

Center Plan
for LaRC
Software Process Improvement

November 2003
(Revised March 2004)

Developed by the
LaRC Software Engineering Process Group
under the Direction of the
LaRC Software Management Steering Group

Approved by
LaRC Center Director _____

Revision Record

Issue Date	Description of Revision (Include reason for change if not self-evident.)	Section Affected	Prepared By	Authorized By
11/15/03	Update plan for FY04. (This Plan is reviewed and updated annually to reflect necessary changes and lessons learned in implementing software process improvement at LaRC.) A) Update list of organizations which have primary responsibilities under this plan in this fiscal year and added text about LMS procedure improvement. B) Take out the reference to “monthly” when referring to gathering status information. Status does in fact get transmitted more frequently than monthly in most cases. C) Updated all references to current fiscal year. D) Clarification to show that NPG 2820 is still being developed and deleted the activity to name Configuration Manager since that has been done. E) Clarification to better show the mapping between this LaRC Plan and the parent Agency Plan. F) Update URL reference. G) Updated the first paragraph of 6.1 to show FY03 status. Updated 6.2 and Figure 6-1 to reflect the new plans for FY04. H) Updated text to show the management decision, made during the initiation of IFMP at LaRC, to shift the LaRC funding source for this Center Plan to Center G&A and to reflect the revised out-year budget changes from Code AE. I) Clarification was made by adding the word “significant”. Only if significant changes occur will this plan be updated. J) Updated table 7-1 to reflect the actual amount of funds received from Code AE in FY03 and the revised FTE projections.	3 Overall Overall 4, App. B 5 5 6 7 7 7	Pat Schuler	MSG Lead
3/9/04	K) Changed to reflect the newly revised out-year budget changes from Code AE. L) Changed Figure 6-1 to reflect consequence of new reorganization M) Corrected organization names to reflect reorganization	7 6 Overall	Pat Schuler	MSG Lead and Center Director

Table of Contents

1. Introduction	4
2. Goal	5
3. Scope	5
4. Ownership of the Plan	6
5. LaRC Software Process Improvement Strategies and Objectives.....	7
6. Schedule	11
7. Funding.....	13
APPENDICES AND ATTACHMENTS.....	14
Appendix A. Overview of Capability Maturity Model–Integrated and the Software Acquisition Capability Maturity Model	15
A.1 Capability Maturity Model–Integrated (CMMI).....	15
A.2 Software Acquisition Capability Maturity Model (SA-CMM).....	17
Appendix B. Definitions.....	18
Appendix C. Risk Management.....	19
Appendix D. Overview of the IDEAL Model.....	20
Attachment 1. Risk Spreadsheet Template (Excel)	22

1. Introduction

Software engineering¹ is a key enabling technology necessary for the support of NASA's Enterprises. Ensuring the quality, safety, and reliability of NASA software is of paramount importance in achieving mission success. Through surveys and assessments, many software challenges within the Agency have been identified and documented. In response to the concerns about NASA's ability to effectively manage the expected continual exponential growth in the scope, complexity, and importance of software within its systems, the Administrator requested the creation of the NASA Software Engineering Initiative.²

That Initiative defines a NASA-wide, comprehensive approach to improve software quality, safety, and reliability by improving software engineering to a quantifiable maturity level, commensurate with mission criticality, to meet the software challenges of NASA. The Goal of the NASA Software Engineering Initiative Implementation Plan is to "Advance software engineering practices to effectively meet the scientific and technological objectives of NASA." The four strategies for achieving the goal are:

1. *Implement a continuous software process and product improvement program across NASA and its contract community.*
2. *Improve safety, reliability, and quality of software through the integration of sound software engineering principles and standards.*
3. *Improve software engineering practices through research.*
4. *Attract and retain software engineers and improve their knowledge and skills.*

This Center Plan for Software Process Improvement (SPI) specifies how the NASA Software Engineering Initiative Implementation Plan will be implemented at the Langley Research Center (LaRC). This Center Plan focuses on Agency Strategy 1 as LaRC's primary strategy; LaRC's role in Agency Strategies 2 through 4 is to support those Agency activities. Section 5 outlines the LaRC strategies and objectives and their alignment with the Agency strategies and objectives. The goals of this Center Plan are not only to improve the quality, safety, and reliability of software developed for or by LaRC, but also to increase the productivity of the developers, and to increase customer satisfaction with LaRC software products. The Plan is largely based on the Capability Maturity Model-Integrated (CMMISM) method formulated by the Software Engineering Institute (SEI) of Carnegie Mellon University and proven in practice. To achieve the goal of this Plan and Strategy 1 of the NASA Software Engineering Initiative Implementation Plan, LaRC will use the CMMI to ultimately achieve a Level 3 rating for selected organizations and will perform additional SPI-related activities with the software developers, managers, and assurance engineers at LaRC. The CMMI will be used for organizations that are responsible for overall software project management, development, and assurance; both CMMI and the Software Acquisition CMM[®] (SA-CMM[®]) will be used when the software is assigned to a contractor. Appendix A provides an overview of CMMI and SA-CMM. These models will be used as

¹ For the purposes of this Plan only, the term 'software engineering' refers to software development, assurance, and management. Other definitions of terms used in this document can be found in Appendix B.

