

NAVAL POSTGRADUATE SCHOOL
Monterey, California



THESIS

**FACILITATING SOFTWARE PROCESS IMPROVEMENT
IMPLEMENTATION EFFORTS: A CASE STUDY OF
FINANCIAL SYSTEMS ACTIVITY, KANSAS CITY**

by

Wendell Bazemore

September 1998

Thesis Co-Advisors:

Susan P. Hocevar
Mark E. Nissen

19981103 062

Approved for public release; distribution is unlimited.

DTIC QUALITY INSPECTED 4

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
September 1998

3. REPORT TYPE AND DATES COVERED
Master's Thesis

4. TITLE AND SUBTITLE
**FACILITATING SOFTWARE PROCESS IMPROVEMENT
IMPLEMENTATION EFFORTS : A CASE STUDY OF FINANCIAL
SYSTEMS ACTIVITY, KANSAS CITY**

5. FUNDING NUMBERS

6. AUTHOR(S)
Wendell Bazemore

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION
REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING
AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (maximum 200 words)

Software process improvement initiatives are not unlike other process reengineering efforts. They are influenced by such dynamics as resistance to change, organizational structure, cultural barriers, and other issues. An effective plan for software process improvement implementation must address concepts of organizational change. In this thesis three perspectives on organizational change provide the frameworks for analyzing the software process improvement efforts of four organizations. Based on the change theory and implementation strategies of four organizations best practices relative to preparing an organization for process improvement, implementing process improvements, and sustaining the improvement effort are derived. A process improvement survey, archival material, personal interviews and site visits provide data on the process improvement efforts of the Financial Systems Activity Kansas City. These data are analyzed to characterize the challenges to the organization's process improvement efforts. Recommendations for mitigating these challenges are provided. The recommendations include an explicit design for planned change, transition management teams, piloting, integration of process improvement activities into the project cycle, and scanning the environment.

14. SUBJECT TERMS
Software Process Improvement, Organizational Change, Software Engineering, Software Engineering Process Group, Capability Maturity Model

15. NUMBER OF PAGES

161

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT
Unclassified

18. SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

19. SECURITY CLASSIFICATION OF ABSTRACT
Unclassified

20. LIMITATION OF ABSTRACT
UL

Approved for public release: distribution is unlimited

**FACILITATING SOFTWARE PROCESS IMPROVEMENT
IMPLEMENTATION EFFORTS: A CASE STUDY OF FINANCIAL SYSTEMS
ACTIVITY, KANSAS CITY**

Wendell Bazemore
Captain, United States Marine Corps
B.S.E.T., Old Dominion University, 1992

Submitted in partial fulfillment of the
Requirements for the degree of

MASTERS OF SCIENCE IN INFORMATION SYSTEMS TECHNOLOGY

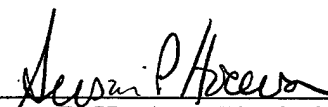
from the

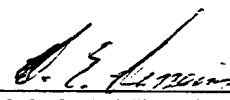
**NAVAL POSTGRADUATE SCHOOL
September 1998**

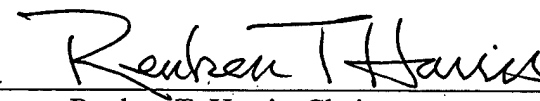
Author:


Wendell Bazemore

Approved by:


Susan P. Hocevar, Thesis Co-Advisor


Mark E. Nissen, Thesis Co-Advisor


Reuben T. Harris, Chairman
Department of Systems Management

ABSTRACT

Software process improvement initiatives are not unlike other process reengineering efforts. They are influenced by such dynamics as resistance to change, organizational structure, cultural barriers, and other issues. An effective plan for software process improvement implementation must address concepts of organizational change. In this thesis three perspectives on organizational change provide the frameworks for analyzing the software process improvement efforts of four organizations. Based on the change theory and implementation strategies of four organizations best practices relative to preparing an organization for process improvement, implementing process improvements, and sustaining the improvement effort are derived. A process improvement survey, archival material, personal interviews and site visits provide data on the process improvement efforts of the Financial Systems Activity Kansas City. These data are analyzed to characterize the challenges to the organization's process improvement efforts. Recommendations for mitigating these challenges are provided. The recommendations include an explicit design for planned change, transition management teams, piloting, integration of process improvement activities into the project cycle, and scanning the environment.

TABLE OF CONTENTS

I. INTRODUCTION	1
A. BACKGROUND	1
B. SPI INFRASTRUCTURE	3
1. Software Engineering Process Group	3
2. Steering Committee	3
3. Process Action Teams	4
4. Related Software Groups	4
5. Capability Maturity Model	4
6. Software Process Assessments and Capability Evaluations	8
C. THE VALUE OF MATURITY	9
D. BENEFITS OF CMM-BASED PROCESS IMPROVEMENT	11
E. CHALLENGES OF SOFTWARE PROCESS IMPROVEMENT	12
F. CASE STUDIES	12
G. STUDY PURPOSE	13
H. RESEARCH QUESTIONS	14
I. METHODOLOGY	14
J. SIGNIFICANCE OF THE STUDY	15
II. REVIEW OF RELATED LITERATURE	17
A. INTRODUCTION	17
B. CHANGING WAYS	17
1. Getting the Organization Ready for Change	18
2. Implementing the Change	19
C. THE SOCIOTECHNICAL SYSTEMS PERSPECTIVE	21
1. The Environment	22
2. The Social System	24

3. The Technical System	25
4. Sociotechnical Systems Redesign	26
D. MANAGING TRANSITIONS	30
1. The Ending	31
2. The Neutral Zone	32
3. The Beginning	33
4. Reinforcing the New Beginning	35
E. SUMMARY	35
1. Organizational Preparation	36
2. Process Improvement Strategy	36
3. Sustaining Change	36
F. SOFTWARE PROCESS IMPROVEMENT CASES	37
1. Introduction	37
2. Boeing Space Transportation Systems	37
3. Hughes Aircraft Software Engineering Division	40
4. The Software Engineering Laboratory at NASA Goddard Space Flight Center (GSFC)	41
5. Raytheon Electronic Systems	45
G. BEST PRACTICES	50
1. Concepts Related to Preparing the Organization for Process Improvement	50
2. Concepts Related to Implementing Process Improvements	50
3. Concepts Related to Sustaining the Improvement Effort	51
III. METHODS	53
A. DESCRIPTION OF RESEARCH SITE	53
1. DFAS	53
2. DFAS Kansas City Center	54
3. DFAS Realignment	54
4. FSA-KC	56

5. Fee-for-Service	57
6. Workforce	58
7. Customers	58
8. Organizational Goals	58
9. History of Software Process Improvement Efforts	59
10. Current SPI Efforts	60
B. DATA COLLECTION PROCEDURES	60
1. Process Improvement Survey	60
2. Archival Data Collection	61
3. Personal Interviews	61
4. Site Visits	62
IV. RESULTS AND ANALYSIS.....	65
A. INTRODUCTION.....	65
B. PROCESS IMPROVEMENT SURVEY	65
1. Clarity and Consistency of Organizational Goals.....	66
2. The Need for Process Improvement	69
3. Organizational Buy-in and Support	70
4. Compatibility with Organizational Practices	71
5. Encouragement of Innovation.....	73
6. Challenges to Process Improvement.....	74
C. ARCHIVAL MATERIAL.....	75
D. PERSONAL INTERVIEWS.....	79
1. Management Perspectives.....	79
2. Customer Perspectives	82
E. GENERAL IMPRESSIONS FROM SITE VISITS	82
F. SUMMARY AND IMPLICATIONS	84
1. Preparing the Organization for Process Improvement.....	85
2. Implementing Process Improvements.....	88
3. Sustaining the Process Improvement Effort	89
V. CONCLUSIONS AND RECOMMENDATIONS.....	91

A. SUMMARY	91
B. CONCLUSIONS FOR FSA-KC	94
C. RECOMMENDATIONS.....	95
1. Recommendations for FSA-KC.....	95
2. Recommendations for Other SPI Programs.....	100
3. Recommendations for Further Study	101
APPENDIX A. PROCESS IMPROVEMENT SURVEY.....	103
APPENDIX B. FSO SPI PROGRAM POST LEVEL 2 IMPLEMENTATION REVIEW.....	109
APPENDIX C. INTERVIEW QUESTIONS.....	141
LIST OF REFERENCES.....	143
INITIAL DISTRIBUTION LIST	147

ACKNOWLEDGEMENT

I would especially like to thank my thesis advisors, Professors Susan Hocevar and Mark Nissen for their professionalism and dedication. Without their responsiveness and timely insight this thesis would not be possible. I would also like to thank the Software Engineering Process Group of FSA-KC for helping with reference material and other support throughout this process.

Finally, I would like to thank my wonderful wife Mina, for the purest and most potent love. And Darius and Jasmine for making it fun. You are constant reminders of everything that is truly important in life!

I. INTRODUCTION

A. BACKGROUND

In an age where one can barely keep up with the technological pace of computer hardware, the consistent production of quality software remains a mystery. While hardware development and production tends to be routine and predictable, poor quality, cost and schedule overruns, and project cancellations plague software development.

That we have been in this "software crisis" for nearly three decades hints that there are some real problems with software development. The requirement for quality software has increased constantly over the years. However, our ability to produce software has remained essentially stagnant (STSC, 1996). The state of software today does not reflect three decades of improvement, especially when compared to improvements in computing hardware over the same period.

There are many factors that contribute to the problems in software development; these include programmer skills, requirements analysis, user expectations, and project management. First, the software development industry has probably the widest variation in its level of professional knowledge of any knowledge discipline (Osmundson, 1997). The disparity between a good programmer and one who is not can spell disaster for many development projects; and tight markets keep the best software engineers in short supply.

Another factor is the adequacy of requirements' analysis and planning. The emphasis on producing software on schedule over producing quality software not only has detrimental effects on software quality but actually makes projects late. In their zeal to begin programming as soon as possible programmers take shortcuts in requirements analysis and specifications that are more costly in the later stages of a project.

Moreover, many projects begin behind schedule because of poor cost and schedule estimates which often result in understaffing and unattainable deadlines.

A third factor is customer expectations. Rapid developments in hardware fuel unrealistic user expectations for the pace of advancements in software (Lowry, 1991). These users also tend to change software expectations as a project progresses, often times shifting requirements through the well known phenomenon of "requirements creep" even into the implementation phase.

Finally, poor management and the absence of process credibility are noted as primary contributors to software failures (STSC, 1996). Contrary to popular perceptions, software engineering professionals have indicated that software failures are more related to poor project management skills than they are to the technical issues of software development.

Software development as a discipline is not keeping pace with our growing reliance on computer systems. In the past, industry's attack on the software crisis has been focused mainly on development of structured software methodologies and development of simpler programming languages and tools (Lowry, 1991). More recently, software process improvement is gaining momentum as the cure for software ills. Software process improvement activities describe those practices and procedures aimed at facilitating the consistent and predictable production of quality software (Paulk, 1995). Improving software development processes may be the best way to mitigate the aforementioned development problems. As in other industries mature processes result in efficient production and consistent quality.

B. SPI INFRASTRUCTURE

The first step in improving software processes is to establish a supporting infrastructure. This infrastructure is the foundation for the activities, relationships, and structures necessary for the software process improvement effort. The form and content of a SPI infrastructure are as varied as the organizations that develop them. However, some baseline components of a SPI infrastructure are a software engineering process group (SEPG), a steering committee, process action teams, and a process improvement model.

1. Software Engineering Process Group

A software engineering process group is an organization's focal point for process improvement activities. It is a group of specialists who facilitate the definition, maintenance, and improvement of the software process used by the organization (Paulk, p. 63). This group takes the lead in implementing and sustaining process change. Effective SEPGs require a broad and diverse mix of skills including specialized software engineering principles, effective communications, negotiation, mediation, and salesmanship to name a few. The size of a SEPG is usually about 1-2% of the organization's workforce. Typically the group is comprised of high achievers from various sections within the organization.

2. Steering Committee

Direction and oversight of the SPI effort is provided by a steering committee. The name of this group may differ from organization to organization. The committee provides the vision and the resources to support the SPI effort. Membership in the steering committee usually includes the director, assistant director, senior managers, and the head

of the SEPG. One of the most important functions of this committee is to communicate a clear vision of the organization's process improvement goals and support from the highest echelons of the organization.

3. Process Action Teams

Process action teams (sometimes called working groups) are the implementation arms of the SPI program. Members are skilled in specific disciplines of software engineering. Their tasks involve defining and implementing specific process improvement activities. Their input is key in ensuring that a proposed change is realistic and in assessing the best means for transition. Participation in a process action team is often on a rotating or part-time basis. The size of the process action team varies with the organization.

4. Related Software Groups

Related software groups are a collection of individuals (both managers and technical staff) representing a software engineering discipline that supports, but is not directly responsible, for performing software development and/or maintenance (Paulk, p. 63). Two of the more important software related groups are the software configuration management group and the software quality assurance group. In most organizations these groups are highly involved in the process improvement effort.

5. Capability Maturity Model

There are a couple of software process improvement models, including the International Standards Organization 9000 series (ISO 9000), the Software Process Improvement and Capability dEtermination (SPICE) and the Capability Maturity Model

(CMM). This thesis examines organizations that use the CMM as the framework for its process improvement effort.

The Capability Maturity Model is a framework that describes the key elements of an effective software process. It is a tool for evaluating an organization's software development process. The model, based on industry best practices, covers all areas of software development including project planning, requirements analysis, software metrics, configuration management, and project management. It was designed to help developers select process improvement strategies by determining their process maturity and identifying the most critical issues to improving their software quality and process (Paulk, p.19). The model was created by the Software Engineering Institute (SEI) a federally funded research and development center located at Carnegie-Mellon University in Pittsburgh. The SEI was commissioned by the Department of Defense to help provide leadership in advancing the state of the practice of software engineering and to reduce variability and unpredictability in the software development process (Paulk, p.4). The first version of the CMM was released in 1991.

The CMM consists of five maturity levels that describe the process capability of an organization from adhoc processes to a continuous improvement environment. The CMM structure consists of maturity levels, key process areas, common features, and key practices. Figure 1.1 is a diagram of the CMM structure. Each maturity level comprises a set of process goals that when satisfied stabilize an important component of a software process (Paulk, p.20).

