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Interim Profile

Development and Trial of a Method to Rapidly Measure Software Engineering Maturity Status

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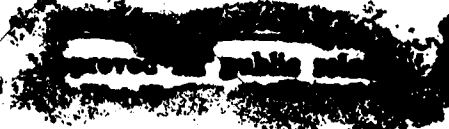Will Hayes
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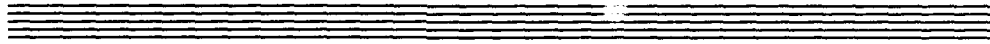
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Empirical Methods Project

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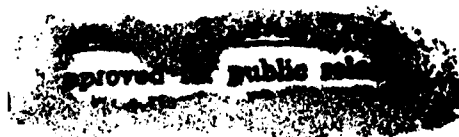
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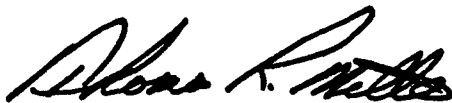
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The ideas and findings in this report should not be construed as an official
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information exchange.

Review and Approval

This report has been reviewed and is approved for publication.

FOR THE COMMANDER

Thomas R. Miller, Lt Col, USAF
SEI Joint Program Office

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Acknowledgments

The interim profile method could not have been designed without the generous assistance of the individuals listed below to review and comment on the requirements document.

Interim Profile

Development and Trial of a Method to Rapidly Measure Software Engineering Maturity Status

Abstract: Development of an interim profile (IP) method was driven by a business need to rapidly measure an organization's software engineering process maturity between organizational software process assessments (SPAs). This document provides information about the process used to develop the method and a description of the method to software engineering process group (SEPG) members and practitioners responsible for diagnosing software process maturity. This document also addresses the next steps in the further development and use of the interim profile method.

1   Introduction

1.1 Need for the IP Method

In the past, senior and middle managers had limited capability to measure the status of software process improvement between software process assessments (SPAs). A SPA usually is done 18 to 36 months after an improvement plan is begun. Following a SPA, organizations often lacked a CMM-based method for tracking progress toward software process improvement goals. Software Engineering Institute (SEI) clients voiced a need to measure their progress against their organizations' CMM objectives on a more frequent basis. The value of the interim profile method is that it makes it easier to get an objective and reliable status update of process improvement progress on an annual basis. This is a need which is not met by the current practice of providing progress and status briefings to managers.

1.2 Background

In August 1990, Pacific Bell (San Ramon, California) conducted an SEI self-assessment in the Systems Technology organization. The SEI-trained assessment team reported findings, and a variety of action plans were implemented to address the issues identified. At the time, the organization consisted of three software development/maintenance departments totaling over 1800 employees. Each department developed process improvement action plans and established departmental groups (similar to software engineering process groups or SEPGs) to support its efforts. Each departmental group developed and used a variety of mini-assessments, project evaluations, and project audit methods to identify further areas for improvement in projects/workgroups. The use of these differing methods made it difficult for senior management to gain insight into the overall status of software process improvement efforts.

Senior management wanted more frequent information on the status and progress of software process improvement efforts underway throughout the organization. This information is useful to managers because comparisons of current information with the baseline established in software process assessments play an important role in determining future process improvement efforts and making other business decisions. During 1990-91, several modified software process assessments were tried out by SEPGs within the 1800 person organization. While these individual approaches may, in fact, work best to enable individual departments to carry out their own process improvement changes, the variety of methods available did not provide management with a standard yardstick for measuring process maturity status. Therefore, the organization needed a consistent method to check the status of its process improvement effort. Furthermore, because the method would be used more frequently than the SPA, the cost and effort would need to be substantially less than a SPA.

Senior management at the Pacific Bell Systems Technology organization asked their central software engineering process group to develop a means for measuring all of the software projects in the organization compared to the CMM In September of 1991. In January 1992, Pacific Bell representatives met with the SEI Empirical Methods (EM) Project to discuss the possibility of working together to meet the senior management's need. As a result of those discussions, a Pacific Bell resident affiliate position was established at the SEI. The collaborative relationship supported codevelopment of the interim profile method.[1]

1.3 SEI Involvement

The Pacific Bell partnership presented a new opportunity for the SEI Process Program. This opportunity to collaborate with an industry partner provided four leverage points for the SEI. The partnership was a means to:

- extend SEI resources,
- meet customer requirements for a new product to support continuous process improvement,
- accelerate product development, and
- test another product (the maturity questionnaire) that was under development.

A key factor in the SEI decision to collaborate was the invitation by Pacific Bell to use the interim profile development effort as a site for testing early prototypes of the SEI's CMM-based maturity questionnaire. Pacific Bell's San Ramon facility housed about 2000 software professionals, which was large enough to allow for efficient and extensive usability testing at a single site.

In return for Pacific Bell's support, the SEI assigned members of its technical staff to provide method design and testing guidance and to support field trials. As testing was completed, EM

[1.] This approach to collaborative product development, in which SEI's customer proposed and managed the development of a product was a first for the SEI.

staff assessed the reliability of product prototypes. The final role EM expects to carry out with Pacific Bell is to support transition of the method to the community.