² Reference the "NASA Initiative for Software Safety and Quality" presented by Lee Holcomb to the NASA Senior Management Council 4/12/00 and "NASA Software Engineering Initiative Implementation Plan" signed by the Chief Engineer, NASA Headquarters, Code AE on 1/11/02 for information on this Initiative and the specific rationale.

benchmarks against which to evaluate LaRC's current practices and identify its software engineering deficiencies. Activities performed under this Plan are intended to eliminate identified deficiencies by putting in place piloted and proven processes, techniques, and tools.

The SEI-recommended approach to implementing CMMs is to form a software Management Steering Group (MSG) to oversee the improvement activities and a Software Engineering Process Group (SEPG) to lead their implementation. Both groups have been in place at LaRC since 1998; their specific roles are described further in Section 4. The SEPG, under the direction of the software MSG, has developed this Plan to describe the software engineering process improvement goals, strategies, approaches, and tasks for the Center. The organization of this Plan follows the outline and required content specified in Appendix C of the NASA Software Engineering Initiative Implementation Plan.

2. Goal

The goals of this Plan are to improve the quality, safety, and reliability of software developed for or by LaRC, to increase the productivity of the developers, and to increase customer satisfaction with LaRC software products. This will be accomplished by implementing software engineering process improvements for mission-critical and research software development activities at the Center. This document provides a detailed plan with strategies and measurable objectives for meeting the above goal.

3. Scope

This Plan addresses SPI for software development that supports Center research and for mission-critical software development. This Plan is to be used by the MSG and SEPG at LaRC, by selected organizations involved in software, and by selected "project partners" within those organizations. The selected organizations which have primary roles and responsibilities in the CMMI and SA-CMM based improvement during this fiscal year are the Flight Software Systems Branch (Systems Engineering Competency), Project Integrated Reliability for Research (Research Facilities Services Competency), the Flight Simulation and Software Branch (Flight Research Services Competency), Mission Assurance Office (Office of Safety, Security, Environment, and Mission Assurance), key personnel involved in the Systems Management Office, software acquisition, and procurement.

The Center will introduce CMM-based improvements (i.e., CMMI and SA-CMM) in phases, beginning with an initially selected organization. After the implementers gain SPI experience with the initial organization, CMM-based improvements will be performed in the remaining organizations selected by the MSG. The bulk of this Plan addresses CMM-based improvements for those selected organizations. The organizations will be internally assessed against the CMM to determine their current baseline. Deficiencies will be identified, best practices will be documented and refined, and improvement activities will be performed to eliminate identified deficiencies. When the best practices have been shown to be successfully repeated across multiple projects and all identified deficiencies for the applicable CMM level have been eliminated, an assessment will be performed by an authorized lead appraiser to obtain a CMM level rating.

In parallel with the above CMM-based improvements, additional SPI activities for the overall LaRC software developers, managers, and quality engineers will be performed. These include identifying and piloting industry best practices to increase productivity and quality (e.g., the SEI *Personal Software Process*), identifying and utilizing labor saving tools, mentoring projects on using these new technologies, and making improvements to the Langley Management System Center Procedures related to software.

4. Ownership of the Plan

The activities documented in this Plan are managed and monitored by the SEPG, under the direction of the software MSG in accordance with their charters (see Langley Policy Directive 1150.2). The membership and list of organizations represented on the MSG and SEPG are defined in the charters. The NASA Software Engineering Initiative Implementation Plan requires the naming of a “software champion” for the Center, and the Leader of the SEPG is hereby so designated. The SEPG is responsible for the content of the Plan and for recording and tracking individual commitments that are made and planned versus actual progress in execution of this Plan. The SEPG also is responsible for the ongoing maintenance and version control of this Plan. The MSG is responsible for providing Plan direction, approving the Plan, and for supporting its implementation. Figure 4-1 shows the LaRC SPI organizational structure and its relationship to other NASA Software Engineering Initiative organizations (Office of the Chief Engineer (OCE) and the Software Working Group (SWG)).