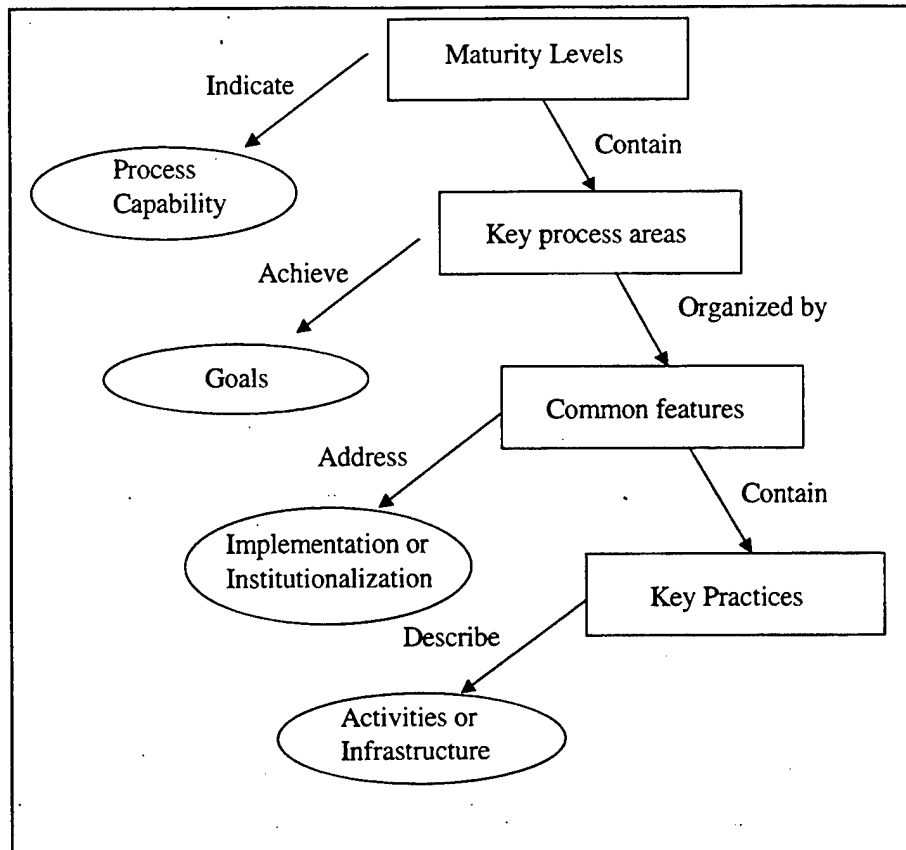


Figure 1.1 The CMM structure (Paulk, p. 31)

Paulk (1995) offers the following brief descriptions of the five maturity levels:

1. **Initial** The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual efforts and heroics.

2. **Repeatable** Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.

3. **Defined** The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version of the organization's standard software process for developing and maintaining software.

4. **Managed** Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.

5. Optimizing Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.

Key process areas (KPAs) highlight the issues that must be resolved to achieve each maturity level. There are a total of 18 key process areas. These related activities when performed collectively achieve a set of goals considered important for enhancing process capability. Figure 1.2 is a diagram of the KPAs for each maturity level.

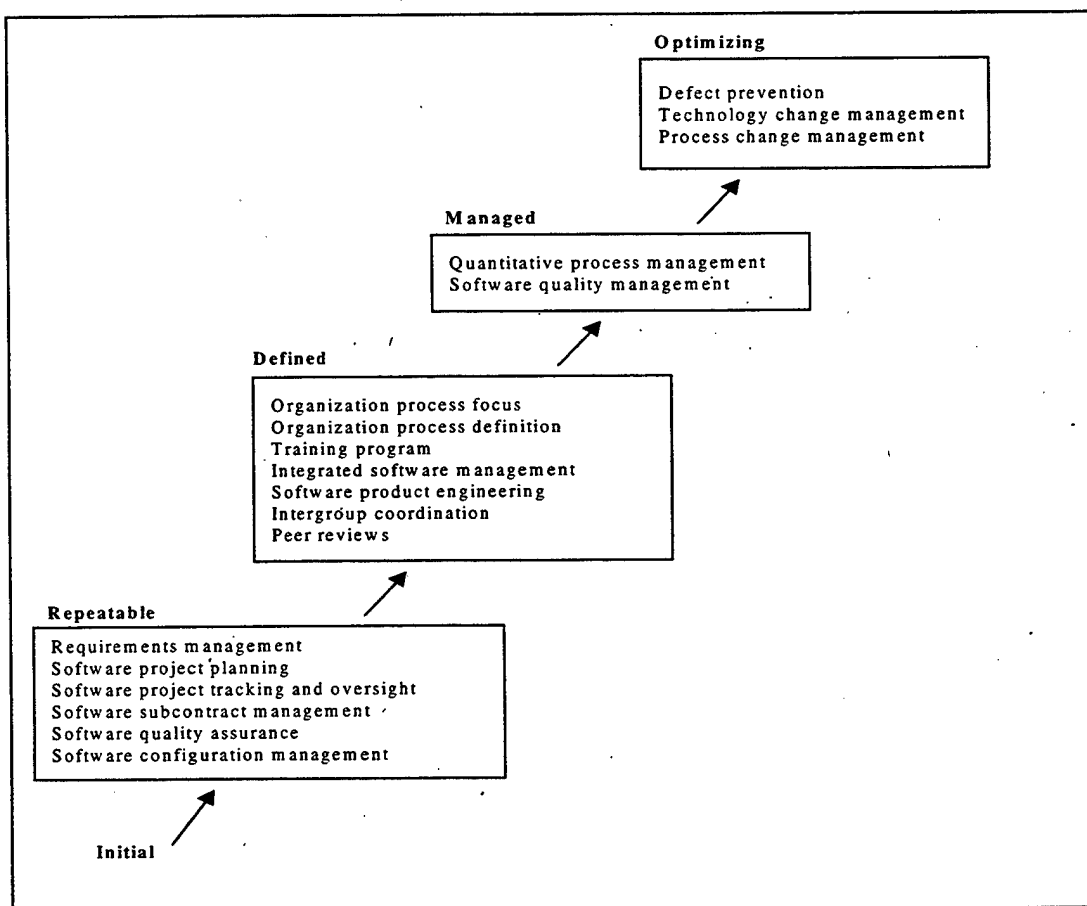


Figure 1.2 Key process areas by maturity level (Paulk, p.33)

Each key process area is described in terms of key practices. Key practices describe what is to be done to accomplish the goals of the KPA. These key practices

describe the activities and infrastructure that contribute to the effective implementation and institutionalization of a KPA.

The key practices for each KPA are organized by the following common features:

- Commitment to perform typically involves establishing organizational policies and leadership to ensure the establishment and sustainment of a process.
- Ability to Perform involves the resources, organizational structures, and training that must exist to implement a process.
- Activities Performed describes the activities, roles, and procedures necessary to implement a key process area.
- Measurement and Analysis describes the basic measurement practices that are necessary to determine status related to the process.
- Verifying Implementation describes the steps to ensure that the activities are performed in compliance with the process that has been established.

These attributes are indicators of the effectiveness of the implementation and institutionalization of key processes. (Paulk, 1995) Refer to figure 1.1.

6. Software Process Assessments and Capability Evaluations

Software Process Assessments (SPAs) and Software Capability Evaluations (SCEs), tools developed by SEI, are key parts of an SPI infrastructure. SPAs and SCEs are the measurement tools of the CMM. Process assessments are performed by software professionals to determine the state of an organization's current software process. In addition to identifying the key software process related issues facing the organization they also generate support for process improvement efforts. A process assessment is a critical step in an internal process improvement program. (Paulk, 1995)

Software Capability Evaluations are performed by software professionals to identify contractors qualified to perform software work or monitor the state of the software process used on an existing software effort. An organization's software process capability is one way to predict the likely outcome of the next software project it will undertake. Capability evaluations are performed by individuals external to the organization and are being used increasingly as a criteria in source selection by agencies with Department of Defense. (Paulk, 1995)

The CMM provides a general framework for process improvement. However, actual methods of implementation of CMM key practices are organizationally dependent, and implementing process improvement initiatives is challenging and time consuming. Much more needs to be learned about how the best software organizations are able to increase process maturity while others remain stagnant. The foundations of process improvement are sound management and a commitment to continuous improvement. While these concepts seem obvious they separate the few great organizations from the many mediocre and poor organizations.

C. THE VALUE OF MATURITY.

It is important that leaders understand the value of a mature software process. Table 1.1 compares an immature software organization with a mature software organization.

Immature Organizations

Mature Organizations

Software processes are improvised by practitioners during the course of the project.	Software processes are defined across the organization.
Firefighting mindset; focuses on immediate crises.	Focus on improvement of processes through pilot studies, cost-benefit analysis and other techniques.
Schedule and budgets are routinely exceeded.	Realistic estimates of schedule and budget based on historical performance are usually achieved.
Product quality is unpredictable.	Quantitative methods exist for judging product quality.

Table 1.1 Immature versus mature software organizations

Software process improvement is an expensive, complicated, and time-consuming undertaking. The SEI maintains a database of the maturity levels of organizations reporting CMM-based process improvement efforts. Figure 1.3 shows the organization maturity profile as of May 1998. The profile is compiled by SEI and characterizes the software process maturity of the software community. The profile is based on input from 700 software organizations representing commercial industry, DoD contractors, military and other contractors worldwide. The profile indicates the relatively immature state of software. These figures were compiled from a variety of organizations. At this time less than one percent of the assessed organizations are CMM Level 5 organizations. Process improvement issues and strategies from two CMM Level 5 organizations are reviewed in this study.

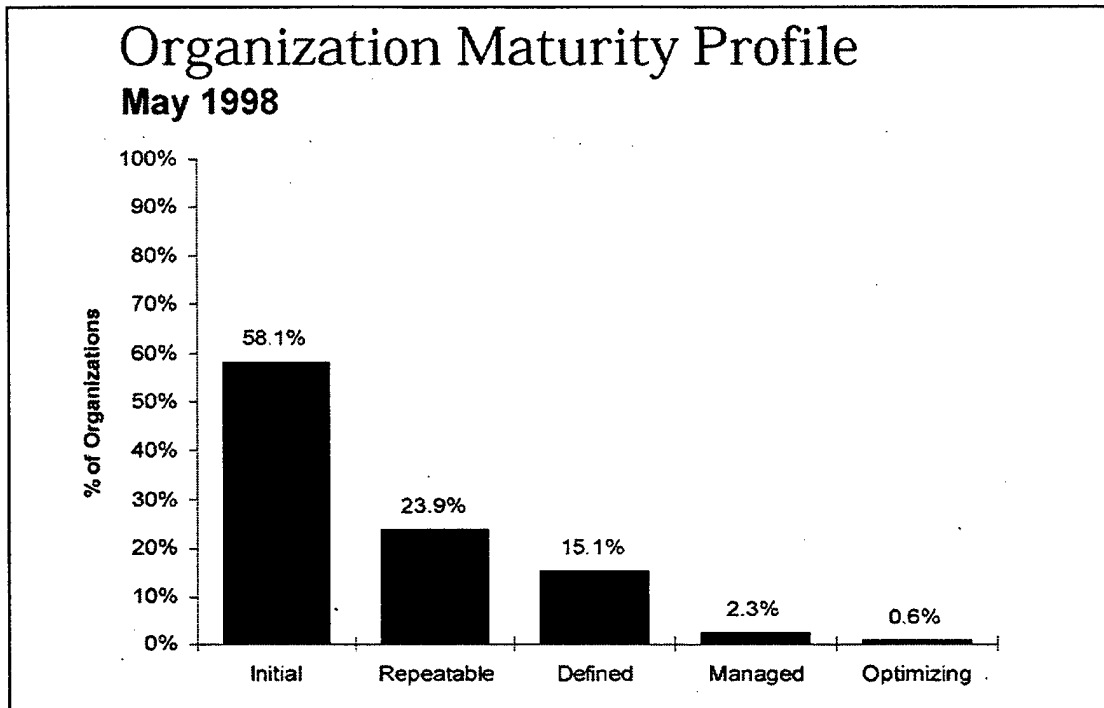


Figure 1.3 Organization Maturity Profile (Source SEI)

D. BENEFITS OF CMM-BASED PROCESS IMPROVEMENT

CMM-based process improvement is but one strategy that is available for an organization to improve its performance. Quantifying the return on investment of CMM-based process improvement is a contentious issue among industry leaders. The parameters for judging its effectiveness are many times more qualitative than quantitative. However, in a technical report published by the SEI (SEI/CMM TR-13) data from a diverse group of 13 organizations (representing DoD contractors, military and commercial software organizations) were analyzed to assess the benefits of CMM-based process improvement. The report indicates significant gains in productivity, cycle time, and product quality from organizations using CMM-based process improvement.

E. CHALLENGES OF SOFTWARE PROCESS IMPROVEMENT

The challenges to process improvement are many. In the schedule driven world of software development, poorly planned process improvement efforts are quickly overwhelmed by delivery dates. Improved processes do not represent the tangible outputs (i.e., a completed project) that organizations are accustomed to. The connection between the strategic goals of the organization and process improvement efforts can be vague or nonexistent to employees. Process improvement is not easy. It requires training on the part of all parties associated with the development process. Sluggish starts and initial mistakes that are common in most software projects contribute to organizational resistance when they are encountered during the process improvement effort. Software developers of the "programming is art" mindset view attempts to manage the development process as a hindrance. Efforts at creating an environment of continuous process improvement must overcome the security that comes from familiar routines.

F. CASE STUDIES

Because of the time, expense and complexity involved many organizations have abandoned their process improvement efforts (after incurring great costs). However, several case studies document well conceived and implemented process improvement efforts. By examining the experiences of different types of software organizations and their approaches to software process improvement, a set of generalizable best practices may be derived.

Software process improvement initiatives are not unlike other process reengineering efforts. They are influenced by such dynamics as resistance to change, organizational structure, cultural barriers, and other issues. Software engineers must understand the need

to change, be convinced the new process will, indeed, improve performance, and be supported as they learn and implement it. (STSC, 1996) An effective plan for software process improvement implementation must address concepts of organizational change including sociotechnical change, transition management, cultural barriers, organizational structure, and resistance to change.

G. STUDY PURPOSE

The purpose of the study is to develop ways to facilitate implementation of software process improvement initiatives. Initially change management theory will be examined to extract those themes relevant to successful implementation and sustainment of change. Then the software process improvement initiatives of a broad cross section of organizations are reviewed in the context of relevant change theory. By analyzing various implementation techniques and the associated results, best practices will be derived.

This research targets the Defense Finance and Accounting Service (DFAS), Financial Systems Agency, Kansas City (FSA-KC) which provides resources and support in performing a variety of software development services for the U. S. Marine Corps and other Department of Defense (DoD) organizations. FSA-KC is in the midst of a software process improvement effort that began in 1993. Information gathered from on-site analysis of FSA's current software process improvement efforts, interviews with FSA personnel, archival material, and a survey provide data for this thesis.

The objective of this thesis is to apply software process improvement best practices and change management theory to the Financial Services Agency (FSA) of the Defense Finance and Accounting Service (DFAS) in an attempt to facilitate their ongoing process improvement efforts.

H. RESEARCH QUESTIONS

Primary:

- How can the software improvement process be facilitated to increase efficiency?

Secondary:

- What is the software process improvement process? What problems does it face?
- What are software process improvement best practices?
- How can we apply change management theory to interpret software process improvement best practices?
- What general guidelines can be developed to facilitate the improvement process?
- What are the challenges to software process improvement efforts at FSA?
- How can these challenges be mitigated using software process improvement best practices and change management concepts?

I. METHODOLOGY

The methodology used in this thesis research consists of the following steps:

1. Conduct a literature search of journals, books, magazine articles, web resources, and other library information resources on change management concepts.
2. Conduct a review of related change management theory.
3. Conduct a review of software process improvement case studies.
4. Compile a list of software process improvement best practices based on common themes from successful cases.

5. Design and conduct semi-structured interviews for assessment of FSA-KC focusing on facts known to influence the effectiveness of improvement efforts based on data from case studies, consultant interviews, and literature reviews.
6. Evaluate interview results and characterize FSA-KC environment.
7. Prepare recommendations for implementation of software process improvement initiatives at FSA-KC.

J. SIGNIFICANCE OF THE STUDY

This study provides recommendations to FSA-KC for successful implementation and maintenance of software process improvement initiatives. It serves as an example for other organizations seeking to implement software process improvement initiatives.