Thus, both Pacific Bell and the SEI benefited from the collaborative approach to product development.

1.4 Audience

We expect this report to interest and be useful to two groups: (1) practitioners who are tracking the status of methods to use in determining software process maturity and (2) practitioners considering the option of collaboration with the SEI to develop new methods for determining software process improvement progress.

This report should assist readers in understanding what an interim profile is and where it fits in an overall software process improvement effort.   ·

Materials explaining how to perform interim profiles will be forthcoming in 1994.

1.5 Organization of This Report

In Chapter 1 we presented a brief background of the IP method. In Chapter 2, we present a brief discussion of existing SEI software process appraisal work to set the context from which this work emerged. Some of the key features of the SPA method are discussed, and the difference in focus between that method and interim profiling are highlighted.

Chapter 3 addresses the requirements, design, and implementation of the IP method. It also includes a discussion of the process for developing the final requirements for the method.

In Chapter 4, the steps of the method are presented following a graphical depiction of the method flow. Finally, Chapter 5 presents key findings from the initial trials of the method followed by a brief discussion of future directions for the method. This report is not intended to provide a detailed set of instructions for executing the IP method. Nor does it include specific data from the participants of the initial trials.

2 Existing Methods to Measure Process Improvement

2.1 SPA Method

The SEI SPA method is an intensive 5-day investigation by a team of 6 to 10 individuals. During this time, the SPA team interviews approximately 40 members of the organization and conducts 3 or 4 briefings aimed at raising awareness and involvement in an organization's software process improvement effort. Through the use of interviews and feedback briefings process, the SPA team develops a deep understanding of the organization's software process and creates organization-wide buy-in to the need for the proposed software process improvements.

The SPA objectives are to:

- learn how the organization works,
- identify its major problems, and
- engage its opinion leaders and senior managers in the change process.

An assessment aims to prioritize areas for improvement and to provide guidance on how to make those improvements.[2] After a SPA, an organization develops and implements an action plan to address major findings from the SPA. Then, after 18 to 36 months, the organization conducts another SPA to reassess its process capability.

The IP method's goal of tracking an organization's progress towards higher levels of maturity on a large scale rapidly and economically differs from the goals of the SPA method. The interim profile method presumes that the process improvement has already been started and participation in process improvement is organization wide. Also, SPAs require that an organization change (unfreeze) its current process and build an organizational climate conducive to change. For the IP method, this change is underway/occurring. IP is an activity within a SPI effort to provide project leaders and management objective data on an on-going basis to track the improvements already in progress throughout the organization.[3]

2.2 The Maturity Questionnaire

The maturity questionnaire (MQ) is an SEI product that provides initial information for software process appraisals.[4] The interim profile method draws heavily upon the maturity questionnaire. In SPAs and software capability evaluation (SCEs), the MQ serves as the primary, but not sole, source of data regarding the software process maturity of the projects within an organization; the SPA and software capability evaluation methods have

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[2.] W.S. Humphrey, *Managing the Software Process*, Addison-Wesley, Reading, MA, 1989.

[3.] A table listing differences between SPA and IP is presented on page 13.

[4.] The first version of the questionnaire (SEI 87 TR-23) was used extensively in SPAs and software capability evaluations (SCEs).

supplemented the data collected on the MQ with interviews and document reviews.[5] Therefore, there has been less reliance on the MQ within these methods for determining software process maturity.

The latest MQ was designed to sample important issues for software process improvement, as described in the Capability Maturity Model for Software (CMM) Version 1.1. The questionnaire focuses on a wide range of issues covered in the CMM, with the expectation that detailed examination of specific maturity issues is accomplished through various validation techniques such as interviews, focus groups and existence of appropriate artifacts.

[5.] These methods are currently being reviewed and will use an upgraded version of the MQ. A sample page from the IP beta trial version of the MQ is in Appendix A.

3 Overview of Interim Profile Method Development

Based on the needs expressed in Chapter 1 and the availability of draft versions of the maturity questionnaire (MQ), Pacific Bell and the SEI began development of the interim profile method. Because the testing and delivery of the IP method occurred in a controlled situation, the SEI was able to use this effort as leverage to gather usability data on preliminary drafts of the MQ. This resulted in continuous upgrades to the MQ throughout the development of the IP method.

3.1 Requirements Phase

Pacific Bell and the SEI started gathering extensive requirements for the method at the 1992 SEPG National Meeting. Meetings were held with other companies experienced in SEI SPAs and with companies trying or using supplemental assessment methods in their process improvement efforts. The companies involved included: Hughes, Hewlett-Packard, Texas Instruments, Schlumberger, Software Productivity Consortium, and IBM Federal Systems Company. Interviews were conducted to determine the needs within Pacific Bell, how the product should be used, and the potential future uses of the method. Interviews were also conducted outside Pacific Bell to determine industry needs, possible markets, and method features. The initial IP requirements document described final outputs, functional requirements lists, and functional diagrams for each step in the IP method.

