrective actions are taken as necessary.
Activity 7	Project	The project is responsible for ensuring that the project's critical computer resources are tracked and corrective actions are taken as necessary.

Key Practice	Classification	Notes
Activity 8	Project	The project is responsible for ensuring that the project's software schedule is tracked and corrective actions are taken as necessary.
Activity 9	Project	The project is responsible for ensuring that software engineering technical activities are tracked and corrective actions are taken as necessary.
Activity 10	Project	The project is responsible for ensuring that the software risks associated with cost, resource, schedule, and technical aspects of the project are tracked.
Activity 11	Project	The project is responsible for ensuring that actual measurement data and replanning data for the software project are recorded.
Activity 12	Project	The project is responsible for ensuring that the software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.
Activity 13	Project	The project is responsible for ensuring that formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the software tracking and oversight activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for software project and tracking are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for software project tracking and oversight are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for software project tracking and oversight and reports the results.

9.5 Key Practice Classification for Software Quality Assurance

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for implementing software quality assurance (SQA).
Ability 1	Project and Organization	Both the organization and the project are responsible for ensuring that a group that is responsible for coordinating and implementing SQA for the project (i.e., the SQA group) exists.
Ability 2	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for performing the SQA activities.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that members of the SQA group are trained to perform their SQA activities.
Ability 4	Project	The project is responsible for ensuring that members of the software project receive orientation on the role, responsibilities, authority, and value of the SQA group.
Activity 1	Project	The project is responsible for ensuring that an SQA plan is prepared for the software project according to a documented procedure.
Activity 2	Project	The project is responsible for ensuring that the SQA group's activities are performed in accordance with the SQA plan.
Activity 3	Project	The project is responsible for ensuring that the SQA group participates in the preparation and review of the project's software development plan, standards, and procedures.
Activity 4	Project	The project is responsible for ensuring that the SQA group reviews the software engineering activities to verify compliance.
Activity 5	Project	The project is responsible for ensuring that the SQA group audits designated software work products to verify compliance.
Activity 6	Project	The project is responsible for ensuring that the SQA group periodically reports the results of its activities to the software engineering group.
Activity 7	Project	The project is responsible for ensuring that deviations identified in the software activities and software work products are documented and handled according to a documented procedure.
Activity 8	Project	The project is responsible for ensuring that the SQA group conducts periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the cost and schedule status of the SQA activities.

Key Practice	Classification	Notes
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the SQA activities are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the SQA activities are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project	The project is responsible for ensuring that experts independent of the SQA group periodically review the activities and software work products of the project's SQA group.

9.6 Key Practice Classification for Software Configuration Management

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for implementing software configuration management (SCM).
Ability 1	Project	The project is responsible for ensuring that a board having the authority for managing the project's software baselines (i.e., a software configuration control board—SCCB) exists or is established.
Ability 2	Project	The project is responsible for ensuring that a group that is responsible for coordinating and implementing SCM for the project (i.e., the SCM group) exists.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for performing the SCM activities.
Ability 4	Project and Organization	Both the organization and the project are responsible for ensuring that members of the SCM group are trained in the objectives, procedures, and methods for performing their SCM activities.
Ability 5	Project	The project is responsible for ensuring that members of the software engineering group and other software-related groups are trained to perform their SCM activities.
Activity 1	Project	The project is responsible for ensuring that A SCM plan is prepared for each software project according to a documented procedure.
Activity 2	Project	The project is responsible for ensuring that a documented and approved SCM plan is used as the basis for performing the SCM activities.
Activity 3	Project	The project is responsible for ensuring that a configuration management library system is established as a repository for the software baselines.
Activity 4	Project	The project is responsible for ensuring that the software work products to be placed under configuration management are identified.
Activity 5	Project	The project is responsible for ensuring that change requests and problem reports for all configuration items/units are initiated, recorded, reviewed, approved, and tracked according to a documented procedure.
Activity 6	Project	The project is responsible for ensuring that changes to baselines are controlled according to a documented procedure.
Activity 7	Project	The project is responsible for ensuring that products from the software baseline library are created and their release is controlled according to a documented procedure.
Activity 8	Project	The project is responsible for ensuring that the status of configuration items/units is recorded according to a documented procedure.