II. REVIEW OF RELATED LITERATURE

A. INTRODUCTION

Software process improvement initiatives are not unlike other process reengineering efforts. They are influenced by such dynamics as resistance to change, organizational structures, and cultural barriers to name a few. A review of related change management theory provides a context for examining SPI implementation issues within these constraints. Specifically, three theoretical perspectives on organizational change provide the frameworks for analysis in this study.

Dalziel and Schoonover (1988) examine the problems of implementing organizational change and provide recommendations for mitigating these problems. Pasmore (1988) approaches the problems of change implementation from the standpoint of optimization of the organization's social and technical systems within the constraints of the environment it operates in. Finally, Bridges (1991) espouses the importance of managing transitions--the ending, the neutral zone, and the beginning--as the key to implementing and sustaining change. These three perspectives are reviewed below. This section concludes with a summary of the key themes.

B. CHANGING WAYS

In "Changing Ways", Dalziel and Schoonover (1988), suggest that effective change leaders deal with the tangible and hidden processes of change by answering three questions:

- Have we got our organization ready for change?
- Do we have the right mix of skills on our team to make the change happen?

- Can we ensure that the implementation process will be successful? (Dalziel and Schoonover, p.15)

1. Getting the Organization Ready for Change

Dalziel and Schoonover (1988) offer the following as attributes of organizational readiness:

- **History of Change:** The prior experience of the organization in accepting change.
- **Clarity of Expectations:** The degree to which the expected results of change are shared across various levels of the organization.
- **Origin of the Idea or Problem:** The degree to which those most affected by the change initiated the idea or problem the change solves.
- **Support of Top Management:** The degree to which top management sponsors the change.
- **Compatibility of Organizational Goals:** The degree to which the proposed change corresponds to past and present organizational practices and plans.

The first three dimensions--history of change, clarity of expectations, and origin of the request or problem--focus on how to motivate people to embrace change. To stimulate a positive attitude toward change, change leaders let "success breed success", by scaling initial interventions to their organization's past performance (Dalziel and Schoonover, p.15). The most important thing is not to fail at the start. You should always ensure an initial success-even if you have to move more slowly or only start a small part of the change. In addition change leaders instill consistent expectations about the change and its ramifications throughout the organization. Finally, they make sure that change is framed to meet key problems of those who will have to live with the change first. (Dalziel and Schoonover, 1988)

Support of top management is critical at the initial stages of planned change and important throughout the process. Upper-level alliances provide tangible support in the

form of resources for various phases of the project and intangible support in the form of sponsorship and networking. Change managers managing successful endeavors generate support much more often than those producing less successful results. Dalziel and Schoonover (1988) suggest building a case for change that appeals to top-level concerns and creating a formal management review process involving key players in top-management as ways that change leaders can build top-management support.

The best change leaders tailor the scope, scale, and type of change to fit existing patterns. This keeps the effort practical (Dalziel and Schoonover, p17). A change that aligns with existing goals, practices, and priorities of the organization is more easily understood and adopted. Every leader who initiates a policy, program, or practice should assess the compatibility of the change with the current organizational culture:

- Does the change fit with an overall business plan?
- Do proposed changes make employees' jobs harder or easier?
- Is the change technically familiar to members of the organization?

Dalziel and Schoonover (1988) suggest that change agents integrate the change into on-going procedures whenever possible. Another technique is to implement the change initially in the most accepting surroundings (i.e., a section with particularly knowledgeable and flexible workers). They also highlight the importance of communicating how the change fits with organizational directions.

2. Implementing the Change

As the change effort evolves, the change leader must address a number of key issues to translate proposed actions into on-going organizational practices. A set of five key processes support the process of successful implementations:

a. Clarifying Plans

Clarifying plans is the process in which implementors define, document, and specify the change. Dalziel and Schoonover (1988) emphasize that successful change leaders make plans public and involve influential members of the end-user group to participate in formulating the plan. They conduct an on-going dialogue about each of the steps in their plan, with both the change agents and the end-users.

b. Integrating New Practices

Integrating new practices is the process in which an organization incorporates change into its operations. Change managers should gradually integrate change efforts into an organization, gearing the rate of change to the organizational context rather than cramming it into a prefixed timeline. Limiting the rate of change until acceptance and understanding is clear produces more effective long-term results. It is also important to limit the amount of change introduced at one time.

c. Providing Education

Education provides programs in which end users learn about and use new approaches and procedures. A good training program is designed from the user's perspective. It incorporates their knowledge and experience, and is constantly evaluated in the context of its affect on work practices and user attitudes.

d. Fostering Ownership

Fostering ownership is the process through which end users come to identify new processes and procedures as their own, rather than regarding them as changes imposed upon them. Ownership is fostered when the primary benefits of the change are apparent to the end-users and when the end-users are involved in the plans,

decisions and outcomes of the effort. When users understand and participate, they become committed to current and future strategies.

e. Feedback

The feedback process is accomplished by first documenting and describing the expected outcomes of the change, and then using input from those affected by the change to judge the effectiveness of the change during and immediately after implementation. Effective change managers perform significant up-front information gathering and continue exploring options throughout the change effort. Assessing employee and management attitudes and practices is key to successful change implementation. The broad perspective gained from multiple inputs that include various business functions and customers often generate ideas for more practical effective change efforts. (Dalziel and Schoonover, 1988)

C. THE SOCIOTECHNICAL SYSTEMS PERSPECTIVE

Pasmore (1988) asserts that an organizations effectiveness is a function of the people (the social system), the tools and techniques they use (the technical systems) and the customers (the environment). By optimizing the social and technical elements of organizational design within the context of the environment, organizations may achieve peak performance and efficiency. Conversely, failures in organizational undertakings can be traced to overlooking the significance of one or more of these elements. While it may be argued that there are other factors that contribute to organizational effectiveness, it seems clear that at a minimum these three must be considered. Pasmore asserts that every organization is a sociotechnical system.

1. The Environment

Every organization is ultimately dependent on the environment (in the form of customers, competitors, sources of resources, and other things) for survival. The environment imposes constraints and opportunities that influence the goals, processes, and outcomes of organizational systems. Internal measures of success that are not consistent with environmental constraints and opportunities are inaccurate predictors of an organizations future success. The external environment is the ultimate judge of system effectiveness. The sociotechnical systems perspective asserts that whatever decisions are made about organizational design should meet the demands of the external environment as well as the internal social and technical systems. (Pasmore, 1998)

As a basic tenet, organizational designs should "fit" with the environment (Kotter, 1978) but rapid and unpredictable changes in the environment make achieving the proper fit difficult. To achieve and maintain an optimal fit between the organization and the environment, the organization must also change continuously. Therefore managers should strive to create a learning capacity within the organization, to facilitate continuous improvement of organizational practices and systems. (Pasmore, 1988)

Pasmore asserts that the greater the level of experimentation in organization design, the greater the likelihood that learning will occur and lead to more effective future adaptations to the environment. However, he realizes that opportunities for managers to experiment with different techniques that enhance their learning is difficult in the face of pressures to settle upon a workable solution that can deal with immediate environmental demands. (Pasmore, 1988)

The environment can be seen as a provocation or a source of inspiration (Pasmore, p21). The more the environment is viewed as a source of provocation, the more adaptation will focus on solving immediate problems versus innovations in organizational design. Companies that are successful in turbulent environments do more than react to competition; they take steps to transform the environment itself to make it more conducive to their well being. (Pasmore, 1988)

Given the impact of the environment on organizational success, it is clear that sociotechnical systems design must begin with an appreciation of organization-environment relationships. Pasmore (1988) details two methods for scanning the environment; open systems planning and the search conference. The methods are very similar. Both methods assess the organization-environment fit, within the context of a particular change initiative. Table 2.1 illustrates the general approach to the two scanning methods.

Open Systems Planning	Search Conference
List the important stakeholders in the environment and expectations they hold regarding both how the organization will operate and what it will achieve.	The external social field (contextual environment) is explored.
Create a realistic future scenario which depicts what would happen if it continued on its current course.	Discuss broad desirable futures for the organization.
Create an idealistic future scenario.	Explore the unique characteristics of the system.
Compare the realistic and idealistic scenarios to identify design constraints and opportunities.	Explore possibilities and constraints of the system.
Plan specific actions to support movement toward the idealistic future scenario.	Begin operational planning to achieve the desired future system.

Table 2.1 Environmental Scanning Methods

These techniques for scanning the environment can be carried out at different levels of the organization. Environmental awareness is enhanced by regularly involving employees at all levels in scanning the environment. Regardless of the mechanisms

employed there is greater potential for generating workable action plans when key external stakeholders are involved in scanning the environment. (Pasmore, 1988)

2. The Social System

Organizational success depends on social system dynamics. Therefore, the social system should receive as much attention during sociotechnical systems design as the technology and the environment (Pasmore, 1988). The social system of an organization is comprised of the people who work in the organization and all that is human about their presence. This includes individual attitudes and beliefs, the implicit psychological contracts between employees and employers, reactions to work arrangements and company policies, and a myriad of other human dimensions. Pasmore (1988) points out that analyzing the organization as a social system is difficult, but social systems are the only parts of the organization that can conceive and implement improvements in organizational processes.

While encouraging managers to strive for joint optimization of social and technical systems, Pasmore (1988) concedes that actual optimization of social and technical systems is extremely challenging considering the complexity and rapidly evolving nature of social systems. However, he points out the following predictable aspects of social systems:

- The better the fit between the organization's culture and its external environment, the more effective the organization will be.
- The greater the disparity between organizational design features and the unique characteristics of organizational members, the less successful a design will be.

- The greater the involvement of employees in the design process, the more flexible the resulting organizational design is likely to be.
- The greater the involvement of employees in the design process, the clearer the understanding of how behaviors are linked to desired rewards.

Pasmore (1988) asserts that at the macro level, social system dynamics can be understood both in terms of the culture of the organization and its structure, which includes the designation of departmental boundaries, reward systems, supervisory and control systems, job design principles, performance expectations, employee involvement opportunities, and the nature of contracts between labor and management as well as psychological contracts between the organization and its members. The challenge for the sociotechnical systems designers is to first understand the constraints that social dynamics within an organization place on design possibilities, and second, to recognize that bold design changes can produce both desirable and undesirable effects on behavior. (Pasmore, 1988)

The social system is the source of all innovation and adaptation. Because innovation and adaptation require human commitment, we need to understand how the design of organizations influences the willingness of people to help organizations succeed. High performance requires commitment; building commitment requires treating people like adults and engaging them fully in shaping their future. (Pasmore, 1988)

3. The Technical System

Pasmore defines the technical system of an organization as the tools, techniques, devices, artifacts, methods, configurations, procedures and knowledge used by organizational members to acquire inputs, transform inputs into outputs and provide

outputs or services to clients or customers. The primary function of technology is to enhance the amount of work an individual can accomplish and the reliability of individual performance. (Pasmore, 1988)

The nature of the technical system used by an organization influences the apparent level of commitment and motivation demonstrated by individuals. The interplay between the roles defined by technology and one's self image gives rise to psychological contracts between the individual and organization which define the level of effort and commitment one will demonstrate in pursuing organizational goals. Technologies which prescribe narrow roles for individuals, produce psychological contracts which preclude learning or change, and are reinforced by structural arrangements which interfere with cooperative problem solving may result in total immobilization. Under such circumstances changes of almost any kind are threatening, since they may undercut the personal or political security associated with traditional arrangements (Pasmore p.62). The design of jobs will be more stimulating when the technology is designed to provide more direct and immediate feedback and when the technology leaves a significant degree of relevant decision making to employees.

4. Sociotechnical Systems Redesign

The sociotechnical systems redesign model (Figure 2.1) is targeted at implementing changes to existing systems. This model for redesign is consistent with

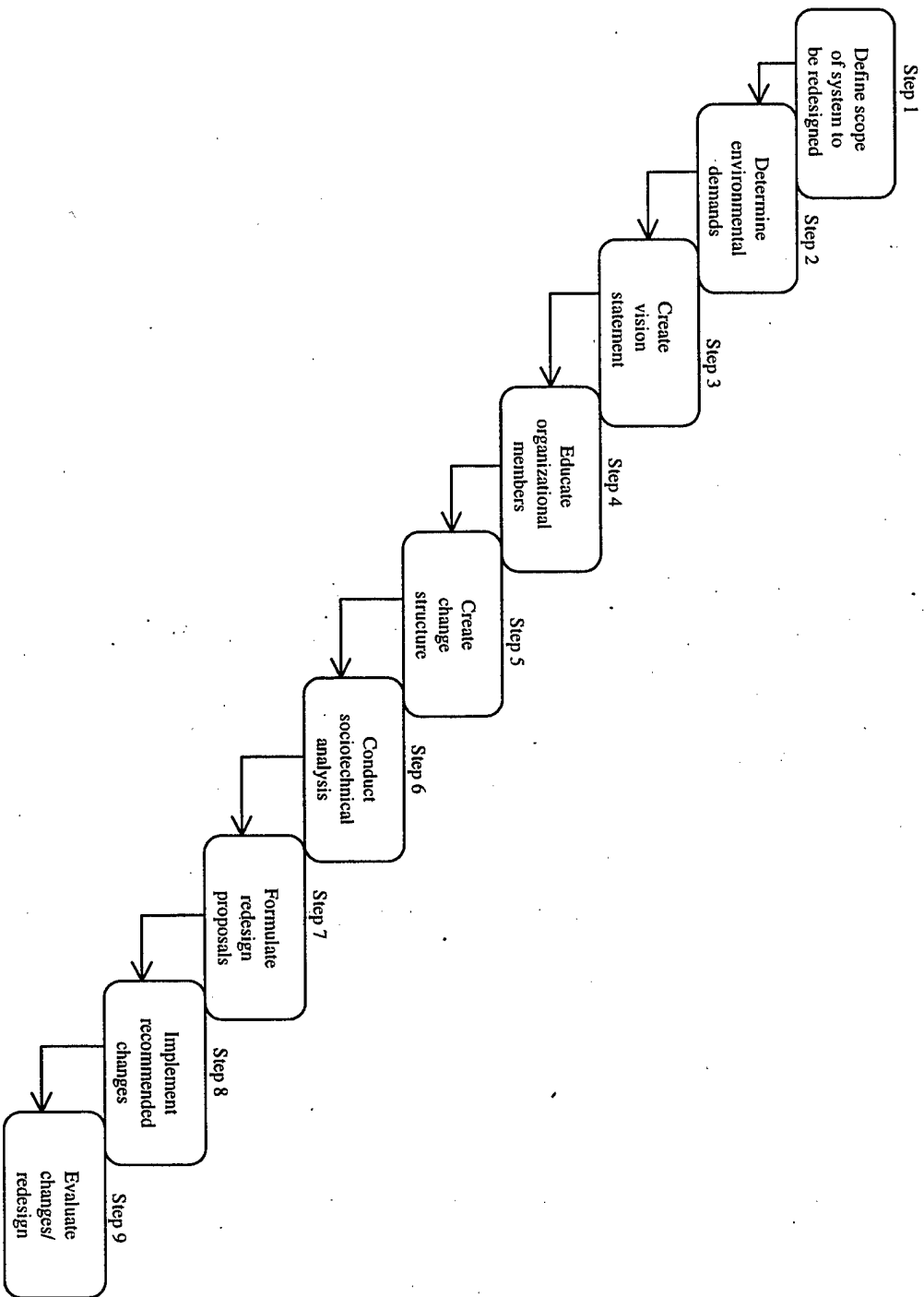


Figure 2.1 Sociotechnical Systems Change Model (Adapted from Pasmore p.111)

those concepts put forth in the sociotechnical systems perspective. Pasmore offers the following cautions on the use of the sociotechnical systems redesign model:

It is not a quick-fix, limited scope, cosmetic process which is tightly controlled by management alone. If followed as outlined here, the model may take anywhere from six months to three years to complete; it will probably demand full-time attention by several organizational members, require a substantial outlay of resources, and call into question every aspect of the organization's design and operating practices; moreover, it is almost certain to disrupt organizational performance for a period of time. But in the end, it is more likely to produce changes that are desired--and often demanded--in a competitive environment (Pasmore, p. 110).