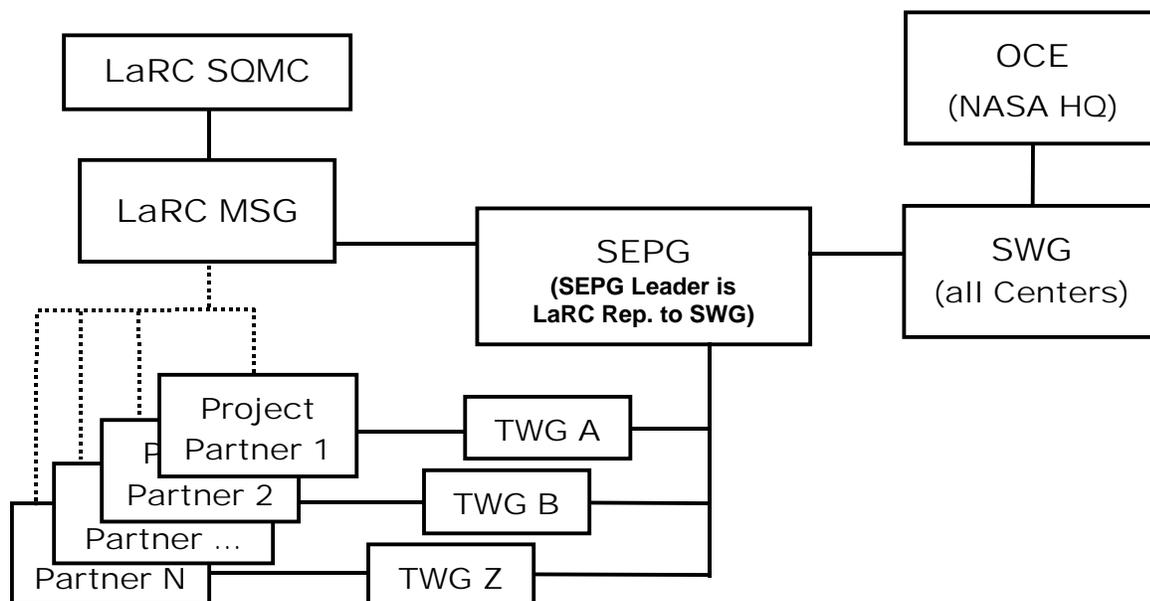


Figure 4-1. LaRC Software Process Initiative organizational structure.

The SEPG will conduct status meetings to update the Center Plan schedule with actual progress evaluated against planned progress and to review the planned activities. Support contractors will provide monthly status, cost, hour, and task reports as required. The SEPG will assist short duration Technical Working Groups (TWGs) to document best practices and define procedures

to eliminate deficiencies; these procedures are then piloted with project partners. The TWGs will also provide status reports to the SEPG. The SEPG will follow the risk management process documented in Appendix C. The SEPG will take corrective actions on both in-house and contracted activities to mitigate risks, or whenever actual progress deviates significantly from planned progress. Changes in commitments will be agreed upon by all concerned. The SEPG will review the status of the Plan quarterly with the MSG and semi-annually with LaRC senior management in a manner determined by the Strategic and Quality Management Council (SQMC). This Plan will be reviewed and updated annually to reflect necessary changes and lessons learned in implementing software process improvement at LaRC and to document detailed activities for follow-on years.

The following information will be used to report progress to the OCE:

- Annual status reports will document progress made against the major Work Breakdown Structure (WBS) milestones and the NASA Software Engineering Initiative Improvement Plan goal; these status reports will include a discussion of schedule planned-versus-actual activities, deliverables, and associated lessons learned.
- Results of assessments against the CMMI and SA-CMM will be documented and included in the annual report.
- NASA Software Metrics, as defined in NPG 2820, will be submitted periodically once the NPG is approved.

5. LaRC Software Process Improvement Strategies and Objectives

This section provides the strategies, objectives, and approaches that LaRC will employ to achieve its SPI goal. The LaRC strategies map directly to and support fully the implementation of the NASA Software Engineering Initiative Implementation Plan strategies listed in the Introduction.

LaRC's primary strategy (Strategy 1) maps to the Agency Strategy 1: *"Implement a continuous software process and product improvement program across NASA and its contract community."* In LaRC's Strategy 1, the objectives are based on the SEI's IDEAL³ model phases, which are commonly used as a roadmap for implementing capability maturity models. An overview of the IDEAL model can be found in Appendix D. The SEI has defined generic activities that should be performed to implement the IDEAL model, particularly its last three phases. These activities form the Process Change Method (PCM), which is outlined in Figure 5-1. The objectives under LaRC's Strategy 1 implement the PCM.