Key Practice	Classification	Notes
Activity 9	Project	The project is responsible for ensuring that standard reports documenting the SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals.
Activity 10	Project	The project is responsible for ensuring that software baseline audits are conducted according to a documented procedure.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the SCM activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the SCM activities are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the SCM activities are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project	The project is responsible for ensuring that the SCM group periodically audits software baselines to verify that they conform to the documentation that defines them.
Verification 4	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for SCM and reports the results.

9.7 Key Practice Classification for Organization Process Focus

Key Practice	Classification	Notes
Commitment 1	Organization	The organization is responsible for ensuring that the organization follows a written organizational policy for coordinating software process development and improvement activities across the organization.
Commitment 2	Organization	The organization is responsible for ensuring that senior management sponsors the organization's activities for software process development and improvement.
Commitment 3	Organization	The organization is responsible for ensuring that senior management oversees the organization's activities for software process development and improvement.
Ability 1	Organization	The organization is responsible for ensuring that a group that is responsible for the organization's software process activities exists.
Ability 2	Organization	The organization is responsible for ensuring that adequate resources and funding are provided for the organization's software process activities.
Ability 3	Organization	The organization is responsible for ensuring that members of the group responsible for the organization's software process activities receive required training to perform these activities.
Ability 4	Organization	The organization is responsible for ensuring that members of the software engineering group and other software-related groups receive orientation on the organization's software process activities and their roles in those activities.
Activity 1	Organization	The organization is responsible for ensuring that the software process is assessed periodically, and action plans are developed to address the assessment findings.
Activity 2	Organization	The organization is responsible for ensuring that the organization develops and maintains a plan for its software process development and improvement activities.
Activity 3	Organization	The organization is responsible for ensuring that the organization's and projects' activities for developing and improving their software processes are coordinated at the organization level.
Activity 4	Organization	The organization is responsible for ensuring that the use of the organization's software process database is coordinated at the organizational level.
Activity 5	Organization	The organization is responsible for ensuring that new processes, methods, and tools in limited use in the organization are monitored, evaluated, and, where appropriate, transferred to other parts of the organization.
Activity 6	Organization	The organization is responsible for ensuring that training for the organization's and projects' software processes is coordinated across the organization.

Key Practice	Classification	Notes
Activity 7	Project and Organization	Both the organization and the project are responsible for ensuring that the groups involved in implementing the software processes are informed of the organization's and projects' activities for software process development and improvement.
Measurement 1	Organization	The organization is responsible for ensuring that measurements are made and used to determine the status of the organization's process development and improvement activities.
Verification 1	Organization	The organization is responsible for ensuring that the activities for software process development and improvement are reviewed with senior management on a periodic basis.

9.8 Key Practice Classification for Organization Process Definition

Key Practice	Classification	Notes
Commitment 1	Organization	The organization is responsible for ensuring that the organization follows a written policy for developing and maintaining a standard software process and related process assets.
Ability 1	Organization	The organization is responsible for ensuring that adequate resources and funding are provided for developing and maintaining the organization's standard software process and related process assets.
Ability 2	Organization	The organization is responsible for ensuring that the individuals who develop and maintain the organization's standard software process and related process assets receive required training to perform these activities.
Activity 1	Organization	The organization is responsible for ensuring that the organization's standard software process is developed and maintained according to a documented procedure.
Activity 2	Organization	The organization is responsible for ensuring that the organization's standard software process is documented according to established organization standards.
Activity 3	Organization	The organization is responsible for ensuring that the descriptions of software life cycles that are approved for use by the projects are documented and maintained.
Activity 4	Organization	The organization is responsible for ensuring that guidelines and criteria for the projects' tailoring of the organization's standard software process are developed and maintained.
Activity 5	Organization	The organization is responsible for ensuring that the organization's software process database is established and maintained.
Activity 6	Organization	The organization is responsible for ensuring that a library of software process-related documentation is established and maintained.
Measurement 1	Organization	The organization is responsible for ensuring that measurements are made and used to determine the status of the organization's process definition activities.
Verification 1	Organization	The organization is responsible for ensuring that the software quality assurance group reviews and/or audits the organization's activities and work products for developing and maintaining the organization's standard software process and related process assets and reports the results.