Each of the items in the sociotechnical systems redesign process is briefly described below:

Step 1: Define the scope of the system to be redesigned.

The first step in the sociotechnical systems change process is intended to clarify the boundaries of the organizational unit to be redesigned. In addition, it includes the activities associated with the entry, scouting and contracting phases in typical organization development efforts. These include defining the need for change, determining the potential for success, agreeing on a change mode, defining rough time and cost parameters, clarifying expectations among parties, forming a steering committee to oversee the effort, and agreeing to a public contract which outlines the work to be done.

Step 2: Determine environmental demands.

The second step in the change process involves identifying important constituencies in the external environment who might impact the nature and scope of changes that will occur in the organization. Based on the perceived demands of

competitors, shareholders, corporate management and others, areas of opportunity as well as constraints on the redesign are identified.

Step 3: Create the vision statement and charter.

Based on the environmental demands identified in Step 2, top level decision makers draft a preliminary statement outlining their vision of the ideal organization they hope to create through the change process. In addition, the statement outlines the perceived constraints in such areas as policies, reward systems and labor agreements and sets clear goals for performance after the redesign.

Step 4: Educate organizational members.

Although designated as a distinct step in the change process, the education of organizational members which begins in Step 4 continues throughout the remainder of the change process and beyond. In addition to education about the sociotechnical systems perspective and change process, organizational members should also begin training that will prepare them to assume their new roles in the redesigned system.

Step 5: Create the change structure.

In step 5, a representative design team is formed which will conduct the actual sociotechnical systems analysis and formulate proposals for changes in the system. The relationship between the design team and the top level decision makers on the steering committee is clarified.

Step 6: Conduct the sociotechnical systems analysis.

Step 6 actually consists of three distinct but interdependent analyses of the social system, technical system, and environment of the organization as detailed in the previous

sections. A clear understanding of how the organization currently operates points toward areas for improvement in the future.

Step 7: Formulate redesign proposals.

Ideas for redesigning the organization flow from the analyses conducted in Step 6 as well as the vision put forth by the steering committee and revised by organizational members. All proposals are reviewed by organizational members and checked against sociotechnical systems principles.

Step 8: Implement recommended changes.

In Step 8 a plan is devised for implementing the changes which pass the review in Step 7. Responsibility for seeing that the changes occur is designated to individuals with the power to make them happen. A review system is created to monitor implementation success.

Step 9: Evaluate changes and redesign as necessary.

Since the process of sociotechnical systems change is complex, it is necessary to evaluate the changes that are made to ascertain whether they are producing their intended effects.

D. MANAGING TRANSITIONS

The leader is no more or less than a manager of transitions (Pasmore, p. 148). Bridges (1991) distinguishes change management theory as focusing on a desired outcome that the change will produce while transition management focuses on the psychological process people will go through to come to terms with the new situation. Bridges terms the three phases of transition as the ending, the neutral zone, and the new beginning respectively. This is not to imply that the phases are distinct and sequential, but

more to isolate the dynamics of transition into its simplest forms. As depicted by the overlapping phases in Figure 2.2 the organization will be in more than one phase at a time. The movement through transition is marked by a change in the dominance of one phase as it gives way to the next. (Bridges, 1991)

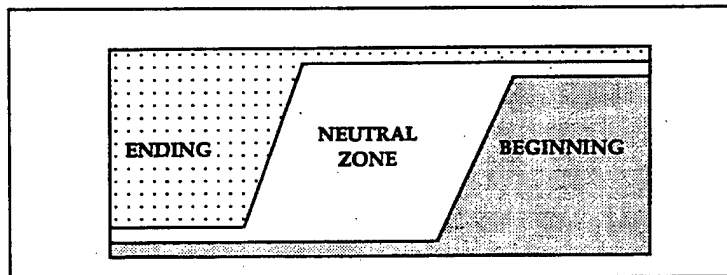


Figure 2.2 The Three Phases of Transition (Adapted from Bridges p. 70)

Transition management recognizes the fact that one of the major challenges of implementing and sustaining change is getting people to stop doing the things that they have grown accustomed to doing. It also recognizes the significance of that time between the ending of established practices and the beginning of new practices. This is a time of increased organizational vulnerability, but can also be a time of increased creativity and ingenuity. Unless transition occurs, change will not work. (Bridges, 1991)

1. The Ending

While the first task of change management is to understand the destination and how to get there, the first task of transition management is to convince people to leave home (Bridges, p.32). The starting point for transition is not the outcome but the ending that you will have to make to leave the old situation behind. If things change at least some employees and managers are going to have to let something go. So beginnings

depend on endings. Bridges (1991) cites the connection between resistance to change and the losses associated with endings. It isn't the changes themselves that people in these cases resist. It's the losses and endings that they experience and the transition that they are resisting. The failure to identify and be ready for the endings and losses that change produces is the largest single problem that organizations in transition encounter.

Bridges (1991) recommends providing frequent and continuous communication as a solution for managing the impact of the ending on people. Change agents should describe the change in as much detail as possible. They should present the innovations as developments that build on the past and help realize its potential.

2. The Neutral Zone

The neutral zone is the no-mans land between the old reality and the new. It is a time when the old way is gone and the new one doesn't feel comfortable yet. The neutral zone is usually a time of confusion and frustration, but if managed properly can be a time of increased creativity and innovation. The more drastic the change the longer the time spent in the neutral zone and the more important it is to effectively manage this time.

(Bridges, 1991)

To minimize the confusion and frustration in the neutral zone senior management must protect their people from unrelated or unnecessary changes as much as possible. If this is not possible, management should try to cluster and relate new changes to the primary on-going changes. People can deal with a lot of change if it is coherent and part of a larger whole. But unrelated and unexpected changes, even if they are small can be the proverbial straw that breaks the camel's back. (Bridges 1991)

One of the persistent problems during transition is for decision makers and those implementing decisions to be clear on precisely what impact the decisions and actions will have. A transition monitoring team (TMT) can provide feedback and facilitate communication between planners and implementors. The TMT's purpose includes:

- Demonstrating organizational concern for the impact of transition on the people.
- Reviewing plans or communications before they are announced.
- Providing ready access to the organization's grapevine. Countering rumors and correcting misinformation. (Bridges, p.42)

In the neutral zone restraints on innovation are the weakest. Only when the old way of seeing things disappears are habit patterns broken, and a new way will emerge. Innovation will take place automatically in the neutral zone if people are protected from further change, informed, and encouraged to find new ways to do things. (Bridges, 1991)

3. The New Beginning

A new beginning can only take place after a well managed ending and neutral zone. Starts involve new situations, a beginning involves the new understandings, values, and attitudes that are required for successful transition. To make a new beginning people need The Four Ps: the purpose, a picture, the plan, and a part to play. (Bridges, 1991)

a. The Purpose

Successful new beginnings are based on a clear purpose that aligns with the internal characteristics of the organization and the external forces that influence the organization. You need to explain the purpose behind the new beginning clearly. You

may discover that people do not have a realistic idea of where the organization really stood and what its problems were (Bridges, p. 53).

b. A Picture

Most of the pain of the neutral zone comes from the fact that it is a time without a viable organizational picture. People in the organization need to be able to visualize the change. They need something they can see, at least in their imaginations. They need a picture of how the outcome will look and they need to be able to imagine how it will feel to be a participant in it. (Bridges, 1991)

c. The Plan

A transition management plan differs from a change management plan in that it starts with where the people are and works forward through the process of ending, getting through the neutral zone, and finally the new beginning. The transition plan starts with where people are and spells out the details of the route from the current state to the future state. Plans are immensely reassuring to most people, not just because they contain information but because they exist. (Bridges, 1991)

d. A Part to Play

Even the best-laid plans leave a troubling doubt in the minds of some people. Until people are given a part to play they will feel left out and find it difficult to make a new beginning. Bridges indicates that people should have two parts to play. First they need to see their role and their relationship to others in the new scheme of things. They should also have a role in dealing effectively with the transition process itself. The easiest way to do this is to be sure that everyone has a place on a planning task force, climate survey group, problem-solving circle or transition monitoring team. If this is not

possible, set up formal input systems for such groupings so that each person has at least an indirect part to play in the transition management process. Commitment to the new beginning is enhanced by involving as many people as possible in the plan. Everyone who plays a part is implicitly implicated in the outcome. (Bridges, 1991)

4. Reinforcing the New Beginning

Bridges indicates that beginnings that are not reinforced will revert to chaos when confronted by the continuing stream of changes that are sure to come along. To reinforce the new beginning, senior management must ensure that they are sending consistent messages about the importance and the priority of the change. If you tell people they need to do five new things but don't remove anything from their list of tasks, you are sending conflicting messages (Bridges p.61). Conflicting messages are confusing in their own right and also provide people with excuses to argue that the new beginning isn't for real. (Bridges, 1991)

It is common and disastrous to tell people to act and react in new ways and then to reward them for the old actions and reactions. People have to feel that they are better off for having changed their attitudes and behavior, and if they don't you'd better look at your reward system. (Bridges, 1991)

E. SUMMARY

A number of significant issues related to change implementation were presented in the work of Bridges (1991), Dalziel and Schoonover (1988), and Pasmore (1988). Although their approaches differ, there is some overlap in their coverage of certain concepts. The overarching themes of the literature addressed assessing an organization's readiness for change, change implementation strategies, and sustaining change.

1. Organizational Preparation

The literature indicates the importance of assessing the organization's preparation for the planned change. Internal dimensions of organizational preparation include the culture and attitudes of the workforce, the workforce's recognition of the problem that the change addresses, and management support. These internal dimensions of organizational preparation can be managed through communication, selling the problem, and the use of information-gathering techniques to assess workforce concerns. External dimensions of organizational preparation reflect the adequacy of open systems planning or a search of environmental factors such as customers, competitors, market conditions, and legislation. Managers must have a clear understanding of the impact of environmental factors on the implementation of the planned change. Scanning the environment is a technique for assessing and working within the constraints of the organization's external environment.

2. Process Improvement Strategy

The literature review highlighted the significant attributes of a change plan. The plan should be detailed and targeted at all levels of the organization and encourage involvement by as many people in the organization as possible. The plan should ensure quick successes initially and align with the business goals of the organization. In addition, changes should be piloted on a representative project where possible.

3. Sustaining Change

The literature emphasizes the importance of establishing a culture where "change is the norm" in an organization for sustaining change. Techniques for establishing such a culture include encouraging innovation, not punishing failure, ongoing training and development, and reward systems that are consistent with a learning culture.

In the section that follows data from software process improvement case studies, technical reports, and other papers will be examined within the context of the aforementioned issues.

F. SOFTWARE PROCESS IMPROVEMENT CASES

1. Introduction

In this section the software process improvement efforts of four organizations are reviewed:

- Boeing Defense and Space Group (D&SG), Space Transportation Systems (STS)
- Hughes Aircraft Software Engineering Division (SED)
- The Software Engineering Laboratory at NASA Goddard Space Flight Center
- Raytheon Electronic Systems Organization

These organizations were selected for review because of their outstanding reputation for software process improvement and because of the rich data available on their efforts. Hughes (1997), NASA/GSFC (1994), and Raytheon (1995) are winners of the IEEE Software Process Achievement Award, and Boeing STS is one of only four CMM level 5 organizations listed on the current organization maturity profile maintained by SEI. It is not the intent of this thesis to enumerate all process improvement activities of these organizations; rather the intent is to derive those best practices that are likely to contribute to the greater knowledge of effective software process improvement activities.

2. Boeing Space Transportation Systems

In July, 1996 the Boeing Defense and Space Group (D&SG), Space Transportation Systems (STS) organization achieved a level 5 rating on the SEI's CMM.

A series of articles relating Boeing's experiences in achieving CMM level 5 provide insight into the process.

George Yamamura, Software Engineering Process Manager for Boeing STS, attributes Boeing's success in process improvement to an approach that is responsive to business goals and an emphasis on the human issues of process improvement (Yamamura, 1998). In a presentation given at the March, 1998 SEPG conference, Yamamura recommended conducting surveys to assess worker's perspectives on issues of importance, levels of satisfaction, and areas of improvement. He suggests using employee inputs in conjunction with an analysis of the situation to develop a change strategy.

Boeing's Management Goal Framework is a practical example of clarifying plans as prescribed by Dalziel and Schoonover (1988). It provides a roadmap for the business case. It starts with the organization's business goals and breaks them down in successive levels until they are translated to process activities at the project level.

Boeing's four step formula for success, RSST: Right thing, Small steps, Simple, and Timing can be summarized as understanding the problem within the context of the environment, looking for simple, appropriate solutions, and implementing in small steps to gain quick successes.

Boeing's mechanism for evaluating candidate process changes (shown in figure 2.2) is of particular significance to this thesis. It provides a framework for satisfying some of the key requirements for successful change implementation, including gaining management support, piloting the change, monitoring, and feedback. (Kness & Satake, 1997)

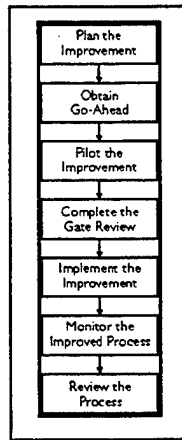


Figure 2.3 Boeings Process Improvement Process
(Adapted from Kness & Satake, 1997)

After an improvement plan is made and initial management support is gained, the potential process improvement initiative is piloted on a representative software development project. Once the benefits of the piloted improvement are evaluated, a gate review is conducted with management to determine if more widespread implementation is warranted. After which, the improvement may be implemented on other projects. The implementation of the improvement is then closely monitored. A working group is established to address issues of refinement of the improvement and training and to develop lessons learned. Boeing indicates that this approach helps prevent waste of resources in process changes that do not achieve the desired results. (Kness & Satake, 1997)

Boeing's approach to SPI is consistent with theoretical concepts of preparing the organization for change (via information gathering and an awareness of the environment) and sound change implementation strategies (via alignment with business goals and clearly defined plans).

3. Hughes Aircraft Software Engineering Division

Hughes Software Engineering Division (SED), formed in 1978, primarily works on US Defense Department contracts. It employs about 500 professionals. Of these, 41 percent have 10 to 20 years experience in software and 12 percent have 20 or more years experience. In 1990, SED was assessed at CMM level 3 by the Software Engineering Institute. The two-year program of improvements cost \$400,000. Hughes found that the investment improved working conditions, employee morale, and the performance of the SED as measured in project schedule and cost. Hughes estimates the resulting annual savings to be about \$2 million. (Humphrey, Snyder, & Willis, 1991) The factors that contributed to Hughes success include top management support, alignment with business goals, employee involvement, and a comprehensive technology transfer function.

Hughes realized that implementation of the SPI action plan as originally drawn up would require additional funding. Consequently support and involvement of top management (who reviewed the action plan prior to approving additional funding) was an early requirement.