³ IDEAL, representing the Initiating, Diagnosing, Establishing, Acting, and Learning phases of SPI, is a service mark of Carnegie Mellon University. See <<http://sei.cmu.edu>>

1. Organize and Prepare

- Form the SEPG
- Educate and train the SEPG
- Establish SEPG processes
- Set up the SPI library and SPI repository
- Develop the SEPG Action Plan
- Communicate the Plan

2. Conduct Organizational Scan

- Define and understand the process requirements
- Plan and prepare for the scan
- Gather the organizational data
- Evaluate the organizational data
- Identify high-leverage opportunities
- Identify project partners
- Plan TWG deployment strategy
- Communicate and obtain buy-in

3. Establish Technical Working Groups

- Establish criteria for team membership
- Select team members
- Charter the team
- Train the TWG(s)
- Define team objectives and roles
- Develop TWG improvement plan
- Communicate the plan

4. Understand Project's Current State

- Conduct collaborative planning with project partner
- Conduct process data-gathering
- Develop an existing process description
- Obtain feedback and refine process description
- Communicate results

5. Redesign the Process

- Perform CMM-based gap analysis
- Identify other improvement opportunities
- Develop the technical design of the new process
- Conduct impact and risk analysis
- Communicate the vision

6. Develop Whole Solution

- Identify solution components
- Conduct research
- Plan the development of solution components (guides, training, etc.)
- Communicate the plan
- Develop or tailor the solution components
- Establish process asset library

7. Conduct Pilots and Evaluate

- Develop pilot implementation plan
- Train project in performing new process
- Support and monitor pilot project
- Evaluate pilot results and improve
- Communicate results and update library

8. Facilitate Organizational Learning

- Select target project(s) and plan
- Tailor process assets
- Support and monitor project(s)
- Conduct ongoing evaluations and identify new improvement opportunities
- Conduct improvement activities
- Communicate results and update the process asset library

Figure 5-1. Outline of SEI's *Process Change Method*

LaRC SPI Plan

The LaRC WBS is summarized below; the detailed WBS and the schedule for implementation are posted at http://sw-eng.larc.nasa.gov/center_plan/schedule.cfm. The WBS and schedule will be updated based on SEPG status and will be posted to the internal SEPG Web site. The detailed WBS also specifies the individuals responsible for implementing each element.

Strategy 1: Implement a continuous improvement program for software processes and products across NASA LaRC and among its support contractors. Use CMMI and SA-CMM along with other successful improvement models to provide a framework for SPI, particularly for organizations that develop complex or mission-critical software.

Objective 1. Establish and maintain the Center's commitment and direction for meeting the NASA Software Engineering Initiative Implementation Plan's goal through the development, approval, implementation, and management of the supporting Center Plan for LaRC Software Process Improvement.

- Organize and plan LaRC SPI activities (include responsibility for the success of LaRC SPI Plan as an element in the performance plan of the Associate Director for R&T Competencies)
- Communicate SPI activities to management and LaRC software community
- Analyze metrics collected through the Langley Management System (LMS) software procedures and use as basis for improvement
- Perform management tracking and oversight of SPI activities

Objective 2. Determine the current level of software development capability relative to the CMM for selected organizations and identify existing best practices for use in SPI activities. Target improvement opportunities based on priority, resources, and expected benefits. Work with project partners to understand, define, and modify existing *project* processes. Bring project partners up to CMM Level 2 maturity.

- Assess the current capability for selected organizations
- Identify and prioritize improvement opportunities
- Establish and plan deployment of TWGs
- Document the existing *project* process
- Modify the process as required
- Conduct pilot(s) and evaluate the results
- Deploy the process to other project partners within the selected organization
- Conduct Level 2 assessment of selected organization

Objective 3. Work toward development of *standard* software processes for the selected organizations and work to bring them up to CMM Level 3 maturity.

- Modify LMS software procedures to improve software processes and to conform to newly released NASA Policy Directives (NPD) and NASA Policy Guides (NPG)
- Establish and plan deployment of TWGs
- Develop *standard* software processes for the selected organization from *project* processes within that organization
- Conduct pilot(s) and evaluate results
- Deploy *standard* processes to other project partners within the selected organization
- Conduct Level 3 assessment of selected organizations
- Encourage external partner compliance with CMM Level 3

LaRC SPI Plan

Objective 4. Identify, adapt, and infuse industry best practices and promising new state-of-the-art technologies to improve software development, assurance, and management (e.g., Personal Software Process/Team Software Process (PSP/TSP) and PSP/TSP for functional teams (PSP/TSPf)).

- Evaluate existing data on new technologies
- Select project partners to pilot promising new technologies
- Train, monitor, and assist pilot staff
- Evaluate pilot results to determine the broader applicability
- Disseminate successfully piloted technologies on a broader scale

Objective 5. Support the Office of Chief Engineer in the management of the NASA Software Engineering Initiative Implementation Plan (e.g., define/update software engineering policy and directives, define metrics to be collected, direct SEI support to the software initiative, and provide software engineering inputs to the systems engineering initiative and coordinate activities between the two initiatives).