The requirements for the IP method were distributed within and outside of Pacific Bell for comments. Feedback from reviewers was used to finalize the method design. In particular, the feedback identified specific method steps to check for accuracy and allow questionnaire respondents to provide additional input to revise the profile results. Feedback on the requirements document also identified major design issues to be addressed.

3.2 Method Design Phase

Based on the requirements information gathered, Pacific Bell and the SEI made seven major decisions at the beginning of the design stage for the IP method. The method would:

1. use the SEI MQ as the data gathering vehicle, thus decreasing the likelihood of major differences in initial data about process maturity for a SPA, SCE, and IP;

2. report the results of the questionnaire in key process area (KPA) profiles both for individual projects and for the organization as a whole so that the projects received feedback in addition to the organization;[6]

3. focus on information to determine the maturity status against the CMM;

4. place minimal demands on the participants' time;

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[6] A three-point scale of: "not satisfied," "partially satisfied," and "fully satisfied" was used pending release of the SEI upgraded rating method in 1994.

5. seek economical ways to collect pertinent supplemental data to help interpret the questionnaire results;

6. follow the confidentiality rules of the SEI SPA method; and

7. include a feedback loop to allow respondents to provide input for revisions to preliminary drafts of the project profiles.

The requirements process and these initial design decisions led to the identification of three primary areas of risk to address in the detailed design of the IP method:

1. accuracy of results,

2. method reliability, and

3. appropriate use of results.

These critical design areas are discussed in the three sections that follow.

3.2.1 Accuracy of Results

The accuracy of results continues to be a significant concern because results are based primarily on the responses to the maturity questionnaire. Unlike SPA, the interim profile method does not use additional data collection steps, such as interviews or focus groups. However, the method takes a different approach from a SPA by having a number of team members fill out the questionnaire and gathering additional data on their confidence in their responses.

In interim profile, the MQ is completed by a majority of project members as opposed to a SPA, where one or two members complete it for the entire team. All software managers and practitioners are encouraged to complete the MQ. High rates of agreement among the MQ responses for project members increases confidence in the conclusions drawn from the responses. In addition, a feedback step in the method is used to obtain each participating project's verification of the accuracy of its results. If an individual group does not believe the results accurately reflect their capability maturity status, a review process is in place to resolve issues and make changes as appropriate to the project's key process area profile.

3.2.2 Method Reliability

Consistency in the method implementation and analyzing the results are viewed as key in addressing the reliability of the method. Reliability issues are addressed through the design of the method and through the incorporation of quantitative indicators. Use of the CMM as an accepted reference model, against which previous assessments and action plans were created at Pacific Bell, ensures consistency with respect to the use of the results. Also, use of the maturity questionnaire (MQ) provides the ability to ask the same questions of all respondents.

Another aspect to increase reliability of the method is the emphasis on a consistent manner in conducting on-site sessions. Specific and consistent instructions for administration of the questionnaire were developed to be used with each questionnaire response session. Also, the

delivery of the overview training for the participants, training for management, and the review process were documented and delivery of each was conducted in the same manner, stressing the same key points and providing an environment open to questions from the participants and management alike.

The following section describes the specific indices of reliability and the methods used to compute them.

3.2.2.1 Indicators of Reliability

For each question on the maturity questionnaire, respondents were asked to select from one of four answers: yes, no, does not apply, and don't know. (See Appendix A, which contains an example page of the MQ.) These responses are used to judge the implementation of key practices in the process used at the organization. In addition to these four response options, the respondents are asked to provide a confidence rating about their response to each question. These ratings are used to capture the respondents' confidence that the answer they gave is accurate. The confidence ratings provided by respondents' are used to quantify the reliability of the information regarding implementation of practices in the organization.[7] We quantify the reliability by using two indicators:

1. The *overall degree of confidence* is a global summary of the percentage of responses that were given with high confidence by the respondents.

2. The *yes degree of confidence* is a similar summary of the percentage of responses given with high confidence, except that it reflects only 'yes' responses.

Computing both of the reliability indicators involves the aggregation of responses across all questions on the questionnaire, as well as across all respondents within a group. For project-level profiles, all respondents in the project are included. Likewise, for organization-level profiles, all respondents in the organization are included. This aggregation is needed to preserve the anonymity of the respondents.

In addition to the two indices of reliability described above, other sources of information are used to reflect contextual information about the pool of responses collected. These indices reflect the degree to which the MQ respondents represent the complete set of potential respondents or project members.

*   The *percentage of group responding* is simply the percentage of the total group (project or organization) who completed questionnaires. In addition to this percentage, the number of people participating is reported as a fraction in order to reflect the size of the total group from which respondents were selected.

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[7] In the social sciences, the reliability of a measurement instrument (i.e., a questionnaire) can be expressed as the correlation between the outcomes (score) on two different administrations of the instrument. Due to the methodological issues surrounding the concept of process maturity, a strict numerical (correlation) approach was viewed as inappropriate. As a result, we have used a proxy to represent the magnitude of the correlation. We believe that the more confident a respondent is in giving a particular answer, the more likely he or she would be to give the same answer on different administrations of the same instrument.