The action plan listed the goals of the SPI effort and put the action plan in the context of a Ground Systems Group Organizational Improvement Strategy. The action plan also included an estimation of the labor required for implementation. Additionally quality indicators (i.e., error and defect counts) were identified, collected and presented to senior management in monthly briefs on the health of each project. (Humphrey et. al., 1991)

Hughes credits the creation of a Head of Technology Transfer function as the most profound action in the entire improvement process.

Among other things, the head of technology transfer coordinated self-assessments, developed a questionnaire glossary, became the local expert in the SEI maturity questionnaire, became a member of the Software Productivity Consortium's technology-transfer advisory group, developed an SPC technology transfer plan, briefed senior management on the state of process maturity, maintained a database of technology used on each project and an awareness of what technology each project needed, facilitated technology transfer among projects, and a special-interest group on process improvement, supported the corporate wide technology transfer program, served on the practices and procedures change review board, the training policy committee, and the technology steering committee (Humprey et al., p.18).

While it is perhaps more impressive that one person could effectively handle so many tasks, the detailed breakdown of these tasks reflects the meticulous nature of Hughes SPI plan.

Hughes' SPI implementation strategy is illustrative of a number of the theoretical concepts for successfully implementing change. Their early involvement of top management and emphasis on employee feedback are practices consistent with Dalziel and Schoonover's (1988) principles for preparing an organization for change. The many tasks of the Head of Technology Transfer seem to be aimed at optimizing the fit between new technologies and the people as Pasmore (1988) advocates. These tasks also provide mechanisms for gauging and guiding the impact of technical changes on the organization, consistent with Bridges (1991) guidance on managing the transition. This SPI strategy allowed Hughes to progress from CMM level 2 in 1987 to a strong level 3 in 1990. In 1997 Hughes was the recipient of the Software Process Achievement Award.

4. The Software Engineering Laboratory at NASA Goddard Space Flight Center (GSFC)

A partnership between NASA/GSFC, the University of Maryland, and Computer Sciences Corporation forms the Software Engineering Laboratory which was created in

1976 for the purpose of understanding and improving the overall software process and products that were being created within Flight Dynamics Division (FDD) of NASA SEL. SELs continual experimentation with software process has yielded an extensive set of empirical studies that has guided the evolution of standards, policies, management practices, technologies and training within the organization. Trends have been observed from as far back as 17 years. (McGarry, Pajerski, Page, & Waligora, 1994) NASA SEL is the first organization to win the IEEE Computer Society Software Process Achievement Award. This organization could represent the pinnacle of SPI implementation. Factors that contribute to their success include: a bottom-up approach to SPI that emphasizes local goals, characteristics, and product attributes, alignment with business objectives, and a learning culture.

Incorporating the key concept of *change guided by development project experiences* (McGarry et. al., 1994), the SEL defined a standard paradigm to illustrate its concept of software process/product improvement. This paradigm is a three-phase model (figure 2.4) which includes the following steps:

1. Understanding: Improve insight into the software process and its products by characterizing the production environment, including types of software developed, problems defined, process characteristics, and product characteristics.
2. Assessing: Measure the impact of available technologies and process change on the products generated. Determine which technologies are beneficial and appropriate to the particular environment and, more

importantly, how the technologies (or processes) must be refined to best match the process with the environment.

3. Packaging: After identifying process improvements, package the technology for application in the production organization. This includes the development and enhancement of standards, training, and development policies. (McGarry et. al., 1994)

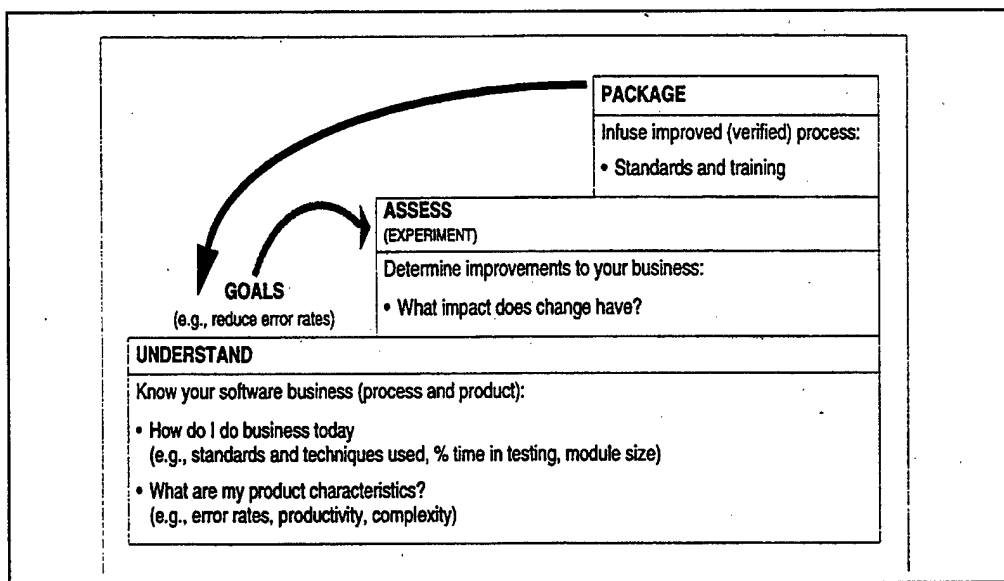


Figure 2.4 NASA SEL 3 Phase Model (Adapted from McGarry et. al., 1994)

Change is driven by product and not merely process alone (McGarry et. al., p.40). SEL's philosophy that if a changed process has no positive impact on the product generated then there is no justification for making the change, closely links SPI efforts with local business objectives. The SEL process improvement strategy emphasizes a baseline understanding of the local software process, products, and goals. SEL

distinguishes their "bottom-up" approach from the typical top-down approach in the following way. (McGarry et. al., 1994)

The top-down approach is based on the assumption that there are generalized, universal practices that are required and effective for all software development, and that without these practices, an organization's process is deficient. This concept does not take into account the performance issues, problems, and unique software characteristics of the local organization. The goals and characteristics of the local organization are not the driving elements of change.

In contrast the underlying principle of the SEL approach is that "not all software is the same." Its basic assumption is that each development organization is unique in some (or many) aspects. Because of that, each organization must first completely understand its local software business and must identify its goals before selecting changes meant to improve software processes. If, based on that understanding, change seems called for, then each change introduced is guided by "experience"—not by a generalized set of practices. (McGarry et. al 1994)

Process change has been infused as a standard business practice at NASA SEL.

Each production project in the Flight Dynamics Division is considered an opportunity for the SEL to expand its knowledge of process understanding and improvement. SEL analysts identify software process modifications that they hypothesize are likely to improve the resultant product and then design an experiment to test the hypothesis. The SEL conducts three general types of analysis, all of which are active continually in the environment. They include:

- Pilot studies of specific techniques and technologies on a project or set of projects.
- Studies of completed projects for development and refinement of local process and product models.
- Trend analysis of completed projects to track the impact of specific process changes on the environment as a whole. (McGarry et. al. 1994)

SELs emphasis on product improvement over process improvement ensures that changes are compatible with existing organizational practices and plans as prescribed by Dalziel and Schoonover (1988). Their view of every project as a learning opportunity is consistent with Pasmore's (1988) assertion that the greater the level of experimentation in organizational plans the greater the likelihood that learning will occur and lead to more effective adaptations to the environment.

5. Raytheon Electronic Systems

Raytheon Company is an international company that operates in four business areas: commercial and defense electronics, engineering and construction, business aviation, and major appliances. Raytheon Electronic Systems focuses on commercial and defense electronics. RES is a recently consolidated organizational entity that emerged from the restructuring of Raytheon's defense business in 1995. (Haley, Ireland, Wojtaszek, Nash, & Dion, 1995)

In the fall of 1987 prompted by the lack of success in delivering software projects on schedule and within budget, the Equipment Division of Raytheon (now part of RES) initiated a SPI effort known as the Software Engineering Initiative. In 1995 the Equipment Division was the recipient of the Software Process Achievement Award. Factors that contributed to Raytheon's success include: an emphasis on quantitative measures of process improvement, a well defined implementation plan, and continuous feedback.

A continuous concern that the \$1 million annual expenditure of discretionary funds on SPI was not really achieving a return sufficient to justify not spending the money on something else fueled Raytheon's drive for quantitative measurements of

process improvements. Raytheon measured the return on investment on SPI based on: the amount of rework, the predictability of software development effort, and software product quality. (Haley, et. al., 1995)

Raytheon's process improvement strategy consists of the organization's standard software engineering process which is defined by an underlying RES software policy. This policy describes the set of common software engineering practices: the "whats" of developing software, detailed procedures describing the how of critical aspects of software development, along with the tools and the training needed to make the developers productive (Haley et. al. p.3).

Raytheon's SPI strategy (Figure 2.5) includes feedback mechanisms, is responsive to the environment and provides guidance at all levels of the organization. The effectiveness of existing procedures are measured and analyzed, with the results of the analysis continuously fed back into the process improvement effort (Haley et. al p.19).

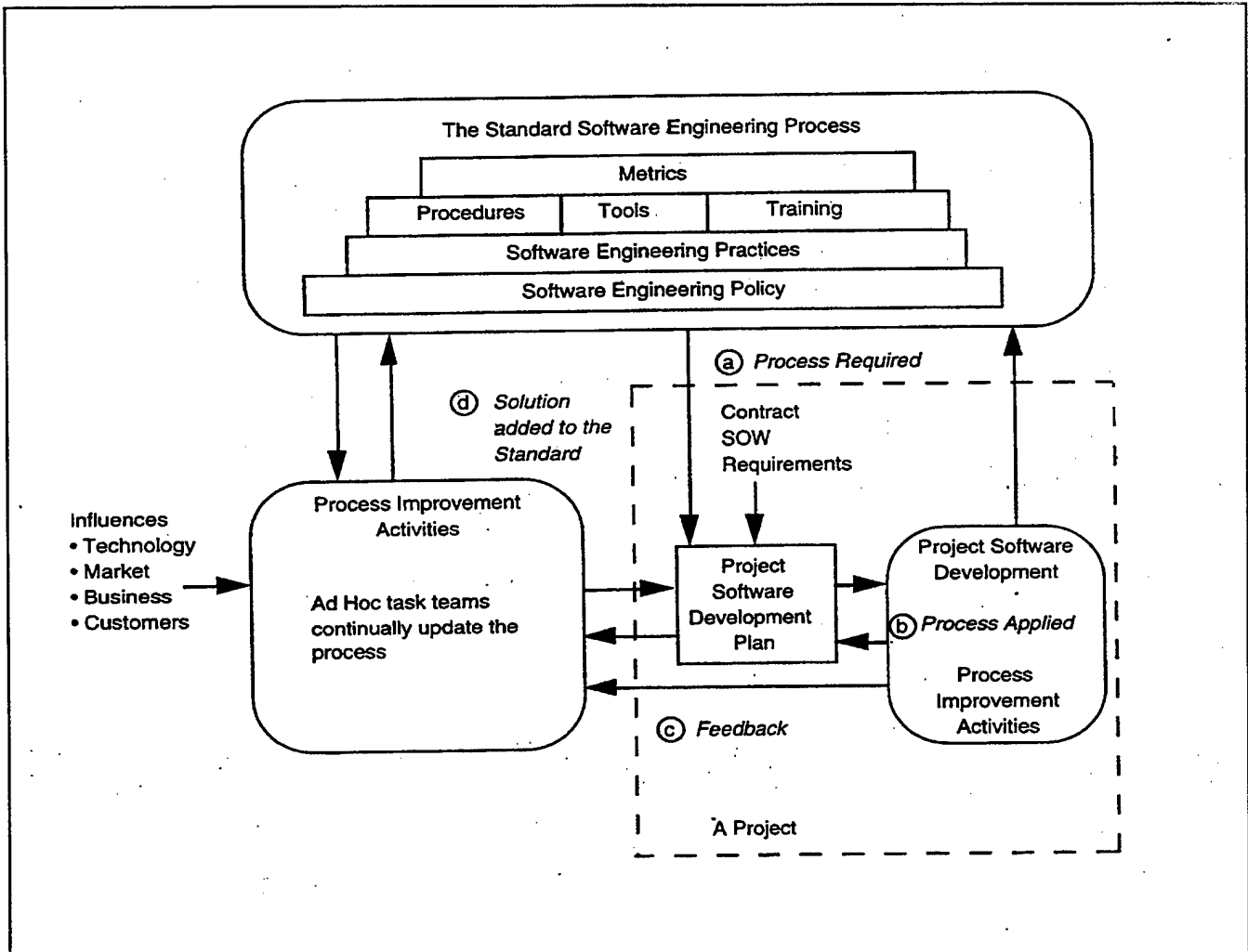


Figure 2.5 Raytheon's SPI Strategy (Adapted from Haley et. al., 1995)

Raytheon's "Blue Books" are a three-tiered set of documents which define Raytheon's processes at the highest level (Software Engineering Policy), the intermediate level (Software Engineering Standards), and the lowest level (Detailed Procedures and Guidelines). Defining the plan in this way has enhanced "buy-in" to Raytheon's improvement process at all levels of the organization. (Haley et. al., 1995)

RES has extended its practice of Key Program Reviews of the major projects in each business area (chaired by the General Manager) to include the review of process

improvement accomplishments by each of the functional areas within RES. This elevates process improvement activities to the level of project activities and keeps levels linked.

Any particular project uses the organization's process, consciously tailored to its particular needs and constraints along with its own project software development plan, the key document binding the project to the process. The plan is typically constrained by the contract, the statement of work, and the requirements of the system as specified by the customer or developed early on during the system definition. As the project software engineering occurs and the specific process is applied, two types of feedback take place. At the project level, the software development plan is refined to reflect lessons learned in early phases of the development, and at the organizational level, these lessons learned will have an impact on the process improvement activities and eventually lead to the creation of generic solutions to be added to the organization's standards. In the meantime, the process improvement activities being conducted by the initiative are benefiting from the real time application of these solutions on projects. The project feedback along with outside influences such as technology drivers, the marketplace, corporate business decisions, customer initiatives, all have an impact on the direction in which process improvement will occur. (Haley et. al., 1995)

Raytheon's unique approach to training also enhances organizational "buy-in". All courses are given during working hours, which promotes the feeling of company support and enhances morale. A detailed feedback questionnaire is completed by the student at the completion of the course. Further, during the transition phase, process improvement discussions examine the effectiveness of the training provided. (Haley et. al., 1995)

Raytheon's software development process relies on pathfinding, which is the process of identifying and testing tools, methods, and software components prior to their required use on a project in both the development and test environment. Pathfinding is a key component of risk management because problems can be identified early, and mitigation steps can be taken before there is schedule or cost impact to the project (Haley et. al., p. 15). Tools that are new to Raytheon are given extra attention so as to develop explicit procedures governing their use and identify peculiar behavior characteristics.

Raytheon's three-tiered set of documents are consistent with Dalziel and Schoonover's (1988) recommendation of clarifying plans as a means of ensuring successful change implementation. Their awareness of environmental factors and the influence that these factors may have on process improvement activities is in line with Pasmore guidance on optimizing social and technical systems within the constraints of the environment. Quantitative measures of process improvements and key process reviews maintain compatibility with organizational practices and plans as recommended by Dalziel and Schoonover (1988).