9.9 Key Practice Classification for Training Program

Key Practice	Classification	Notes
Commitment 1	Organization	The organization is responsible for ensuring that the organization follows a written policy for meeting its training needs.
Ability 1	Organization	The organization is responsible for ensuring that a group responsible for the training needs of the organization exists.
Ability 2	Organization and Project	Both the organization and the project are responsible for providing adequate resources and funding to implement the organizational and the project's training plans, respectively.
Ability 3	Organization	The organization is responsible for ensuring that members of the training group have the necessary skills and knowledge to perform their training activities.
Ability 4	Organization	The organization is responsible for ensuring that software managers receive orientation on the training program.
Activity 1	Project	The project is responsible for developing and maintaining a training plan that specifies its training needs.
Activity 2	Organization	The organization is responsible for ensuring that the organization's training plan is developed and revised according to a documented procedure.
Activity 3	Organization	The organization is responsible for ensuring that the training for the organization is performed in accordance with the organization's training plan.
Activity 4	Organization	The organization is responsible for ensuring that training courses prepared at the organization level are developed and maintained according to organization standards.
Activity 5	Organization and Project	The organization is responsible for ensuring that a waiver procedure is established, and the project is responsible for using the waiver procedure to determine whether or not individuals already possess the knowledge and skills required to perform their designated roles.
Activity 6	Organization	The organization is responsible for ensuring that records of training are maintained.
Measurement 1	Organization	The organization is responsible for ensuring that measurements are made and used to determine the status of training program activities.
Measurement 2	Organization	The organization is responsible for ensuring that measurements are made and used to determine the quality of the training program.
Verification 1	Organization	The organization is responsible for ensuring that the training program activities are reviewed with senior management on a periodic basis.
Verification 2	Organization	The organization is responsible for ensuring that the training program is evaluated on a periodic basis for consistency with, and relevance to, the organization's needs.

Key Practice	Classification	Notes
Verification 3	Organization	The organization is responsible for ensuring that the training program activities and work products are reviewed and/or audited, and that the results are reported.

9.10 Key Practice Classification for Integrated Software Management

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy requiring that the software project is planned and managed using the organization's standard software process and related process assets.
Ability 1	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for individuals developing the project's defined process.
Ability 2	Project and Organization	Both the organization and the project are responsible for ensuring that the individuals responsible for developing the project's defined software process receive required training in how to tailor the organization's standard software process and use the related process assets.
Ability 3	Project and Organization	Both the project and the organization are responsible for ensuring that the project's software managers receive required training in managing the technical, administrative, and personnel aspects of the software project based on the project's defined software process.
Activity 1	Project	The project is responsible for ensuring that the project's defined software process is developed by tailoring the organization's standard software process, according to a documented procedure.
Activity 2	Project	The project is responsible for ensuring that each project's defined software process is revised according to a documented procedure.
Activity 3	Project	The project is responsible for ensuring that the project's software development plan, which describes the use of the project's defined software process, is developed and revised according to a documented procedure.
Activity 4	Project	The project is responsible for ensuring that the software project is managed in accordance with the project's defined process.
Activity 5	Project	The project is responsible for ensuring that the organization's software process database is used for software planning and estimating.
Activity 6	Project	The project is responsible for ensuring that the size of the software work products (or size of changes to the software work products) is managed according to a documented procedure.
Activity 7	Project	The project is responsible for ensuring that the project's software effort and costs are managed according to a documented procedure.
Activity 8	Project	The project is responsible for ensuring that the project's critical computer resources are managed according to a documented procedure.
Activity 9	Project	The project is responsible for ensuring that the critical dependencies and critical paths of the project's software schedule are managed according to a documented procedure.

Activity 10	Project	The project is responsible for ensuring that the project's software risks are identified, assessed, documented, and managed according to a documented procedure.
Activity 11	Project	The project is responsible for ensuring that reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the effectiveness of the integrated software management activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for managing the software project are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for managing the software project are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for managing the software project and reports the results.