Using demographic information about questionnaire respondents, the experience level reflected in the people responding to the MQ is also provided. This is done so that projects can use the experience data to determine how well the respondents represented the total group in their level of experience and what impact that may have had on their results. In order to understand the interpretation of experience level, the reader must be familiar with the concept of percentiles.[8] The 25th and 75th percentiles for the distribution of experience across all respondents are calculated.

- The percentage of respondents in *each project* whose years of experience is less than the 25th percentile for the population is reported to show the number of *novices* in the project (relative to the entire set of respondents).

- The percentage of respondents in *each project* whose years of experience is more than the 75th percentile for the population is reported to show the number of *experts* in the project (relative to the entire set of respondents).

The above distinction between novices and experts is admittedly artificial. However, with knowledge of the history of the organization as well as the experience level of the staff, managers in the organization can estimate how well the people responding to the MQ represent the experience level of the group as a whole.

3.2.3 Appropriate Use of Results

The use/misuse of results is an important issue in all evaluative methods. Therefore, in the design of the interim profile method, management training on the use of the results was seen as an important step. This training explains the treatment of the data in deriving the results in order to help managers make proper interpretations, and avoid reading more into the results than is warranted.

Training for managers includes specific information on the ways data should and should not be used. The topics in the training address the following classes of issues that a manager might have:

- assessing the results,
- planning improvement,
- using the method with other metrics, and
- addressing cautions in using IP.

Finally, in an effort to set appropriate expectations for the results obtained in the method, managers are presented with information describing the similarities between SPA and IP, as well as the differences between the two methods. The similarities are:

[8.] For any given set of quantitative observations, the observations may be separated according to some commonly accepted methods for deriving 'cut-scores.' One such scheme is to identify the value below which 25% of the observations fall, and the value above which 25% of the observations lie. These two values are termed the 25th and 75th percentiles, respectively.

- Both use the CMM as a framework reference standard.
- Both use the SEI maturity questionnaire and respondent questionnaire (RQ).
- Both tools help diagnose current status.

Differences between the two methods are listed in Table 1. Additionally, interim profile results include both key process area (KPA) ratings and reliability factors, thereby making it necessary for a project or organization to look at both components in order to determine how reliable they believe the information to be and to what extent they wish to use the data to continue or change their process improvement plans. It was also felt that by providing two components of data, it would tend to de-emphasize the focus on comparing results and, instead, focus on the action required to continue process improvement.

Table 1: Differences Between SPA and IP

Software Process Assessment (SPA)	Interim Profile (IP)
Organization uses to improve software process	Organization uses to check status of process improvement efforts between organizational self-assessments
Findings may include issues not in the CMM	Profile restricted to CMM KPAs
Collaborative approach — members of the organization are on the assessment team	Expert approach — two people (profile builders) evaluate responses to questionnaire
Catalyst for process improvement	Checkpoint for process improvement
Organizational results only	Organizational and individual project profiles
Trained team verifies and probes for more information and more details of answers to the questions	To analyze data, profile builders use only the information provided through the responses to the questionnaire comments and organizational knowledge and verification inputs.

4 Detailed Description of the Interim Profile Method

This chapter describes the process activities of the interim profile method and definitions of the roles/functions of the method. The method is presented first in order to explain the activities; then, the roles are defined to support the method. This chapter also includes a summary of the effort required to implement each phase at the trial sites. Detailed development and trial effort data for Pacific Bell and the SEI are not included in this report.

Figure 1 illustrates the general process activity in each phase of the interim profile method. These activities are then described in Sections 4.1-4.4.
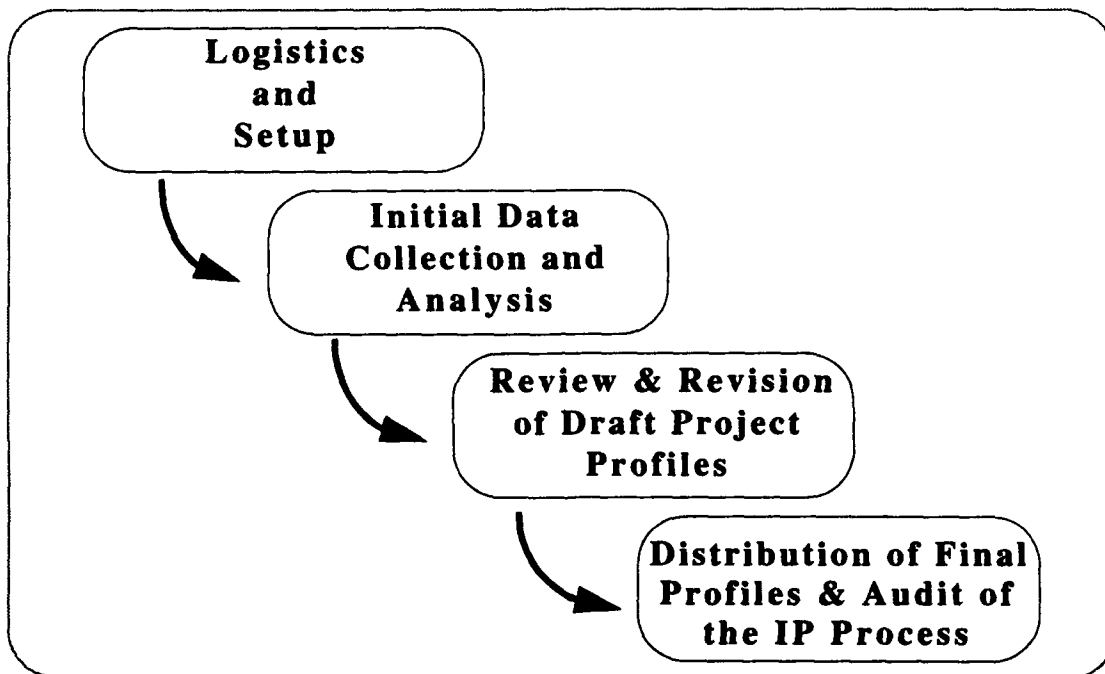