Over the lifetime of the initiative, rework involved in building software has undergone a reduction from about 40% of the development cost to about 10%. During this same period, productivity of the development staff has increased by a factor of almost 2.8, and predictability of their development budget and schedule have been reduced to the range of +/- 3%. RES' ability and willingness to analyze the impact of the initiative in these business-oriented terms has greatly influenced their success in maintaining the ongoing sponsorship of senior management. (Haley, et. al., 1995)

G. BEST PRACTICES

Based on a review of related change management theory and software process improvement technical reports and papers the following best practices have been derived. It seems logical to group the concepts as follows: concepts related to preparing the organization for process improvement, concepts related to implementing process improvements, and concepts related to sustaining the improvement effort.

1. Concepts related to preparing the organization for process improvement.

- Detailed assessment of the organization's preparation for change is a logical first step in a software process improvement effort. Dalziel and Schoonover's (1988) five attributes of organizational readiness provide a framework for assessing the challenges of the process improvement effort: 1) history of change, 2) clarity of expectations, 3) origin of idea or problem, 4) support of top management, and 5) compatibility of organizational goals.
- Scanning the environment is a critical step in understanding the overall context of the process improvement initiative. Buy-in of key customers, subcontractors, and suppliers is a must for successful change implementation. The search conference method detailed in Pasmore's (1988) sociotechnical systems perspective is one example of a framework for assessing the organization-environment fit.

2. Concepts related to implementing process improvements.

- Improvements should be integrated gradually within the context of an overall change design. A change design that relates and makes sense of changes within the organizational context is a means of combating "change overload".

- Transition Management Teams, consisting of personnel representing all levels of the organization, provide a feedback mechanism for assessing the "real impact" of improvement activities and demonstrate organizational concern for the people involved in the change. They also enhance participation, provide linkage across levels and assign responsibility for change management.
- SPI initiatives as projects. Treating SPI initiatives like projects enhances the alignment with the organizational goals and increases visibility of the efforts.
- Maximize involvement in the SPI process. By involving as many organizational members as possible in process improvement related groups (including discussion groups, transition management teams, training groups, etc.) we increase communication between change agents, senior managers, and practitioners. We also enhance organizational awareness and buy-in of improvement efforts.

3. Concepts related to sustaining the improvement effort.

- Piloting techniques evaluate new technologies and methods prior to their implementation organization wide. The concept of an on-going process of experimentation to improve the organization is an important mechanism for establishing a learning culture.
- By integrating small process improvements within the project cycle (guiding change by development project experience) we closely link the process improvement efforts to the organization's business goals. Additionally we "piggy-back" on the existing reward structures and motivations geared toward

successful project releases. The process should be reinforced with structured project reviews and lessons learned to enhance the next release.

- Training in change concepts. Transforming the organization into a learning organization is a long-term project. It requires a commitment to life long learning on the part of the individual and the organization. It is obvious that extensive technical training will be required at all levels. However, training in concepts of change management and learning organizations is also required to institutionalize the movement to change as the norm.

III. METHODS

The research method employed for this thesis is a case study of software process improvement efforts at the Financial Systems Activity-Kansas City (FSA-KC). It relies on multiple sources of data, including site visits, archival material, personal interviews and a survey. This chapter begins with a description of the research site. Limited descriptions of Defense Finance and Accounting Service (DFAS) and DFAS-KC Center are provided because activities at FSA-KC are profoundly affected by these organizations. The remainder of the chapter details the data collection procedures cited above.

A. DESCRIPTION OF RESEARCH SITE

1. DFAS

The Defense Finance and Accounting Service (DFAS) was activated on January 15, 1991, to reduce the cost and improve the overall quality of Department of Defense (DoD) financial management through consolidation, standardization and integration of finance and accounting procedures, operations, and systems. In December 1992, DFAS took over responsibility for all finance and accounting operations, and the associated 332 installation finance and accounting offices nationwide and began the consolidation process. Currently, DFAS (Figure 3.1) consists of a headquarters, five centers, and 17 operating locations. DFAS is also actively consolidating and standardizing the hundreds of finance and accounting systems within DoD. By fiscal 2002, DFAS will reduce the number of DoD finance systems from 67 in 1996 to 9. (DFAS, 1997)

2. DFAS Kansas City Center

The successor to the Marine Corps Finance Center, DFAS-Kansas City Center (DFAS-KC) continues to coordinate and supervise disbursement of funds in payment for all active duty, reserve survivor annuitants, and retired Marines. In addition DFAS-KC provides financing and accounting services to DoD components worldwide. DFAS-KC depends on FSA-KC for the development of software to provide these finance and Accounting services. The total workforce at DFAS-KC including civilians, service members, and Defense Accounting Office employees is close to 1000. (DFAS, 1997)

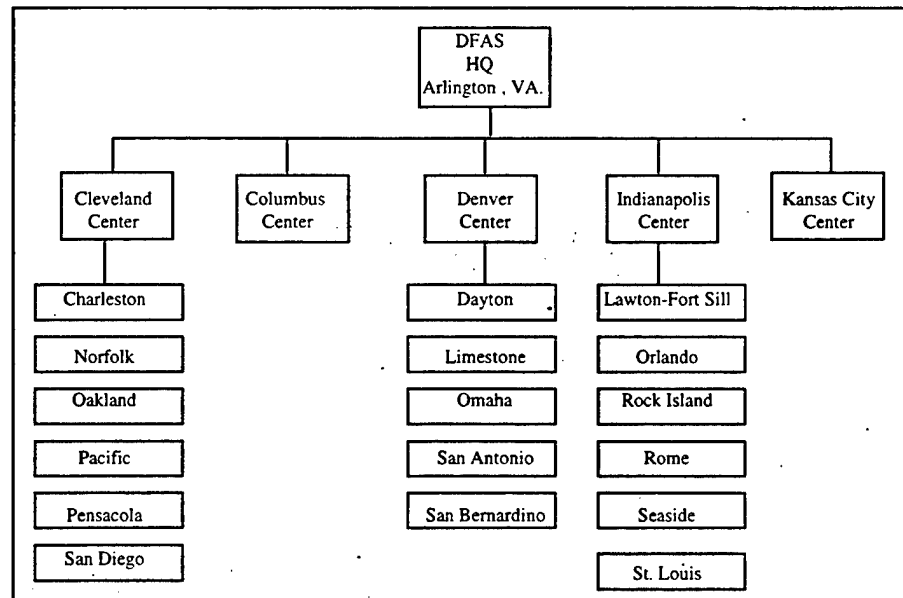


Figure 3.1 Defense Finance and Accounting Service
(Adapted from DFAS, 1997)

3. DFAS Realignment

Four of the six FSAs within DFAS are co-located with the centers that they provide software development services for. However, the DFAS command structure (pre-April 98) has all FSAs reporting directly to the Director Financial Systems Organization (FSO). The FSO provides DFAS-wide infrastructure services including development services, operations services, and business management services. Prior to April 1998

there was a "customer-service provider" relationship between the DFAS Centers and the FSAs. The Center Director was not responsible for the performance/viability of the FSA.

See Figure 3.2.

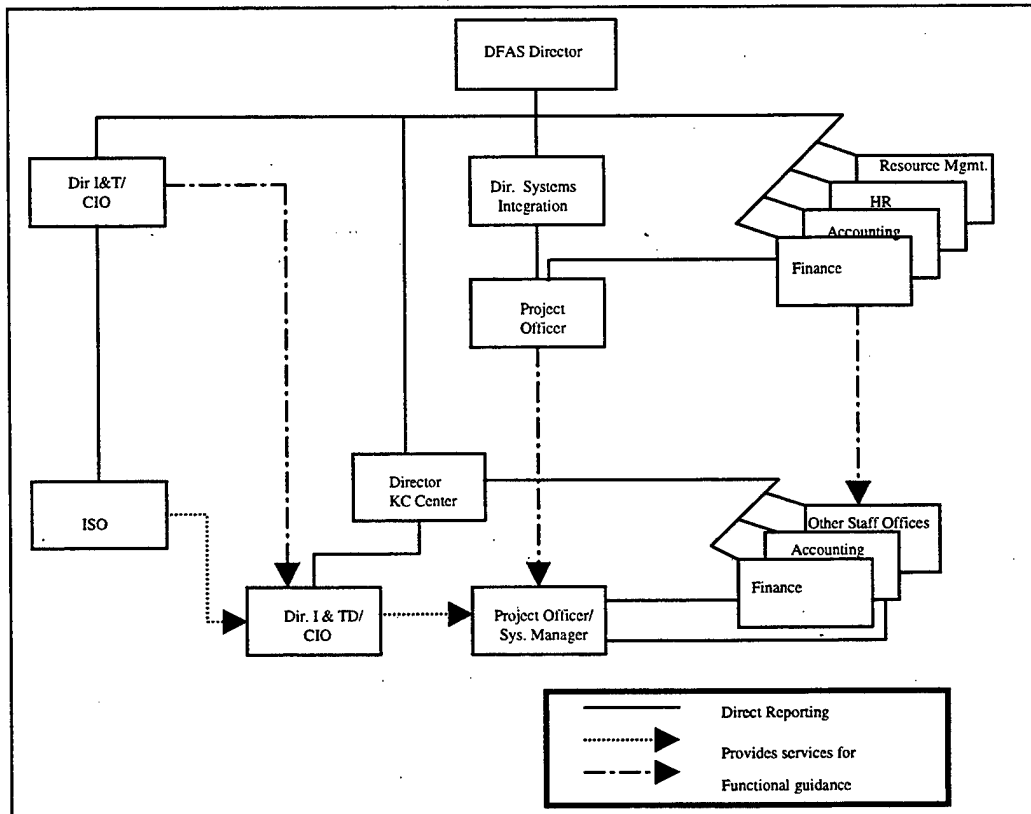


Figure 3.2 DFAS Prior to Realignment (Adapted from DFAS, 1998)

Effective 5 April 1998 control of FSAs was transferred from the FSO to the DFAS center directors. The move was initiated to mitigate "customer-service provider" problems by placing responsibility for both functions (information systems and financial operations) under one manager. Another reason for the realignment is to leverage the information systems expertise (which is concentrated in the FSA/FSO structure) across the DFAS Center. The FSA Director has become the DFAS Center Director for Information and Technology and the FSO has been renamed the Infrastructure Services

Organization (see Figure 3.3). DFAS is taking a phased approach to the realignment. The new command, control, and staff relationships, and revisions to policy and procedures will evolve over the next few months with October 1, 1998 as the target date for completion of realignment.

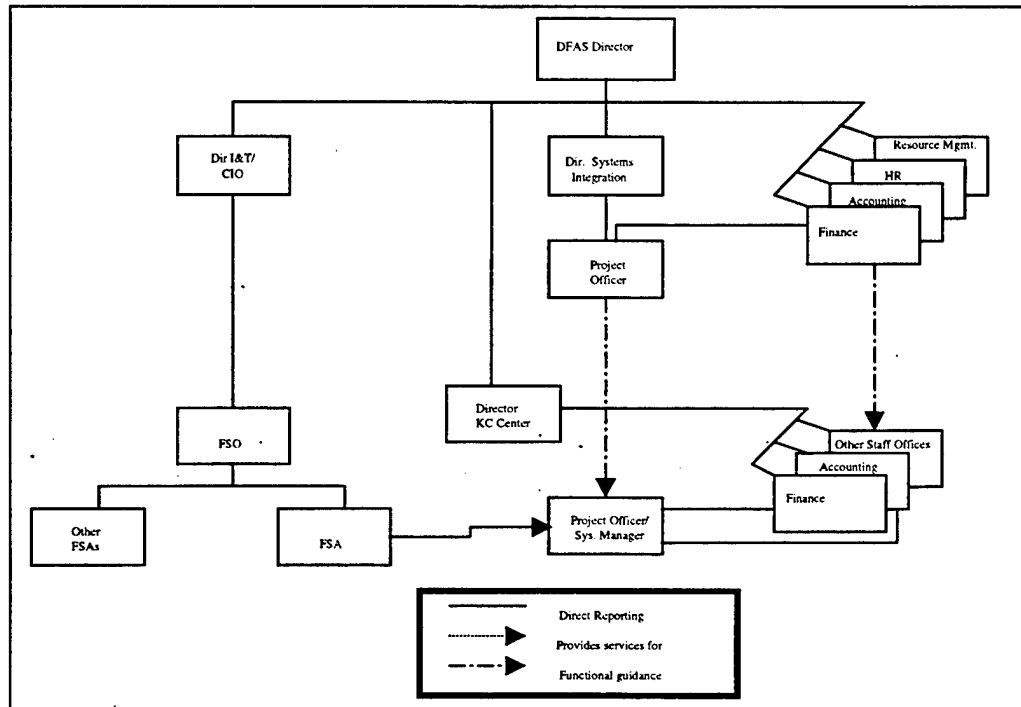


Figure 3.3 DFAS After Realignment (Adapted from DFAS, 1998)

4. FSA-KC

FSA-KC provides resources and support in performing a variety of software development services for the US Marine Corps, and the DFAS Center. FSA's primary software development arenas are service unique pay and personnel systems (for the Marine Corps) and "purple systems" or systems that are developed for DoD-wide use. (FSA, 1997) The mainstay of the work at FSA involves the scheduled implementation of improvements and revisions to software. These "software releases" normally occur in

April and October. The organization develops and maintains a growing number of automated information systems (AIS). At this time FSA's major automated information systems are the Marine Corps Total Force System (MCTFS) and DoD's Standard Accounting and Budgeting Reporting System (SABRS). They account for 40% and 19%, respectively of the organization's software development effort. The current organization chart for FSA appears in Figure 3.4. (FSA, 1997)

FSA-KC is co-located with the director and staff of DFAS-KC Center. However prior to April 1998 the relationship between the DFAS-KC and FSA was a customer-service provider relationship. Effective 5 April 1998 control of FSA-KC was transferred from the Director FSO to the Director DFAS-KC.

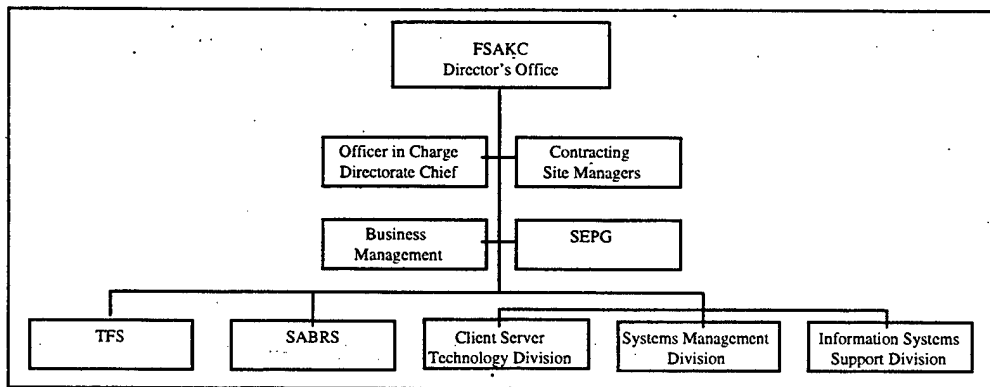


Figure 3.4 Financial Systems Agency (Adapted from FSA, 1997)

5. Fee-for-Service

FSA is a revolving fund activity. The activity operates similar to a not-for-profit business. Customers are charged a fee sufficient for the activity to recover the costs of providing the service. In this "fee-for-service" arrangement, the objective (for FSA) is to break even. Unit costs are adjusted annually based on an agreed upon work-load between the activity and customers. Obviously in this era of shrinking defense budgets, FSA's

customers (DoD and USMC) still maintain the traditional view of trying to get the lowest price. Therefore lowering unit costs is a high priority at FSA.