9.11 Key Practice Classification for Software Product Engineering

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for performing the software engineering activities.
Ability 1	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for performing software engineering tasks.
Ability 2	Project and Organization	The project and organization are responsible for ensuring that members of the software engineering technical staff receive required training to perform their technical assignments.
Ability 3	Project	The project is responsible for ensuring that members of the software engineering technical staff receive orientation in related software engineering disciplines.
Ability 4	Project	The project is responsible for ensuring that the project manager and all software managers receive orientation in the technical aspects of the software project.
Activity 1	Project	The project is responsible for ensuring that appropriate software engineering methods and tools are integrated into the project's defined software process.
Activity 2	Project	The project is responsible for ensuring that the software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process.
Activity 3	Project	The project is responsible for ensuring that the software design is developed, maintained, documented, and verified, according to the project's defined software process, to accommodate the software requirements and to form the framework for coding.
Activity 4	Project	The project is responsible for ensuring that the software code is developed, maintained, documented, and verified, according to the project's defined software process, to implement the software requirements and software design.
Activity 5	Project	The project is responsible for ensuring that software testing is performed according to the project's defined software process.
Activity 6	Project	The project is responsible for ensuring that integration testing of the software is planned and performed according to the project's defined software process.
Activity 7	Project	The project is responsible for ensuring that system and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.
Activity 8	Project	The project is responsible for ensuring that the documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process.

Activity 9	Project	The project is responsible for ensuring that data on defects identified in peer reviews and testing are collected and analyzed according to the project's defined software process.
Activity 10	Project	The project is responsible for ensuring that consistency is maintained across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the functionality and quality of the software products.
Measurement 2	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the software product engineering activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for software product engineering are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for software product engineering are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for software product engineering and reports the results.

9.12 Key Practice Classification for Intergroup Coordination

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for performing Intergroup coordination activities.
Ability 1	Project and Organization	Both the organization and the project are responsible for ensuring adequate resources and funding are provided for coordinating software engineering activities with other engineering groups.
Ability 2	Project	The project is responsible for ensuring that the support tools used by the different engineering groups are compatible to enable effective communication and coordination.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that all managers in the organization receive required training in teamwork.
Ability 4	Project	The project is responsible for ensuring that all task leaders in each engineering group receive orientation in the processes, methods, and standards used by the other engineering groups.
Ability 5	Project	The project is responsible for ensuring that the members of the engineering groups receive orientation in working as a team.
Activity 1	Project	The project is responsible for ensuring that the software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements.
Activity 2	Project	The project is responsible for ensuring that representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues.
Activity 3	Project	The project is responsible for ensuring that a documented plan is used to communicate intergroup commitments and to coordinate and track the work performed.
Activity 4	Project	The project is responsible for ensuring that the critical dependencies between engineering groups are identified, negotiated, and tracked according to a documented procedure.
Activity 5	Project	The project is responsible for ensuring that the work products produced as input to other engineering groups are reviewed by representatives of the receiving groups.
Activity 6	Project	The project is responsible for ensuring that the intergroup issues not resolvable by the individual representatives of the project engineering groups are handled according to a documented procedure.
Activity 7	Project	The project is responsible for ensuring that the representatives of the project engineering groups conduct periodic technical reviews and interchanges.

Key Practice	Classification	Notes
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the intergroup coordination activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for intergroup coordination are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for intergroup coordination are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for intergroup coordination and reports the results.

9.13 Key Practice Classification for Peer Review

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for written policies for performing peer reviews.
Ability 1	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for performing peer reviews on each software work product to be reviewed.
Ability 2	Project	Both the organization and the project are responsible for ensuring that peer review leaders receive required training in how to lead peer reviews.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that the reviewers who participate in peer reviews receive required training in the objectives, principles, and methods of peer reviews.
Activity 1	Project	The project is responsible for ensuring that the peer reviews are planned, and the plans are documented.
Activity 2	Project	The project is responsible for ensuring that peer reviews are performed according to a documented procedure.
Activity 3	Project	The project is responsible for ensuring that data on the conduct and results of the peer reviews are recorded.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the peer review activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for peer reviews and reports the results.