Figure 1: Interim Profile Process Flow

The roles defined include:
- on-site coordinator
- management overview trainer
- questionnaire facilitator
- data reduction performer
- profile builder
- results distributor, and
- results reviewer.

4.1 Logistics and Setup

During this phase of the process three main activities occur:

- identification of the population,
- preparation of materials, and
- scheduling and logistics coordination.

Identification of the population entails creating a complete list of projects within the organization requesting the interim profile. This list should include at a minimum: project/workgroup name, project manager/group leader, and number of project members. This information is used for all communications with the groups of respondents and provides background information which may be of use when the questionnaire responses are summarized and rated.

Preparation of materials should occur well in advance of the planned administration of the questionnaire. Questionnaires should be numbered for tracking purposes. The use of identification numbers stamped on each questionnaire allows anonymous reporting of the information, thus avoiding attribution of information to individual respondents.

Scheduling and logistics require advance planning and consideration for the potential participants. Multiple two-hour sessions should be set up to make completion of the questionnaire as convenient as possible, thereby meeting the requirement that this method cause the least disruption possible to the workforce. Communication regarding dates and locations should be made well in advance to enable people to work this activity into their schedule. Alternative appointments should be made available for cases where the group cannot be appropriately represented.

Rooms for the questionnaire administration must be sufficient in size to provide comfortable seating for the respondents. Tables able to accommodate people with multiple, spread-out forms are needed.

Sufficient numbers of questionnaire packages, each containing a maturity questionnaire, respondent data questionnaire, confidence data questionnaire, and instructions, need to be printed and delivered to the site in advance.

During the initial planning phases, it is also advisable to begin identifying potentially problematic terms used on the MQ. A review of the questionnaire should be conducted by the organization in order to provide an explanation of the language used in the MQ from the CMM in terms of the language that is used by the people who will be completing the MQ.

4.2 Initial Data Collection and Analysis

Scheduling and logistics coordination requires effective contingency planning and coordination with both the support staff and the interim profile participants. This method requires that the questionnaires be administered in a group setting, using standardized

instructions to ensure that all respondents have the same understanding of the purpose and intent of the method. It is very important that the administrator of these sessions be knowledgable in the subject matter and the organization in which the respondents work. The sessions typically take two hours, with the first 30 minutes reserved for an overview of the purpose, scope, outputs, and use of the outputs.

A trained facilitator covers issues including background of the method and samples of profiles. The facilitator also instructs participants on how to complete the questionnaires and how to ask questions, and emphasizes the need for individual answers, not consensus of the workgroup or others sitting at the table. Before the participants leave, the facilitator checks the completed questionnaires to ensure proper workgroup identification.

Data entry for this type of effort can require a great deal of time and effort. It is very important that the files created be checked for accuracy and completeness.

Once the questionnaire data have been entered and checked for accuracy, the first draft of the project profiles is created. Because of the need to examine numeric results (e.g., number of people answering yes or no) as well as comments written to clarify the answers, this part of the method is very human-intensive. The interpretation of comments and the profile builders' knowledge of the organization contributes a great deal to the interpretation of the responses. Rating rules were developed for the IP method based on information gathered during requirements elicitation from individuals conducting various versions of CMM-based evaluations.[9]

4.3   Review and Revision of Draft Project Profiles

The review cycle is an extremely important process in the interim profile method. This process acts as the validation step usually found in traditional CMM-based assessments. Participating projects must review their results before they are summarized at the organizational level and given to senior management. Project results are confidential to the project and are distributed only to the designated project manager to review with his or her project. A documented review process is included with the results so that teams know what they are expected to do.

After the project team receives the results, all members of the team review the results. If the team has any questions or would like to challenge the results, they contact the results reviewer. The results reviewer (see Section 4.5) will meet with the team to explain the results and to determine if changes should be made to the profile. An example of the organization profile is presented in Appendix B.