Note that in Strategies 2 through 4, LaRC's role is to support the corresponding NASA Software Engineering Initiative Implementation Plan strategies. Examples of support include participating in subgroups to update NASA assurance policies and guidelines, and coordinating LaRC seminars and classes to infuse new methods or techniques into local software development activities. The implementation details and specific responsibilities for support of those strategies are defined in that Agency-level Plan.

Strategy 2: LaRC will support the Agency strategy to improve safety, reliability and quality of software products through the integration of sound software engineering principles and standards.

Strategy 3: LaRC will support the Agency strategy to improve software engineering practices through research.

Strategy 4: LaRC will support the Agency efforts to attract and retain software engineers and improve their knowledge and skills.

6. Schedule

6.1 Summary of FY03 Activities

At a Center level, during the past fiscal year the SEPG concentrated on the following:

- Training and piloting the PSP/TSP technology
- Working with Systems Management Office (SMO) and existing flight project staff to effect improvements in requirements capture, documentation, review, and management
- Making changes to software LMS Center Procedures to improve their usability (by incorporating new Process Modeling, and Information Mapping techniques), increase compliance, and incorporate user feedback
- Assisting in software engineering as well as assurance improvements

In addition, with the SEPG's support, Project Integrated Reliability for Research (PIRR) reached a CMM Level 2 rating. LaRC was the first Code R Center in NASA and the third Center in the Agency to accomplish a CMM Level 2 rating.

At the Agency level, the SEPG has concentrated on the following:

- Assisting in revising the NASA Software Engineering Initiative Implementation Plan
- Chairing the Agency Software Working Group's Acquisition Subgroup
- Assisting the new chair of the Research Infusion Subgroup formulate an implementation plan
- Providing extensive review comments on the Software Safety Standard
- Providing extensive revisions to and dispositioning comments on the NASA Software Assurance Standard
- Developing a Software Assurance NASA Policy Document.

6.2 Summary of FY04 Activities

In this year's plan, the SEPG continues with the same approach as in FY03 in supporting the organization to effect improvements. The plan adds activities to implement CMMI improvements at a branch level in the Flight Software Systems Branch. The plan also covers completing improvements to the existing LMS software procedures, continuing to address software acquisition improvements, and performing additional requirements capture, documentation, review, and management pilots.

Figure 6-1 shows a high-level schedule of the activities to be performed under the Plan for this fiscal year.

LaRC SPI Plan

The detailed WBS, deliverables, and schedule for this Plan are in a separate document (FYxx_Center_Plan_WBS_for_LaRC_SPI_R#_V#.mpp, where FYxx is the fiscal year, R# is the release number, and V# is the version number). After initial CMM assessments are performed, the detailed schedule will be refined to reflect the knowledge of weaknesses to be eliminated and the associated schedule and resources required. Significant changes that affect the detailed schedule require approval by the MSG; changes that affect the budget require approval by the SQMC. As the detailed WBS document is updated annually for resubmission to the OCE, the schedule for specific activities in the subsequent fiscal year will be baselined.