9.14 Key Practice Classification for Quantitative Process Management

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for measuring and quantitatively controlling the performance of the project's defined software process.
Commitment 2	Organization	The organization is responsible for ensuring that the organization follows a written policy for analyzing the process capability of the organization's standard software process.
Ability 1	Organization	The organization is responsible for ensuring that a group that is responsible for coordinating the quantitative process management activities for the organization exists.
Ability 2	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for the quantitative process management activities.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that support exists for collecting, recording, and analyzing data for selected process and product measurements.
Ability 4	Project and Organization	Both the organization and the project are responsible for ensuring that the individuals implementing or supporting quantitative process management receive required training to perform these activities.
Ability 5	Project and Organization	Both the organization and the project are responsible for ensuring that the members of the software engineering group and other software-related groups receive orientation on the goals and value of quantitative process management.
Activity 1	Project	The project is responsible for ensuring that the software project's plan for quantitative process management is developed according to a documented procedure.
Activity 2	Project	The project is responsible for ensuring that the software project's quantitative process management activities are performed in accordance with the project's quantitative process management plan.
Activity 3	Project	The project is responsible for ensuring that the strategy for the data collection and the quantitative analyses to be performed are determined based on the project's defined software process.
Activity 4	Project	The project is responsible for ensuring that the measurement data used to control the project's defined software process quantitatively are collected according to a documented procedure.
Activity 5	Project	The project is responsible for ensuring that the project's defined software process is analyzed and brought under quantitative control according to a documented procedure.

Key Practice	Classification	Notes
Activity 6	Project	The project is responsible for ensuring that reports documenting the results of the software project's quantitative process management activities are prepared and distributed.
Activity 7	Project and Organization	Both the organization and the project are responsible for ensuring that the process capability baseline for the organization's standard software process is established and maintained according to a documented procedure.
Measurement 1	Project and Organization	Both the organization and the project are responsible for ensuring that measurements are made and used to determine the status of the activities for quantitative process management.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for software quality management are reviewed with senior management on a periodic basis.
Verification 2	Project	The software project's activities for quantitative process management are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for quantitative process management and reports the results.

9.15 Key Practice Classification for Software Quality Management

Key Practice	Classification	Notes
Commitment 1	Project and Organization	Both the project and the organization are responsible for ensuring that the project follows a written organizational policy for managing software quality.
Ability 1	Project and Organization	Both the project and the organization are responsible for ensuring that adequate resources and funding are provided for managing the quality of the software products.
Ability 2	Project and Organization	Both the project and the organization are responsible for ensuring that the individuals implementing and supporting software quality management receive required training to perform their activities.
Ability 3	Project and Organization	Both the project and the organization are responsible for ensuring that the members of the software engineering group and other software-related groups receive required training in software quality management.
Activity 1	Project	The project is responsible for ensuring that the project's software quality plan is developed and maintained according to a documented procedure.
Activity 2	Project	The project is responsible for ensuring that the project's software quality plan is the basis for the project's activities for software quality management.
Activity 3	Project	The project is responsible for ensuring that the project's quantitative quality goals for the software products are defined, monitored, and revised throughout the software life cycle.
Activity 4	Project	The project is responsible for ensuring that the quality of the project's software products is measured, analyzed, and compared to the products' quantitative quality goals on an event-driven basis.
Activity 5	Project	The project is responsible for ensuring that the software project's quantitative quality goals for the products are allocated appropriately to the subcontractors delivering software products to the project.
Measurement 1	Project	The project is responsible for ensuring that measurements are made and used to determine the status of the software quality management activities.
Verification 1	Project and Organization	Both the project and the organization are responsible for ensuring that the activities for software quality management are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the activities for software quality management are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the project and the organization are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for software quality management and reports the results.