Resolution of the challenges to the results must be completed within a designated time frame (generally two to three weeks). Changes to a profile require objective evidence to substantiate the change. If evidence exists that contradicts the initial profiles, appropriate changes are made to the project profiles.

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[9] The rating rules will be rewritten to incorporate the upcoming SEI common rating framework document. For that reason and others, the rating rules used in the method trials at Pacific Bell and other locations are not presented here.

4.4 Distribution of Final Profiles and Audit of the IP Process

Using approved project profile data from projects, an organizational profile is constructed. This organizational profile is designed to provide information to senior management. The profile summarizes the percentage of projects rated in each KPA as fully satisfied, partially satisfied, or not satisfied. The organizational profile also includes reliability factors summarized at the organizational level as discussed in Section 3.2.2. An example of the organization profile is presented in Appendix C.

Organizational profiles are available to all members of the organization. They are distributed to the senior management team in advance of being distributed to the entire organization. On the other hand, project profiles are confidential. Finalized project profiles are distributed only to the designated project managers. The project team must determine if and how they will share their results with their middle and senior managers.

The interim profile process should be evaluated with respect to its usefulness to the organization and the accuracy of the results. In addition, other data should be collected to capture respondents' views regarding things that worked well and things that did not work well in the process. The findings of this audit process, and the actions taken in response to them, should be communicated back to the participants. One method for collecting this type of feedback — the interim profile results survey — is discussed in Appendix D.

4.5 Roles

It is important to identify roles and responsibilities involved in the implementation of the IP method. The roles and their functions are listed below. In some cases, multiple roles may be performed by one individual. This is dependent on the organization's size, culture, experience, etc., and is determined during implementation planning.

On-site coordinator

This role performs the up front project planning on all aspects of implementation. This coordinator has overall responsibility of on-site communication, logistics and setup, sponsorship building, and customization of the results distribution and review process. In addition, the on-site coordinator works with the on-site software process improvement groups to coordinate support and involvement.

Management overview trainer

This role provides the management training to the appropriate/identified senior and middle managers. The function could be performed by the on-site coordinator, a sponsoring senior or middle manager, or a member of the software engineering process group (SEPG). At Pacific Bell, a train-the-trainer approach was selected. Three senior managers were trained, and they trained the middle managers.

Questionnaire facilitator

This role is responsible for delivering the up-front overview of the method and detailed instructions on completing the questionnaire to the questionnaire respondents/participants. The facilitator must be able to answer all questions from the participants, maintain "control" of the session and ensure that all questionnaires have been correctly labeled with project and individual identities mapping to the correct profiles. In addition, the facilitator is responsible for building the organizational master mapping list and providing it to the data reducer so that the correct questionnaire responses are mapped to the correct identified projects and organizations. This master mapping list includes the organizations, projects in the organization, and completed questionnaires in each project. The list also includes total number of members of each team so the project participation data can be determined.

Data reducer

This role inputs the data and summarizes the responses to the groupings identified in the master mapping list. A response report is generated for each project/group identified with the summarized responses, comments, and confidence rating data.

Profile builder

This role is responsible for producing the final results upon completion of the review phase. Producing the results requires the evaluation and rating of the MQ responses using the rating rules. This role requires individuals well experienced with the SEI CMM, preferably with assessment training and experience. In the trials conducted to date, the maximum number of profile builders was three.

Results distributor

In planning activities, the process for results distribution is determined for both initial and final profiles. The results distributor is responsible for seeing that the process is followed and that individual profile results are distributed to the participating project following the confidentiality rules discussed previously.

Results reviewer

This role is responsible for making decisions on whether the profile should be changed based on the information provided by the project. Once the reviews are completed, this function is responsible for notifying the profile builder and results distributor of the changes. This may be one or many individuals.

4.6 Effort Required to Implement IP

In addition to the trial and implementation at Pacific Bell, additional trials were conducted with three industry organizations and two Department of Defense software development groups. In total, 11 sites and 165 projects have completed an interim profile.

Table 2 depicts the average or range of time to complete the activity phases of interim profile based on the work at Pacific Bell and participating trial sites. Ranges are provided because the effort varied depending on the size of the site, quality of the data, and communication requirements.

Table 2: Time Required to Complete IP Phases

Phase	Description	Completion time
Phase 1	Logistics and Set-Up	70-100 hours
Phase 2	Initial data collection and analysis	
	Management training	2 hours
	Participant briefing and question completion (per participant)	2 hours
	Questionnaire administration (per organization)	1-4 days
	Data reduction and report generation	10-20 days
	Profile analysis and generation	1-4 days
	Distribution	4-24 hours
Phase 3	Review and revision	
	Project teams	1-4 hours
	Results reviewer	4-20 hours
Phase 4	Distribution of organizational results	1-2 days

It appears from the trials to date that the interim profile cost is approximately one-fourth the cost of a full software process assessment. However, it is important to point out again that interim profile cannot replace a SPA as the initial appraisal for launching a software process improvement initiative.