6. Workforce

FSA has a diverse workforce consisting of civilians, contractors, and military personnel. The current workforce at FSA consists of 42% civilian employees, 32% contractors, and 26% military personnel. The breakdown of employees is:

- Civilian: 147
- Military: 93
- Contractor: 113
- Total: 353 (FSA, 1997)

7. Customers

The primary customers of the FSA are the US Marine Corps and DoD.

Headquarters Marine Corps (HQMC) submits requirements for improved or upgraded services via the Manpower Information Systems Support Activity (MISSA), Kansas City, which acts as the site representative. DoD initiated modifications and improvements to software are routed via the Accounting and Finance Directorates of the DFAS-KC Center. (FSA, 1997)

8. Organizational Goals

The goals of the FSA as stated in the document entitled "FSA Director's Goals and Commitments" are:

- Provide exemplary customer service.
- Reduce business costs.

- Continue process improvement to reach Level 3 of the CMM for the entire FSA.
- Develop migration strategy to implement the Joint Technical Architecture

9. History of Software Process Improvement Efforts

The SPI infrastructure for FSA-KC was formed in 1993. The Management Steering Committee and the Software Engineering Process Group (SEPG) were formed in July. Membership in the management steering committee includes the director, deputy director, senior managers, and the head of the SEPG. The SEPG is an independent team with 4 full time members. The FSO, which has a similar SPI infrastructure, provides leadership and guidance, especially in the areas of technical architecture and process improvement. (FSA, 1998)

The SPI efforts were initiated in the organization's Marine Corps Total Force System (MCTFS) Division. The initial assessment of the software engineering practices was performed on 11 June 1993. The purpose of the assessment was to gain an understanding of the division's software engineering practices, identify key areas for process improvement, and develop an action plan. At that time the division was assessed as CMM Level 1.

A Software Capability Evaluation (SCE) was performed for MCTFS on September 16-20, 1996, at which time the division was found to satisfy four (out of 6) of the CMM Level 2 key process areas (KPAs). Software Project Tracking and Oversight (SPTO) was rated as unsatisfied. The Software Subcontract Management KPA was not evaluated. A second SCE was performed on TFS on January 27- January 30, 1997 to

evaluate the SPTO key process area. Having satisfied all requirements for the SPTO key process area, MCTFS was assessed at CMM Level 2.

10. Current SPI Efforts

FSA-KC's software process improvement efforts are ongoing. Currently the MCTFS program is assessed at CMM level 2 and the SABRS program is at CMM level 1. SPI efforts in the SABRS AIS were initiated in 1997 but were quickly overcome by events--specifically a backlog of requests for software modification and development in the upcoming releases. The FSA-KC organization is in the planning stages of a level 3 initiative that they expect to complete by October 1999. At that time it is expected MCTFS will be at CMM Level 3 and SABRS will be at CMM Level 2.

B. DATA COLLECTION PROCEDURES

1. Process Improvement Survey

A 40-question survey was designed to assess the challenges facing the FSA's process improvement initiative. Survey content was designed to capture the following key aspects of implementing change as indicated in the literature review.

- Level of Buy-in Across the Organization
- Management Support
- Clarity and Consistency of Organizational Goals
- Alignment with Organizational Goals and Practices
- Encouragement of Innovation

The survey was designed to be administered to the entire FSA organization during the author's second site visit. Demographic data was requested to classify results by division, role (senior management, management, and section personnel), software

experience, and time employed at the organization. The survey was administered via organizational e-mail with the use of a commercial survey software tool. The survey software provided a means to collect and statistically analyze responses.

Due to a requirement for prior approval by the Union and to other surveys scheduled to be administered during the same time frame, the process improvement survey was administered a month after the second site visit. The survey was sent out without the demographic data. There were 72 responses from a possible 250 civilian and military employees for a 29% response rate. Appendix A contains the complete survey.

2. Archival Data Collection

During the site visits volumes of data relating to the FSA organization and its software process improvement efforts were obtained. Documentation on general procedures, SPI activities, and Benchmark studies provided valuable data on the functioning of this complex organization, the history of its SPI efforts, and its current plans for implementation of SPI initiatives. The FSO's Post Implementation Review of Level 2 Implementation (December 1997) provided particularly rich data on employee attitudes about process improvement. The survey consists of 16 questions (12 rating questions and 4 open-ended questions). The questions address issues relative to the support provided for level 2 SPI activities. The survey was administered at all six FSAs, and across all levels of the organizations. Data from this report are analyzed in the chapter that follows. Appendix B contains the complete survey.

3. Personal Interviews

Semi-structured interviews were conducted during both visits to FSA-KC. The purpose of the interviews was to assess organizational buy-in, senior management

support, and general attitudes and perceptions of software process improvement. A total of 14 individuals were interviewed including: FSA Director, Project Officers for MCTFS and SABRS, 3 Division Heads (out of the 7 that were available), 6 Branch Heads (out of 13 that were available), and on site customer representatives for the US Marine Corps and the DFAS Center. Each interview was conducted individually, lasting approximately 15 minutes on average, and notes were taken. Interview results were analyzed for common themes and unique perspectives. Appendix C lists the interview questions.

4. Site Visits

Two visits to FSA-KC were conducted over the course of the thesis research. The initial visit took place from 23-27 March 1998 and the follow on visit was from 20-23 July 1998. The purpose of the initial visit was to become familiar with the organization, including its structure, the software process improvement infrastructure, and general attitudes/perceptions about software process improvement. During this time the author shadowed the SEPG, attending number of meetings on the status of SPI efforts within FSA, and also observing the SEPG's brief on software process improvement to the new DFAS Center Director. Additionally, the author reviewed documents and conducted interviews.

On the subsequent visit, the goal was to focus more specifically on gathering data related to the research question: What are the challenges to the software process improvement efforts at FSA? Again, the author spent a good portion of the week shadowing the SEPG, reviewing documents, conducting interviews and asking questions. These data, along with the more formal interviews are used in conjunction with survey

data from FSA and FSO to identify the perceptions of SPI, its purpose, progress and challenges.

IV. RESULTS AND ANALYSIS

A. INTRODUCTION

In this chapter the results of a process improvement survey, archival material, personal interviews, and general impressions gained from site visits are presented and analyzed. These data are used to extract themes relevant to challenges of the FSA's software process improvement efforts. This chapter concludes with a summary of the results and their implications.

B. PROCESS IMPROVEMENT SURVEY

A forty-question survey was designed to analyze the dimensions of the challenges to the FSA's process improvement initiative. The survey was administered via organizational e-mail with the use of a commercial survey software tool. There were 72 responses from a possible 250 civilian and military employees, for a 29% response rate. Due to the limited sample size and the lack of demographic information, the reader is cautioned that survey results may not be representative of the population. The survey is of value to the extent that it may be used with other data gathering techniques in analysis of the FSA organization. Survey questions cover a broad range of organizational structure and culture issues. However, the most relevant results are found in the responses to questions regarding the following issues:

- Clarity and consistency of organizational goals.
- Perceptions on the need for process improvement.
- Compatibility of process improvement with organizational practices.
- The extent to which innovation is encouraged.

Survey questions and statements addressing the aforementioned issues and summaries of responses by percentage are provided in Tables 4.1 through 4.7. The complete results are provided in Appendix A.

Responses to questions are rated on one of two five point scales as shown below.

Selection	Rating	Selection
Very Much	5	Strongly Agree
Some what	4	Agree
Very Little	3	Disagree
Not at all	2	Strongly Disagree
Don't know	1	Don't know

A level 5 response (Very much or Strongly Agree) is considered a high rating reflective of a more definitive or positive response to the question or statement. A level 2 response (Not at all or Strongly disagree) is considered a low rating indicating a more definitive negative response to the question or statement.

1. Clarity and Consistency of Organizational Goals

The questions regarding organizational goals are designed to assess the clarity and consistency of organizational goals throughout the organization. Dalziel and Schoonover (1988) discuss compatibility of a planned change with organizational goals as a primary factor in getting an organization ready for the change. A good starting point is ensuring that current goals are understood and shared by all.

The first series of questions (Table 4.1) assess respondents perceptions on the extent to which each factor—customer satisfaction, product quality, controlling cost and schedule—is a measure of the organization's success. The second series of questions regarding organizational goals (Table 4.2) ask respondents to indicate the extent to which each of the aforementioned factors is a measure of success in their immediate work area.

	Very Much	Some what	Very Little	Not at all	Don't know
To what extent is customer satisfaction used as a measure of success at FSA?	45	37	4	0	14
To what extent is product quality used as a measure of success at FSA?	39	37	7	0	17
To what extent is controlling cost used as a measure of success at FSA?	45	30	8	0	17
To what extent is schedule used as a measure of success at FSA?	48	31	6	1	14

Table 4.1 Ratings of Goal Clarity and Consistency in FSA (%)

Responses to the first series of questions are almost equally distributed with respondents indicating that all of the factors are measures of organizational success. Between 45% and 48% of respondents gave level 5 responses for cost and schedule as measures of the organizations success. Although there were slightly more level 5 responses for schedule as a measure of organizational success, none of the factors really emerges as the primary measure of success.

In contrast, responses to the second series of questions regarding measures of success within the immediate work area indicate that respondents view product quality (69% selected "very much") as a primary measure of success within their immediate work area. Both customer satisfaction and schedule also received level 5 ratings by over 50% of the respondents. Cost is reported less frequently as a significant measure of success in the work area.

	Very Much	Some what	Very Little	Not at all	Don't know
To what extent is customer satisfaction used as a measure of success in your immediate work area?	59	28	6	1	6
To what extent is product quality used as a measure of success in your immediate work area?	69	23	4	1	3
To what extent is controlling cost used as a measure of success in your immediate work area?	35	38	15	3	8
To what extent is schedule used as a measure of success in your immediate work area?	52	28	11	1	7

Table 4.2 Ratings of Goal Clarity and Consistency in Work Area (%)

The results in Table 4.1 and Table 4.2 indicate that respondents are more aware of the measures of success in their immediate work area than they are of the measures of success for the organization. This is indicated by the higher percentage of "Don't know" responses to the first series of questions. While this is an expected outcome, the difference between respondents perceptions of the importance of product quality as a measure of success within their immediate work area and the importance of product quality to the success of the organization is significant. The results suggest that employees believe that their efforts at ensuring high product quality may be at odds with the organization's other goals. Customer satisfaction and reducing cost are two of the stated goals of the FSA Director. (FSA, 1997) However, these factors don't emerge as the primary measures of organizational success in this survey.

The results in Table 4.1 and 4.2 are indicators of the organization's goals to the extent that perceived measures of success are an enactment of such goals. The implications are that the organization's goals are not sufficiently well understood and shared by all. Additionally, senior management at FSA may be bypassing a great

opportunity to facilitate adoption of process improvement efforts by not building on the employee motivation for product quality. The discontinuity between employee perceptions of measures of success in their work areas and organizational measures of success may suggest that employees do not understand how their efforts contribute to the organization's success. For example the lower rating of importance of the measure of costs at the unit level may reflect a lack of awareness of the importance of this criteria and an unclear understanding of unit level contribution to total costs. Moreover, the discontinuity between measures of success in the work area and organizational measures of success may signal that employees feel that the "product quality" indicator of success that dominates at the work unit level is not valued as significantly at the organizational level.

2. The Need for Process Improvement

Achieving a CMM Level 3 rating is a stated goal of the FSA Director. Statements regarding FSA's primary motivation for initiating process improvement are designed to assess employee perceptions of the need for process improvement. (FSA, 1997) The responses shown in Table 4.3 indicate some confusion regarding FSA's primary motivation for implementing process improvement efforts. It is surprising that only 30% feel strongly (as indicated by a "Very much" (5) response) that product quality is the primary motivation for the organization's process improvement efforts. Additionally, the results suggest that a large percentage of respondents don't know what the organization's

primary motivation for initiating SPI efforts is.

	Very Much	Some what	Very Little	Not at all	Don't know
In the future a CMM level 3 certification will be required for DoD software developers.	41	25	1	1	31
The requirement to initiate software process improvement efforts came from higher headquarters.	37	35	1	1	25
Process improvement efforts will result in FSA producing higher quality products in a more timely fashion.	30	32	17	3	18

Table 4.3 Ratings of the Need for Process Improvement

Bridges (1988) asserts the importance of a clear purpose for a planned change.

The purpose should align with internal organizational characteristics. The results here seem to reinforce the results of the previous section that suggest the connection between product quality and process improvement efforts has not been made clear to employees. To the extent that employees view SPI as mandated from higher authority without acknowledging the potential benefits to organizational performance, there will likely be greater resistance to the changes involved in SPI implementation.

3. Organizational Buy-in and Support

Support of top management is critical at the initial stages and throughout the process of planned change. (Dalziel and Schoonover, 1988) Questions of how much organizational buy-in/support are designed to assess the buy-in and support at the senior management, middle management, and section levels of the organization. Responses to the questions have implications for the level of commitment and motivation for process improvement at the various levels.

	Very Much	Some what	Very Little	Not at all	Don't know
In your judgement how much buy-in and support for process improvement is there among Senior Management?	35	27	13	3	23
In your judgement how much buy-in and support for process improvement is there among Middle Management?	23	39	14	3	21
In your judgement how much buy-in and support for process improvement is there among Section Personnel?	17	42	18	6	17

Table 4.4 Ratings of Organizational Buy-in and Support (%)

The responses (Table 4.4) are very dispersed for each of these questions. This shows low consensus. However, the data do not suggest a great deal of organizational buy-in/support at any level. The data indicate that the buy-in/support for process improvement decreases as we go from senior management to middle management and is lowest at the section level. This may indicate that the organization's efforts at achieving buy-in are aimed at managers and not practitioners. It may also indicate that section-level practitioners are not sufficiently involved in SPI activities.

4. Compatibility with Organizational Practices

A process is not likely to be adopted when it is not clear that the change will enhance current practices. Statements regarding compatibility with organizational practices are designed to determine the degree to which process improvement efforts fit into existing organizational practices. See Table 4.5 for actual results.

Responses to the first statement indicate that 51% "don't know" whether the CMM framework for process improvement will address important AIS specific areas of software development. The remainder of responses are almost evenly split as to whether the CMM framework addresses important AIS specific areas of software development.

While the majority of respondents do not agree that process improvement efforts detract from day to day operations (45%), a significant minority (34%) does agree with

the statement. Responses to the third statement, that the organization's preoccupation with process improvement has caused neglect of other issues are fairly evenly split. Most respondents (50%) disagree with the fourth statement that day to day operations don't leave time for SPI activities, but a significant percentage (35%) do agree with the statement. Finally, the majority of respondents agree (48% agree, and 11% strongly agree) that SPI initiatives will make their jobs easier.

The responses to the first question regarding whether the CMM addresses AIS specific areas are significant in light of case study findings on the need to recognize and adopt general CMM guidelines to unique product/process or organizational requirements. The abundance of "don't know" responses is another indicator of the need for more participation in process improvement efforts. Top down change management will over-emphasize the generic rather than the more useful locally specific process changes.