9.16 Key Practice Classification for Defect Prevention

Key Practice	Classification	Notes
Commitment 1	Organization	The organization is responsible for ensuring that the organization follows a written policy for defect prevention activities.
Commitment 2	Project and Organization	Both the organization and the project are responsible for ensuring that the project follows a written organizational policy for defect prevention activities.
Ability 1	Organization	The organization is responsible for ensuring that an organization-level team to coordinate defect prevention activities exists.
Ability 2	Project	The project is responsible for ensuring that a team to coordinate defect prevention activities for the software project exists.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for defect prevention activities at the project and organization levels.
Ability 4	Project and Organization	Both the organization and the project are responsible for ensuring that members of the software engineering group and other software-related groups receive required training to perform their defect prevention activities.
Activity 1	Project	The project is responsible for ensuring that the software project develops and maintains a plan for its defect prevention activities.
Activity 2	Project	The project is responsible for ensuring that at the beginning of a software task, the members of the team performing the task meet to prepare for the activities of that task and the related defect prevention activities.
Activity 3	Project	The project is responsible for ensuring that causal analysis meetings are conducted according to a documented procedure.
Activity 4	Project	The project is responsible for ensuring that each of the teams assigned to coordinate defect prevention activities meets on a periodic basis to review and coordinate implementation of action proposals from the causal analysis meetings. Note: For this key practice, the SW-CMM elaborates, “The teams involved may be at the organization or project level.” For this technical report, the project level was chosen.
Activity 5	Project	The project is responsible for ensuring that defect prevention data are documented and tracked across the teams coordinating defect prevention activities. Note: For this key practice, the SW-CMM is ambiguous about where this responsibility lies. For this technical report, the project level was chosen.
Activity 6	Organization	The organization is responsible for ensuring that revisions to the organization’s standard software process resulting from defect prevention actions are incorporated according to a documented procedure.
Activity 7	Project	The project is responsible for ensuring that revisions to the project’s defined software process resulting from defect prevention actions are incorporated according to a documented procedure.

Key Practice	Classification	Notes
Activity 8	Project and Organization	Both the organization and the project are responsible for ensuring that members of the software engineering group and software-related groups receive feedback on the status and results of the organization's and project's defect prevention activities on a periodic basis.
Measurement 1	Project and Organization	Both the organization and the project are responsible for ensuring that measurements are made and used to determine the status of the defect prevention activities.
Verification 1	Organization	The organization is responsible for ensuring that the organization's activities for defect prevention are reviewed with senior management on a periodic basis.
Verification 2	Project	The project is responsible for ensuring that the software project's activities for defect prevention are reviewed with the project manager on both a periodic and event-driven basis.
Verification 3	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for defect prevention and reports the results.

9.17 Key Practice Classification for Technology Change Management

Key Practice	Classification	Notes
Commitment 1	Organization	The organization is responsible for ensuring that the organization follows a written policy for improving its technology capability.
Commitment 2	Organization	The organization is responsible for ensuring that senior management sponsors the organization's activities for technology change management.
Commitment 3	Organization	The organization is responsible for ensuring that senior management oversees the organization's technology change management activities.
Ability 1	Organization	The organization is responsible for ensuring that a group responsible for the organization's technology change management activities exists.
Ability 2	Organization	The organization is responsible for ensuring that adequate resources and funding are provided to establish and staff a group responsible for the organization's technology change management activities.
Ability 3	Organization	The organization is responsible for ensuring that support exists for collecting and analyzing data needed to evaluate technology changes.
Ability 4	Organization	The organization is responsible for ensuring that appropriate data on the software processes and software work products are available to support analyses performed to evaluate and select technology changes.
Ability 5	Organization	The organization is responsible for ensuring that members of the group responsible for the organization's technology change management activities receive required training to perform these activities.
Activity 1	Organization	The organization is responsible for ensuring that the organization develops and maintains a plan for technology change management.
Activity 2	Organization	The organization is responsible for ensuring that the group responsible for the organization's technology change management activities works with the software projects in identifying areas of technology change.
Activity 3	Organization	The organization is responsible for ensuring that software managers and technical staff are kept informed of new technologies.
Activity 4 .	Organization	The organization is responsible for ensuring that the group responsible for the organization's technology change management systematically analyzes the organization's standard software process to identify areas that need or could benefit from new technology.
Activity 5	Project and Organization	Both the organization and the project are responsible for ensuring that technologies are selected and acquired for the organization and software projects according to a documented procedure.