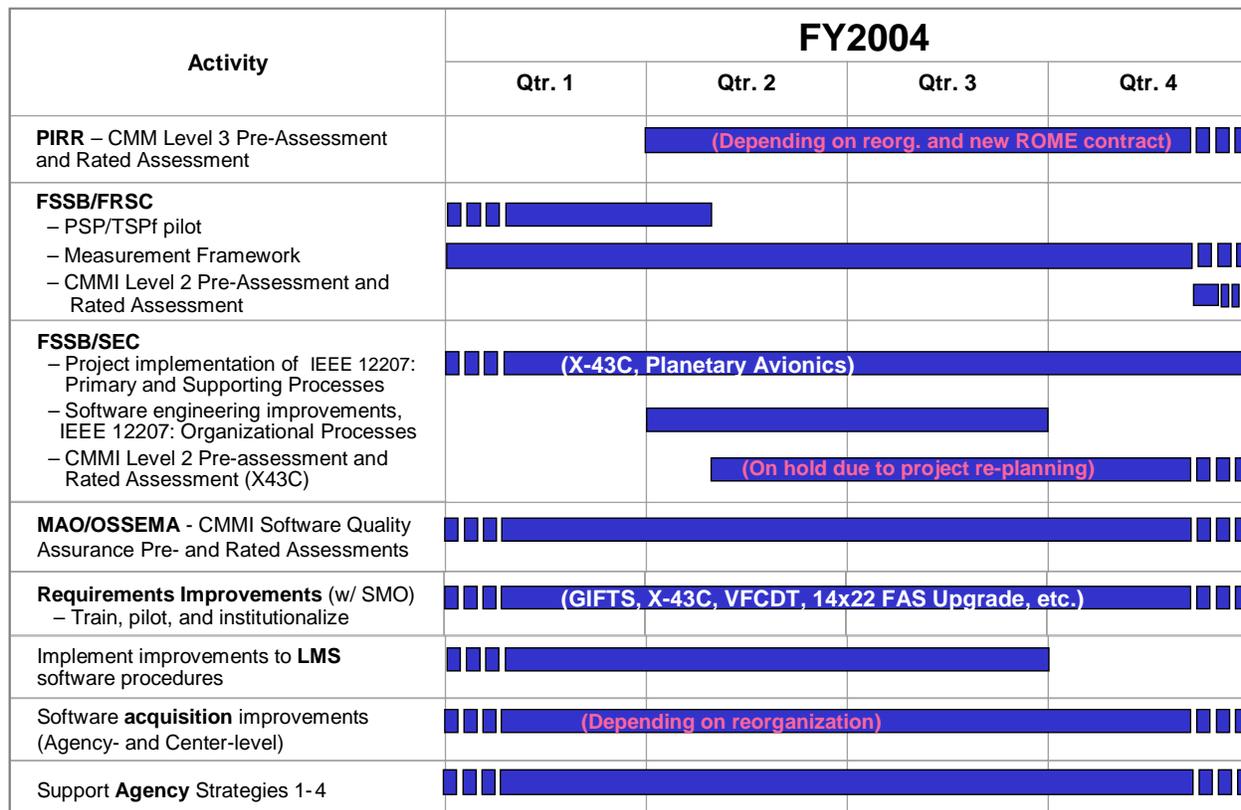


Figure 6-1. Schedule

Organization Acronyms Used in Figure 6-1

PIRR: Project Integrated Reliability for Research

FSSB/FRSC: Flight Simulation and Software Branch/Flight Research Services Competency

FSSB/SEC: Flight Software Systems Branch/Systems Engineering Competency

MAO/OSSEMA: Mission Assurance Office/Office of Safety, Security, Environment, and Mission Assurance

SMO: Systems Management Office

LaRC SPI Plan

7. Funding

For planning purposes, the following table shows projected civil service workforce and funding to implement this Plan. The civil service workforce for the SEPG has been approved by the Associate Director for R&T Competencies. Additional civil service FTEs will be provided by the organizations participating in the SPI activities. The LaRC G&A funds have been previously approved through the LaRC budget process. Code AE Funds are included in the OCE budget, for which FY04 and beyond approval is pending. These funds will be used only for software process improvement activities, not for software product development. Any significant changes in the available work force or funding from that shown below is an automatic basis for changing this Plan and the associated schedule.

Table 7-1. Resources for LaRC SPI

FY	CS SEPG FTEs	LaRC IT Service Activity Funds/G&A ⁴	Code AE Funds ⁵
2002	3.0	\$184K	\$150K
2003	3.0	\$184K	\$120K
2004	4.5	\$129K	\$200K
2005	4.5	\$129K	\$200K
2006	4.5	\$129K	\$200K
2007	4.5		\$200K
2008	4.5		\$200K
2009	4.5		\$200K

⁴ ITSA funding was moved to Center G&A in FY04.

⁵ This column's changes reflect Code AE / NASA Software Engineering Initiative funding changes (initiative budget has been flattened and extended past FY06).

APPENDICES AND ATTACHMENTS

Appendix A. Overview of Capability Maturity Model–Integrated and the Software Acquisition Capability Maturity Model

A.1 Capability Maturity Model–Integrated (CMMI)

NASA has elected to use a CMM-based framework as a guide for SPI and has allowed the use of CMMI as a benchmark for measuring progress on improving organizational capability in software engineering. Either the CMMI or the SA-CMM can be used as benchmarks for improvements in software acquisition. The focus of the CMMI is on management, engineering, and quality assurance for the development and maintenance of products such as software. Performing these tasks plays a critical role in the quality of the products produced. The CMMI outlines five levels of maturity that characterize an organization’s capabilities (see figure A-1).

Level	Focus	Process Areas	Result
5 Optimizing	<i>Continuous process improvement</i>	Organizational Innovation & Deployment Causal Analysis and Resolution	Productivity & Quality Risk
4 Quantitatively Managed	<i>Quantitative management</i>	Organizational Process Performance Quantitative Project Management	
3 Defined	<i>Process standardization</i>	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution	
2 Managed	<i>Basic project management</i>	Requirements Management Project Planning Project Monitoring & Control Supplier Agreement Management Measurement and Analysis Process & Product Quality Assurance Configuration Management	
1 Initial	<i>Competent people and heroics</i>		

Figure A-1. CMMI Process Areas by level.