5 Key Findings

Pacific Bell used two types of data gathering techniques to evaluate the method and look for ways to improve the interim profile process. First, feedback surveys were sent to all participating project managers to check for perceived accuracy of the profiles, ability of the team participants to represent the group, and finally, whether the questionnaire addressed the software engineering processes of the group. Second, separate focus groups for middle and senior managers, project managers, and technical professionals were held to identify strengths and weaknesses of the method along with recommendations for improvement.

In general, the combination of this data allowed us to identify the following benefits and areas for improvement of the IP method as described below.

Benefits: the IP method provides:

- Overall view of organizational position.

- Objective view of individual project status.

- General perception of no penalty among participants, as a result of confidentiality principles.

- Vehicle for more education and information on CMM and process improvement.

Areas for improvement:

- Questionnaire language. The focus group feedback indicated that many participants did not like the language of the questionnaire. They found it cumbersome and hard to translate into their local terms.

- Questionnaire response categories. It was felt that the response categories limited the ability of the respondents to identify what was actually in place, in progress. Suggestions were made to use a different kind of response classification, ranging from "Not done at all," to partially in place, to fully operational.

- Rating rules. This issue is directly related to the response categories. Participants felt that the criteria for answering yes was unreasonable and limiting. Again, it was felt that a different response category could improve this.

- More coordination of on-site process improvement support. Project teams expressed the need for more support from either the local SEPG or core software engineering process improvement (SEPI) team to help them understand the results and use them as a basis for improvement action. This particular issue has been addressed in interim profile trials at subsequent non-Pacific Bell sites.

To date, the method has been trialed at 11 organizations within 6 companies. These have included military, commercial, and in-house software development organizations. The feedback from the additional trials has tended to affirm the issues raised during the Pacific Bell trials. Nonetheless, the general response to the method has been very positive.

6   Summary

The development of the interim profile method was driven by a need among software organizations for a way to monitor improvements in software process maturity between software process assessments. Because the method would be employed frequently, it had to be relatively low in cost to conduct and require minimal disruption in the work schedule of the organization. The interim profile method was designed to meet these requirements. It relies heavily on the CMM-based maturity questionnaire as a means for gathering data from software projects on their software process maturity. Project members typically spend less than two hours completing the questionnaire. To aid their understanding of how improvement efforts are progressing, software projects receive results based on the MQ responses of the project members. Organizational process improvement status is derived by aggregating the project results. The method satisfies a need expressed by the software community and expands the suite of SEI appraisal products.

Appendix A   Maturity Questionnaire Sample

Defect Prevention involves analyzing defects that were encountered in the past and taking specific actions to prevent the occurrence of those types of defects in the future. The defects may have been identified on other projects as well as in earlier stages or tasks of the current project. Trends are analyzed to track the types of defects that have been encountered and to identify defects that are likely to recur. Both the project and the organization take specific actions to prevent recurrence of the defects.

audit - An independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria.

causal analysis meeting - A meeting, conducted after completing a specific task, to analyze defects uncovered during the performance of that task.

common cause (of a defect) - A cause of a defect that is inherently part of a process or system. Common causes affect every outcome of the process and everyone working in the process.

policy - A guiding principle, typically established by senior management, which is adopted by an organization or project to influence and determine decisions.

software quality assurance (SQA) - (1) A planned and systematic pattern of all actions necessary to provide adequate confidence that a software work product conforms to established technical requirements. (2) A set of activities designed to evaluate the process by which software work products are developed and/or maintained.

1 Are defect prevention activities planned?

2 Does the project conduct causal analysis meetings to identify common causes of defects?

3 Once identified, are common causes of defects prioritized and systematically eliminated?

Appendix B   Sample Project Profile
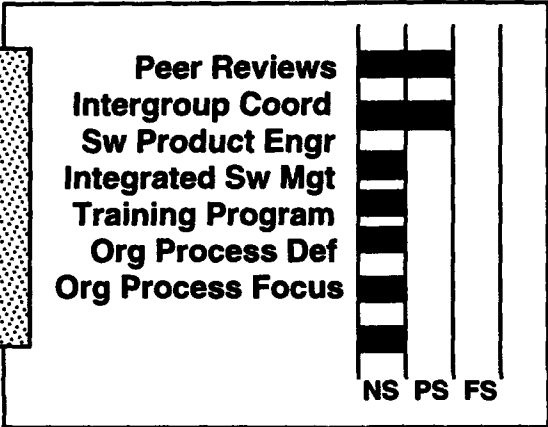
**Interim Profile
Key Process Area
Project Profile**

Organization: Division XYZ
Project: 999

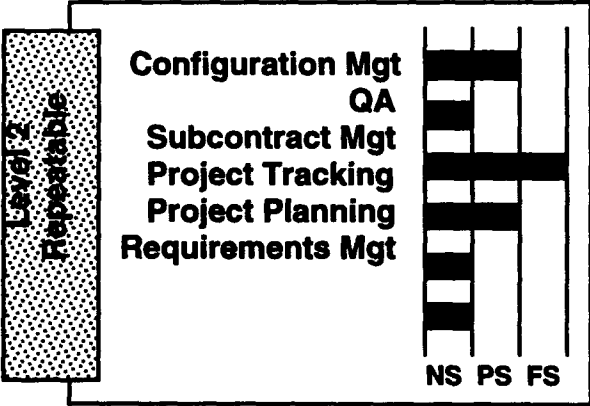May 18, 1993

Level 5 Optimizing

Level 4 Managed

Maturity Level

Maturity level is determined by the highest level at which all KPAs up to and including that level are fully satisfied (or not applicable).