Key Practice	Classification	Notes
Activity 6	Organization	The organization is responsible for ensuring that pilot efforts for improving technology are conducted, where appropriate, before a new technology is introduced into normal practice.
Activity 7	Organization	The organization is responsible for ensuring that appropriate new technologies are incorporated into the organization's standard software process according to a documented procedure.
Activity 8	Project and Organization	Both the organization and the project are responsible for ensuring that appropriate new technologies are incorporated into the projects' defined software processes according to a documented procedure.
Measurement 1	Organization	The organization is responsible for ensuring that measurements are made and used to determine the status of the organization's activities for technology change management.
Verification 1	Organization	The organization is responsible for ensuring that the organization's activities for technology change management are reviewed with senior management on a periodic basis.
Verification 2	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for technology change management and reports the results.

9.18 Key Practice Classification for Process Change Management

Key Practice	Classification	Notes
Commitment 1	Organization	The organization is responsible for ensuring that the organization follows a written policy for implementing software process improvements.
Commitment 2	Organization	The organization is responsible for ensuring that senior management sponsors the organization's activities for software process improvement.
Ability 1	Project and Organization	Both the organization and the project are responsible for ensuring that adequate resources and funding are provided for software process improvement activities.
Ability 2	Project and Organization	Both the organization and the project are responsible for ensuring that software managers receive required training in software process improvement.
Ability 3	Project and Organization	Both the organization and the project are responsible for ensuring that the managers and technical staff of the software engineering group and other software-related groups receive required training in software process improvement.
Ability 4	Organization	The organization is responsible for ensuring that senior management receives required training in software process improvement.
Activity 1	Organization	The organization is responsible for ensuring that a software process improvement program is established which empowers the members of the organization to improve the processes of the organization.
Activity 2	Organization	The organization is responsible for ensuring that the group responsible for the organization's software process activities (e.g., software engineering process group) coordinates the software process improvement activities.
Activity 3	Organization	The organization is responsible for ensuring that the organization develops and maintains a plan for software process improvement according to a documented procedure.
Activity 4	Organization	The organization is responsible for ensuring that the software process improvement activities are performed in accordance with the software process improvement plan.
Activity 5	Organization	The organization is responsible for ensuring that software process improvement proposals are handled according to a documented procedure.
Activity 6	Project and Organization	Both the organization and the project are responsible for ensuring that members of the organization actively participate in teams to develop software process improvements for assigned process areas.
Activity 7	Project and Organization	Both the organization and the project are responsible for ensuring that where appropriate, the software process improvements are installed on a pilot basis to determine their benefits and effectiveness before they are introduced into normal practice.

Activity 8	Project and Organization	Both the organization and the project are responsible for ensuring that when the decision is made to transfer a software process improvement into normal practice, the improvement is implemented according to a documented procedure.
Activity 9	Project and Organization	Both the organization and the project are responsible for ensuring that records of software process improvement activities are maintained.
Activity 10	Project and Organization	Both the organization and the project are responsible for ensuring that software managers and technical staff receive feedback on the status and results of the software process improvement activities on an event-driven basis.
Measurement 1	Project and Organization	Both the organization and the project are responsible for ensuring that measurements are made and used to determine the status of the software process improvement activities.
Verification 1	Project and Organization	Both the organization and the project are responsible for ensuring that the activities for software process improvement are reviewed with senior management on a periodic basis.
Verification 2	Project and Organization	Both the organization and the project are responsible for ensuring that the software quality assurance group reviews and/or audits the activities and work products for software process improvement and reports the results.

10 Conclusion

Examining the relationship between the TSP and the SW-CMM shows the TSP strongly supports the key practices of the SW-CMM, especially the project-level practices it targets. When adopted across an organization, the TSP is an instantiation of an effective, high-maturity process.

Organizations choosing to use the TSP should have no concerns about compatibility between the TSP and the SW-CMM. In fact, an organization can build or tailor its SW-CMM based process improvement effort around the consistent, high-maturity operational framework provided by the TSP.