LaRC SPI Plan

In an organization of maturity level 1, success of the organization depends on the competence and heroics of individuals and cannot be repeated unless the same competent and experienced individuals are assigned to the next project; although these organizations frequently produce products that work, they often greatly exceed the budget and schedule.

In an organization of maturity level 2, the organization has ensured that its processes are planned, documented, performed, monitored, and controlled at the project level; objectives established for the process, such as cost, schedule, and quality objectives are achieved; when these practices are used on similar efforts, similar results are expected; the status of work products and delivery of the services are visible to management at defined points; and work products and services satisfy their specified requirements, standards, and objectives.

At maturity Level 3, the organization's processes are understood and described in standards, procedures, tools and methods; processes are tailored from the organization's set of standard processes and related assets to suit the circumstances in which they will be performed; the organization's set of standard processes are established and improved over time; and an organization level infrastructure to support the current and future use of the organization's set of standard processes is established and improved over time.

At level 4, processes are controlled using statistical and other quantitative techniques; quantitative objectives for product quality, services quality, and process performance are established and used as criteria in managing processes.

At level 5, organizational process performance is continually improved based on an understanding of the common causes of variation inherent in processes; process performance is improved through both incremental and innovative technological improvements; improvements are selected based on a quantitative understanding of their expected contribution; and selected improvements are deployed into the organization systematically.

A.2 Software Acquisition Capability Maturity Model (SA-CMM)

The SEI's SA-CMM is a model for benchmarking and improving the software acquisition process. The model follows a five-level architecture similar to other CMM staged architectures (see figure A-2) but with a unique emphasis on acquisition issues and the needs of individuals and groups who are planning and managing software acquisition efforts.

Level	Focus	Key Process Areas	Result
5 Optimizing	<i>Continuous process improvement</i>	Acquisition Innovation Management Continuous Process Improvement	Productivity & Quality
4 Quantitative	<i>Quantitative management</i>	Quantitative Acquisition Management Quantitative Process Management	
3 Defined	<i>Process standardization</i>	Training Program Acquisition Risk Management Contract Performance Management Project Performance Management Process Definition and Maintenance	
2 Repeatable	<i>Basic project management</i>	Transition to Support Evaluation Contract Tracking and Oversight Project Management Requirements Development & Mgt. Solicitation Software Acquisition Planning	
1 Initial	<i>Competent people and heroics</i>		Risk

Figure A-2. SA-CMM Key Process Areas by level.

Appendix B. Definitions

Capability Maturity Model (CMM): A description of the stages through which software organizations evolve as they define, implement, measure, control, and improve their software processes. This model provides a guide for selecting process improvement strategies by facilitating the determination of current process capabilities and the identification of the issues most critical to software quality and process improvement.⁶

Computer Software Configuration Item (CSCI): An aggregation of software that is designated for configuration management and treated as a single entity in the configuration management process.⁷

IDEAL model: The SEI's Initiating, Diagnosing, Establishing, Acting, and Learning model for implementing process improvement.

Mission-critical software:

- (a) All CSCI's developed, reused, or acquired for inclusion in an NPG 7120.5 project, which fall under one of the two following items:
 1. Flight CSCI's, in which failure of the software could cause mission failure, harm to humans, damage to facilities or equipment, or risk to NASA's public reputation, or
 2. Ground CSCI's⁸ designed for use in mission operations in which failure of the software could cause mission failure, harm to humans, damage to facilities or equipment, or risk to NASA's public reputation, or
- (b) Other software development items as designated by the GPMC, the NASA CIO, the NASA OCE, the NASA Office of SMA/NASA Code Q, or by Center SMA office.⁹

Non mission-critical software: All software developed, reused, or acquired for or by NASA except for (a) mission-critical software as defined above, or (b) common desktop COTS software.

⁶ *The Capability Maturity Model: Guidelines for Improving the Software Process*, Software Engineering Institute at Carnegie Mellon University, Addison-Wesley (1994), ISBN 0-201-54664-7.

⁷ IEEE Standard 610.12-1990, IEEE Standard Glossary of Software Engineering Terminology.

⁸ Ground CSCI's are defined as software products associated with controlling flight hardware and software.

⁹ NPG 2820.1, NASA Software Procedures and Guidelines, currently under development.

Appendix C. Risk Management

A Risk Management Spreadsheet (see template in attachment 1) will be maintained on a continuous basis to identify, analyze, plan, track, control and communicate risks to the LaRC SPI initiative. Responsibility for maintaining the Risk Management Spreadsheet will be assigned by the SEPG. The assigned member will record risks in the Risk Spreadsheet and review them during the regular SEPG meetings. The SEPG will assign a member to analyze each identified risk, to plan and implement mitigating actions on highest priority risks, and to track their progress. The SEPG will take steps to control deviations from mitigation plans.