Level 3 Defined

Peer Reviews
Intergroup Coord
Sw Product Engr
Integrated Sw Mgt
Training Program
Org Process Def
Org Process Focus

NS PS FS

Legend

NS = not satisfied;
PS = partially satisfied;
FS = fully satisfied;
blank = not applicable.

Level 2 Repeatable

Configuration Mgt
QA
Subcontract Mgt
Project Tracking
Project Planning
Requirements Mgt

NS PS FS

Reliability Factors

Overall degree of confidence	48%
"Yes" degree of confidence *	16%
% of group responding: 6/6	100%
Respondent experience:	
< 3 years	0%
> 13 years	33%

*Respondents' confidence in answering each question (rating >=3 on a scale of 1-5)

Level 1 Initial

Appendix C   Sample Organization Profile

**Interim Profile
Key Process Area
Organization Profile**

Organization: Division XYZ

May 18, 1993

Level 5 Optimizing

Level 4 Managed

Level 3 Defined

	NS	PS	FS
Peer Reviews	10%	10%	80%
Intergroup Coord	90%	10%	0
Sw Product Engr	50%	40%	10%
Integrated Sw Mgt	50%	50%	0
Training Program	5%	15%	80%
Org Process Def	95%	5%	0
Org Process Focus	95%	5%	0

Level 2 Repeatable

	NS	PS	FS
Configuration Mgt	10%	10%	80%
QA	0	0	100%
Subcontract Mgt	50%	40%	10%
Project Tracking	80%	15%	5%
Project Planning	95%	5%	0
Requirements Mgt	95%	5%	0

Level 1 Initial

Maturity Level

Maturity level is determined by the highest level at which all KPAs up to and including that level are fully satisfied (or not applicable).

Legend

NS = not satisfied;
PS = partially satisfied;
FS = fully satisfied;
blank = not applicable.

Reliability Factors

Overall degree of confidence	48%
"Yes" degree of confidence *	16%
% of group responding: 6/6	100%
Respondent experience:	
< 3 years	0%
> 13 years	33%

*Respondents' confidence in answering each question (rating >=3 on a scale of 1-5)

Appendix D   Use of Interim Profile Results Survey

Following the initial distribution of profiles, a simple one-page survey may be used to elicit feedback from the recipient of the profiles. Use of this type of feedback allows the recipients to focus their review of the draft profiles, and also allows the IP practitioner to gage the acceptability (or validity) of the results. The following questions were used with the first full implementation of the IP method at Pacific Bell.

Interim Profile Results Survey

Please rate your level of agreement with the following statements on a scale of 1 - 7 where :
1 = Completely Disagree, 7 = Completely Agree

1. The results on my profile accurately reflect the software engineering maturity status of my work group.   1   2   3   4   5   6   7

2. An adequate number of people responded to the questionnaire to represent the nature of our group.   1   2   3   4   5   6   7

3 The people from my group responding to the questionnaire are knowledgable about all aspects of the work performed by our group.   1   2   3   4   5   6   7

4. The questions on the maturity questionnaire are appropriate to the kind of work my group does.   1   2   3   4   5   6   7

5. There were enough questions on the maturity questionnaire to adequately capture the key process area practices in my organization.   1   2   3   4   5   6   7

COMMENTS

When using this type of feedback mechanism, it is important to have space for open-ended comments. Even if the response rate to the survey is low, the feedback provided in the comments can provide valuable insights for interpreting results and for improving the IP method. The ratings provided for the questions may also be used for informative 'post-hoc' analyses of the data collected in the IP process. Examples of 'post-hoc' analyses include:

- Examine the number of people who participated for each project and the distribution of ratings given for question 2 on the survey (which reads "An adequate number of people responded to the questionnaire...."). If projects with a low turn out at the MQ administrations tend to give poor ratings on the question, this might provide evidence of the need for wide participation which you can take to your management.

- Examine the confidence data for respondents completing the results survey to see if the answers provided for questions 1, 3, and 4 relate to the confidence of the survey respondent.

- Examine the number of maturity questions that were answered as "does not apply" in light of the responses to survey question 4 (which reads "The questions on the maturity questionnaire are appropriate to the kind of work my group does").

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Development of an interim profile (IP) method was driven by a business need to rapidly measure an organization's software engineering process maturity between organizational software process assessments (SPAs). This document provides information about the process used to develop the method and a description of the method to software engineering process group (SEPG) members and practitioners responsible for diagnosing software process maturity. This document also addresses the next steps in the 1further development and use of the interim profile method.

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