11 References

[Ferguson 99] Ferguson, P.; Leman, G.; Perini, P.; Renner, S.; & Seshagiri, G. *Software Process Improvement Works! Advanced Information Services Inc*. (CMU/SEI-99-TR-027, ADA371804). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, 1999. <http://www.sei.cmu.edu/publications/documents/99.reports/99tr027/99tr027abstract.html>

[Hayes 97] Hayes, W.: & Over, J. *The Personal Software Process (PSP): An Empirical Study of the Impact of PSP on Individual Engineers*. (CMU/SEI-97-TR-001, ADA 335543). Pittsburgh, PA.: Software Engineering Institute, Carnegie Mellon University, 1997. <http://www.sei.cmu.edu/publications/documents/97.reports/97tr001/97tr001abstract.html>

[Herbsleb 94] Herbsleb, J.; & Carleton, A. et al., *Benefits of CMM-Based Software Process Improvement: Initial Results*. (CMU/SEI-94-TR-013, ADA 283848). Pittsburgh, PA: Software Engineering Institute, Software Engineering Institute, Carnegie Mellon University, 1994. <http://www.sei.cmu.edu/publications/documents/94.reports/94.tr.013.html>

[Humphrey 89] Humphrey, W. *Managing the Software Process*. Reading, MA: Addison-Wesley Publishing Company, Inc., 1989.

[Humphrey 95] Humphrey, W. *A Discipline for Software Engineering*. Reading, MA: Addison-Wesley Publishing Company, Inc., 1995.

[Humphrey 98a] Humphrey, W. “Three Dimensions of Process Improvement Part I: Process Maturity.” *Crosstalk: The Journal of Defense Software Engineering 11,* 2 (February 1998): 3–16. <http://www.stsc.hill.af.mil/crosstalk/1998/feb/processimp.asp>

[Humphrey 98b] Humphrey, W. "Three Dimensions of Process Improvement Part II: The Personal Process." *Crosstalk: The Journal of Defense Software Engineering 11,* 3 (March 1998): 13–15. <http://www.stsc.hill.af.mil/crosstalk/1998/mar/dimensions.asp>

[Humphrey 98c] Humphrey, W. "Three Dimensions of Process Improvement Part III: The Team Process." *Crosstalk: The Journal of Defense Software Engineering 11,* 4 (April 1998): 14–17. <http://www.stsc.hill.af.mil/crosstalk/1998/apr/dimensions.asp>

[Humphrey 00] Humphrey, W. *Introduction to the Team Software Process.* Reading, MA: Addison-Wesley Publishing Company, Inc., 2000.

[Humphrey 02] Humphrey, W. *Winning with Software: An Executive Survival Strategy.* Reading, MA: Addison-Wesley Publishing Company, Inc., 2002.

[Lawlis 95] Lawlis, P.; Flowe, R.; & Thordahl, J. "A Correlational Study of the SW-CMM and Software Development Performance." *Crosstalk: The Journal of Defense Software Engineering 8,* 9 (September 1995): 21–25.

[McAndrews 00] McAndrews, D. *The Team Software Process: An Overview and Preliminary Results of Using Disciplined Practices*. (CMU/SEI-2000-TR-015). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, 2000. <http://www.sei.cmu.edu/publications/documents/00.reports/00tr015.html>

[Paulk 95] Paulk, M., et al. *The Capability Maturity Model: Guidelines for Improving the Software Process.* Reading, MA: Addison-Wesley Publishing Company, Inc., 1995.

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13. ABSTRACT (MAXIMUM 200 WORDS)

Organizations using the Capability Maturity Model for Software® (SW-CMM®) to guide their software process improvement efforts often struggle with implementation details. The Team Software Process℠ (TSP℠) was designed to implement effective, high-maturity processes for project teams. The TSP contains a framework as well as a set of processes, procedures, guidelines, and tools for project teams to use in the production of high-quality software on time and on budget.

Since the SW-CMM describes *what* an organization at a high level of process maturity should be doing, and the TSP describes *how* high-maturity processes are implemented for project teams, the question arises: If all projects in an organization were using the TSP, would the organization exhibit the characteristics of high process maturity, as described in the SW-CMM? To help answer this question, we performed an analysis of the degree to which the SW-CMM is addressed by the TSP. Each key practice described in the SW-CMM was classified as having an organizational or project scope, or both. Then each practice was examined to determine how it was addressed by the TSP. The results presented in this report show that the TSP implements a majority of the key practices of the SW-CMM.

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