For each risk in the Risk Management Spreadsheet, the following will be recorded:

- Risk identification number and risk statement (in “condition; consequence format”)
- Priority, probability, impact, time frame
- Mitigation strategy and success measures
- Responsible person(s)
- Status, date opened, date updated, date closed

The following definitions of risk attributes will be used:

- Probability
 - High Likelihood of occurrence greater than 70%
 - Medium Likelihood of occurrence between 40 and 70%
 - Low Likelihood of occurrence less than 40%
- Impact
 - High Schedule delay of more than 4 weeks, or cost overrun of greater than 6%
 - Medium– Schedule delay of 3 to 4 weeks, or cost overrun of 3 to 6%
 - Low Schedule delay of less than 3 weeks, or cost overrun of less than 3%
- Time Frame (when effect of risk is expected to occur if risk is not mitigated)
 - Near-term Less than 2 months
 - Mid-term From 2 to 6 months
 - Far-term More than 6 months

Appendix D. Overview of the IDEAL Model

The IDEAL¹⁰ model was developed by the SEI at Carnegie Mellon University. This model is a framework that describes the necessary phases, activities, and resources needed for a successful process improvement effort. The five phases of the IDEAL software process improvement cycle are described below.

Initiating phase – The Initiating phase is the starting point of the IDEAL model. The initial improvement infrastructure is established, the roles and responsibilities for the infrastructure are initially defined, and initial resources are assigned. In this phase, an SPI plan is created to guide the organization through the completion of the Initiating, Diagnosing, and Establishing phases. Approval for the SPI initiative is obtained along with a commitment of future resources for the job ahead. The general goals of the SPI program are defined. The MSG and SEPG are typically established as key elements for implementing SPI.

Diagnosing phase – The Diagnosing phase lays the groundwork for the later phases. In this phase, the SPI action plan is initiated in accordance with the organization’s vision, strategic business plan, lessons learned from past improvement efforts, key business issues, and long-range goals. Appraisal activities are performed to establish a baseline of the organization’s current state. The results and recommendations from appraisals and any other baselining activities will be reconciled with existing and/or planned improvement efforts for inclusion into the SPI action plan.

Establishing phase – During the Establishing phase, the issues that the organization has decided to address with its improvement activities are prioritized; strategies for pursuing the solutions are also developed, and the SPI action plan draft is revised accordingly. The general goals from the Initiating phase are refined to create measurable goals that will be included in the final version of the SPI action plan. Metrics necessary to monitor progress are also defined, resources are committed, and training is provided for the TWGs. The action plan developed will guide SPI activity as the TWGs address the prioritized findings and recommendations from the Diagnosing phase. Tactical action plan templates are also created and made available for the TWGs to complete and follow.

Acting Phase – In the Acting phase of the IDEAL model, solutions to address the areas for improvement discovered during the Diagnosing phase are created, piloted, and deployed throughout the organization. Plans are developed to execute pilots to test and evaluate the new or improved processes. After successful piloting of the new processes and determining their readiness for organization-wide adoption, deployment, and institutionalization, plans to accomplish the rollout are developed and executed.

Learning Phase – The objective of the Learning phase is to make the next pass through the IDEAL model more effective. By this time, solutions have been developed, lessons have been learned, and metrics on performance and goal achievement have been collected. These artifacts

¹⁰Bob McFeeley: “IDEAL: A User’s Guide for Software Process Improvement”, Carnegie Mellon University, Software Engineering Institute, Technical Report CMU/SEI-96-HB-001, 1996.

LaRC SPI Plan

are added to the process database that will become a source of information for personnel involved in the next pass through the model. Using this collected information, an evaluation of the strategy, methods and infrastructure used in the SPI program can be performed. From this evaluation, corrections or adjustments to the strategy, methods, or infrastructure can be made before the start of the next IDEAL cycle.

Some of the questions that should be asked include: Has the infrastructure (MSG, SEPG, TWGs, etc.) performance been appropriate? Have the methods employed by the TWGs in their solution development activities been satisfactory? Have the SPI communication activities been sufficient? Does the sponsorship for SPI need to be reaffirmed? Does another baselining activity need to be performed? The reentry point into the IDEAL model for the next cycle depends on the answers to questions such as these.

Attachment 1. Risk Spreadsheet Template (Excel)

Risk Spreadsheet											
ID #	Priority	Probability	Impact	Time Frame	Risk Statement (Condition; consequence format)	Assigned To	Mitigation Strategy	Status	Date Opened	Date Updated	Date Closed
1											
2											
3											
4											
5											
6											
7											
8											