The responses to the second, third and fourth statements indicate the challenge that faces FSA with respect to balancing the process improvement initiative with day to day operations. The responses demonstrate cause for concern that software process improvement initiatives may be in conflict with organizational practices and goals. This concern reinforces the question of the importance of SPI goals relative to the existing performance goals of the organization.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't know
Regarding the process improvement framework, there are important AIS specific areas that the CMM does not address.	6	21	23	0	51
Process improvement efforts detract from day to day operations.	17	17	42	3	21
Our preoccupation with software process improvement has caused us to neglect other important issues facing the organization.	8	28	35	7	21
Day to day operations don't leave time for software process improvement activities.	4	31	44	6	15
Planned software process improvement initiatives will make my job easier.	11	48	11	4	25

Table 4.5 Ratings of Compatibility with Organizational Practices (%)

5. Encouragement of Innovation

Statements regarding encouragement of innovation (Table 4.6) are designed to assess the organization's effectiveness in creating an environment that encourages employees to actively participate in process improvement. Bridges (1991) believes innovation will happen automatically in the neutral zone if people are provided with encouragement and support. The extent to which employees believe that their ideas will be acknowledged and acted on and that innovation will be rewarded is a key indicator of the climate of the organization as it relates to the enhancement of learning and innovation.

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't know
Recommendations/ideas for process improvement are acknowledged or acted on.	4	51	23	6	17
Successful ideas or recommendations for process improvement are rewarded.	1	28	35	6	30

Table 4.6 Ratings of Encouragement of Innovation (%)

A majority of those surveyed agree that recommendations for process improvement are acknowledged and acted upon. However, there is virtually no strong agreement with this statement. In addition, a majority of respondents disagree or are not aware that there are any rewards for successful process improvement ideas.

6. Challenges to Process Improvement

Six statements are provided to gauge employee perceptions of the challenges to FSA's process improvement efforts. The statements cover a range of typical problems encountered in process improvement efforts as indicated in a review of case studies and technical reports. See Table 4.7 for results.

The results indicate that respondents view all of the statements as likely challenges to the process improvement efforts. However, the responses indicate that employees perceive the following as the most likely challenges to the organization's process improvement efforts, based on the aggregate of the top 2 rating categories:

- Time and resource constraints.
- The possibility of being overcome by other priorities.
- Lack of customer support.
- Insufficient developer training and education

	Very Much	Some what	Very Little	Not at all	Don't know
Process improvement goals are not integrated into currently established FSA goals.	15	38	14	8	24
Lack of customer support.	33	33	10	6	19
Time and resource constraints.	36	41	9	1	13
Problems matching CMM requirements to AIS specific activities.	9	30	33	3	26
Insufficient developer training and education.	26	39	17	3	16
Overcome by other priorities.	39	29	17	1	14

Table 4.7 Ratings of Challenges to FSAs SPI Efforts (%)

These results have implications to employee perceptions of the viability of the organization's SPI program. The above factors may be an indicator that employees perceive that process improvement is not a high priority of the organization, or that the organization's leadership will not ensure that the necessary resources and support are sustained.

These responses provide a starting point for senior management in addressing employee attitudes and concerns about the current process improvement effort. The possible perception that process improvement is a passing fad will make gaining the commitment and energy of employees a challenge.

C. ARCHIVAL MATERIAL

The Financial Systems Organization's Level 2 Post Implementation Review provides a wealth of data and perspectives on the challenges of SPI. As part of this review, a survey was conducted of all six FSAs to capture the perspectives of managers, SEPG members, practitioners, and others involved. Because all FSAs reported directly to the FSO prior to April 1998, the FSO was highly involved in the level 2 efforts

of all FSAs. Additionally, some aspects of the FSA's SPI program were mandated by the FSO.

The review, compiled in December 1997, consists of sixteen questions. Ten of the questions ask respondents to provide a 1-5 rating. The other questions are open-ended and comments are recorded. Eight of the questions (6 rating questions and 2 open-ended) covering concepts most relevant to this thesis are included in this section. The full text of the review is provided in Appendix B. Data from the review are analyzed comparing FSA-KC and FSO as a whole.

Table 4.8 lists six questions concerning support mechanisms for software process improvement and the ratings provided by members of FSA-KC and by the members of the other FSAs. Results of all FSAs (including FSA-KC) are averaged and listed under the heading of FSO. For all questions using the numeric scale a rating of 3.00 represents the middle ground of the response. Any rating below 3.00 indicates a disagreement or low appraisal, while any rating above 3.00 represents agreement or a high rating.

	FSA-KC (N = 50)	FSO (N =237)
Rate senior management support at your FSA for SPI.	3.63	3.70
Rate the info. related to improvement activities that was made available to you.	3.61	3.52
Rate the training you received on SPI initiatives.	3.54	3.40
Rate the FSO support activities to SPI initiatives (These activities include training, FSO SPI conferences, SMS workshops, and process definition).	3.12	3.07
Rate the tools provided by FSO for SPI initiatives.	2.70	2.70
Rate the local SEPG support you received on SPI initiatives.	4.07	3.62

Table 4.8 FSO Level 2 Post Implementation Review

As shown in Table 4.8, support mechanisms internal to the FSAs, senior management support, SPI related information made available and training on SPI initiatives, received ratings above the midpoint (3.0). SEPG support for SPI initiatives was rated high FSO-wide, with FSA-KC receiving a rating higher than the average rating of SEPGs within FSO. In contrast, FSO-level support activities received lower ratings than local support; and tools provided by FSO for SPI initiatives received the worst rating of the support mechanisms.

The responses to open-ended questions shed some light to the low ratings of FSO support. Some respondents commented that the major problem with FSO's approach to employing support tools is that tools are selected based on their success within a particular automated information system and are then expected to yield similar success in other automated information systems. The following worker comments regarding the use of software development tools mandated for use by FSO are illustrative of the problem:

AISs are expected to adopt to tools developed for AISs in different environments (i.e. CMIS). Trying to force round pegs in square holes. Attempting to use LRS for metrics in ways it is inadequate for.

They all have that awkward, home-grown feel. Probably would have been better to find tools that suit the needs rather than enforcing tools to fit needs that were never envisioned when they were developed.

CMIS is old and outdated. Written by individuals in a specific site and everyone is expected to use.

Comments and responses to questions regarding FSO support mechanisms have implications on the responsiveness of externally provided support and on technology insertion FSO-wide. The implications are that internal support mechanisms are more responsive to process improvement requirements than FSO provided support mechanisms, which are expected to support the needs of all six FSAs. This is particularly significant as it applies to software management tools.

Another problematic aspect of the level 2 effort identified in the survey was the impact of process improvement on customer relations. When provided the open-ended statement: 'The most significant negative impact caused by SPI efforts was...' the predominant theme was that process improvement activities add to cost (in time and money) and stress customer relations. The following comments are representative of the theme.

Need more customer commitment and support for SPI. The program is too costly and important to FSO not to gain strong, active, early commitment starting at the top of the DFAS management chain.

Cost too high, cost to implement and maintain.

Added paperwork that needs to be charged to a customer who already doesn't have enough money to get the job done.

Customer has claimed slower turnaround for impacts and releases.

These responses reinforce the data gathered in the FSA-KC process improvement survey (section B) that point to competition for resources and customer support as the primary challenges to the organization's process improvement efforts. The implications

are that customer support may not be sufficiently addressed by the leadership of FSA. The expense of process improvement activities in time, resources, and personnel requires not only internal support and buy-in, but also an enlightened, supportive customer.

D. PERSONAL INTERVIEWS

1. Management Perspectives

Semi-structured interviews were conducted during both visits to FSA-KC. Due to time constraints and limited personnel availability, only managers (Project Officers, Division Heads and Branch Heads) were interviewed. Management perspectives are provided in question and answer format in this section. The responses to these questions are indicators of management expectations for process improvement efforts, Director support for process improvement, organizational goals, and areas for improvement within the organization. The questions here represent a subset of the interview questions. The full set of interview questions appear in Appendix C.

a. Expectations for Process Improvement Efforts

- What concrete observable outcomes will result from process improvement efforts?
- Do the proposed changes make the employees jobs easier or harder?

The following statements are representative of the responses to these questions.

More structure will facilitate control, accountability, and efficiency.

Better quality. Less Production Incident Reports.

Reduced duplication of effort. That was one of the benefits from level 2.

The responses echo those found in the FSA-KC process improvement

survey and the Level 2 Post Implementation Review. Managers are receptive to the concept of software process improvement and have positive expectations. All respondents believe that planned changes will make employees jobs easier.

b. Director Support

- What does the Director say about SPI? What does he do?

Managers cited inconsistent Director support for SPI. The following statements are representative of the responses to this question.

The Director talks SPI, but does not provide adequate support.

He (the Director) wants to achieve level 3... he's not really willing to make sacrifices to get there. His #1 priority is to get the release out on time.

The Director must be held accountable for SPI if you want real support from him.

The responses here are an indicator of competition for resources and conflicting priorities. In discussions with respondents the perception is that the Director does in fact value SPI activities. However, within the constraints of limited resources and competing priorities SPI initiatives often take a back seat.

c. Organizational Goals

- The most important thing to the leadership of FSA is...

The question of what is the most important thing to the leadership of FSA, is designed to assess management's perceptions of organizational goals. This is significant because if the organization's SPI efforts are to be adopted and maintain consistent support, they must be compatible with the organization's goals.

Decreasing cost and meeting the release schedule are seen as the primary goals of FSA. All responses to the question of referenced cost, schedule or both. The obsession with reducing cost appears to be due mostly to the fee-for-service concept that

the FSA works under. The concept of fee-for-service is a major part of the Department of Defense's attack on waste and abuse of government funds, by encouraging DoD activities to operate like commercial businesses. It provides visibility of fees charged by service providers (unit costs), with the ultimate goal of eliminating any non-value added aspects of business. Decreasing unit costs is an obvious priority of any fee-for-service activity.

d. Areas for Improvement

- What specific parts of the organization provide the most opportunity for increases in efficiency and quality?

This question is designed to elicit responses that address problematic aspects or areas for improvement within the organization. Managers see the issues of customer-relations and requirements analysis as the areas with the highest potential to increase the organization's efficiency and quality. The following statements are representative of the responses to this question:

The customer has set unrealistic requirements and schedule demands... SPI is seen as delaying the process.

They (senior management) want it all--cost, quality, schedule--even in situations where it is obvious that there are tradeoffs to be made. This is driven mainly by the customer.

This is another reference to the importance of the customer in the organization's plans and practices. As Pasmore (1988) asserts, the external environment (represented here by the customer) is the ultimate judge of an organization's survival. The comments are also consistent with the Level 2 Post Implementation Review comments discussed previously (section C). This demonstrates the problem of customer support for SPI is systemic and not particular to FSA-KC.

2. Customer Perspectives

Two customer representatives for the MCTFS AIS were interviewed to assess the level of awareness, buy-in and support for process improvement. They were asked the following questions:

- Have you been briefed on SPI?
- What are your initial impressions of SPI at FSA?
- Will SPI initiatives help you? Are you willing to pay?

Both interviewees indicated that they were not provided a briefing on SPI. Neither could pinpoint how FSA's level 2 efforts impacted the customer whom they represent. One representative indicated that FSAs level 2 efforts were transparent to the Marine Corps. The second representative remarked "DFAS headquarters says they have to be at 'a level'. It would be easier to justify the investment if it lowered costs or increased quality or something".

E. GENERAL IMPRESSIONS FROM SITE VISITS

During the initial visit to FSA-KC the author had the opportunity to attend a number of organizational meetings including: The SPI/SEPG Meeting between Director, Deputy Directors and SEPG; MCTFS Project Officers Meeting; SEPG Morning Meeting; and SEPG/FSO Conference Calls. Discussions in these meetings provide perspectives on the inner-workings of the FSA and its SPI efforts.

In terms of the organization's readiness for software process improvement efforts, indications are that at the middle management level and above there is enthusiasm for SPI. The indications are that SPI initiatives fit into the current organizational practices. Specifically managers seem well aware of the benefits of mature software engineering

practices and believe SPI activities will enhance day to day operations. However, managers are equally aware of the constraints of SPI implementation--limited resources, fixed schedules and lack of customer support. This is consistent with data from interviews and archival material.

A high level of cooperation exists between the SEPG and AIS managers. SEPG members are able to use technical knowledge, experience, and relationships gained in part from previous work within the divisions to generate workable action plans that reflect the input of personnel. The SEPG is viewed favorably as internal technical consultants on SPI issues. This fact indicates possible opportunities for the organization to enhance its process improvement efforts by expanding the role of the SEPG.

While process improvement efforts are somewhat compatible with organizational practices they are separate and distinct from the organization's day to day goals. Process improvement efforts have a loose connection to the organization's business goals but they are challenged by schedule pressure, other priorities, and competition for resources. Support for SPI from the Director ebbs and flows with these factors. Recent delays in implementation of process improvement activities in the Standard Accounting and Budgeting Reporting System (SABRS), due to a backlog of key modifications requested by the customer, are an example of how intense schedule pressure can derail SPI efforts. While the Director is knowledgeable and enthusiastic about the potential benefits of SPI, he appears to be constrained by environmental pressures which many times conflict with SPI efforts. This is consistent with data obtained from personal interviews and the FSA-KC survey.

There is a perceived emphasis on “making the grade” in the process improvement initiative. This detracts from key objectives sought through process improvement: improving product quality, and improving customer satisfaction. The “grade” aspect is the explicit or implicit view that the primary goal of SPI is the attainment of a certification. This is evident in directive statements like “we will be at level 3 by October 1999.” This approach is particularly detrimental when the date is selected without an appraisal of the social and technical issues that must occur to accomplish the goal. (Pasmore, 1988) This “grade” centered approach to process improvement strains the alignment of SPI with organizational practices and goals.

While the reward system at FSA does not explicitly address software process improvement, it is flexible enough to be used as a tool to reinforce desired behaviors. During and subsequent to MCTFS' level 2 efforts, senior management rewarded a number of individuals for their process improvement efforts. This provides additional confirmation of the survey data reporting some use of rewards. It may also suggest that this use of rewards is not sufficiently publicized, thus explaining the low agreement on the use of rewards reported in the survey (see Table 4.6).

F. SUMMARY AND IMPLICATIONS

In Chapter II, best practices were derived based on a review of relevant change management theory and software process improvement technical reports and papers. These best practices were categorized as concepts related to: 1) preparing the organization for process improvement, 2) implementing process improvements, and 3) sustaining the improvement effort. This section summarizes the results of the data analyzed and examines the implications of the results along the same criteria.

1. Preparing the Organization for Process Improvement

Concepts relative to preparing the organization for process improvement include a clear understanding of current organizational goals, communication of a clear purpose for process improvement, establishing compatibility with organizational practices and goals and ensuring top management support. Dalziel and Schoonover (1988) discuss compatibility of the planned change with organizational goals as a primary factor in getting an organization ready for a planned change. A good starting point is ensuring that current goals are understood and shared by all. The goals of the Director FSA as stated in the October, 1997 document entitled FSA Director's Goals are: to provide exemplary customer service, reduce business costs, continue process improvement to reach level 3 of the CMM, and develop a migration strategy to implement the Joint Technical Architecture. (FSA, 1997) In the document the Director commits to using customer service as the driving force for FSA efforts.

Results of the data indicate that cost, schedule, and customer service are all viewed as measures of organizational success. It is significant that no single factor really emerges as a primary measure of the organization's success. In the software industry there are constant tradeoffs between customer demands, cost, schedule, and product quality. The perception on the part of managers and practitioners that senior management does not recognize that there are tradeoffs to be made can lead to frustration and hostility. As one interviewee put it: "They want it all--cost, schedule, quality--even when they know it's impossible."

It is also significant that product quality is not one of the Director's explicit primary goals. Product quality is addressed within the context of the other goals.

However, the data in this thesis suggest that employees believe that, while product quality is the primary measure of success in their work areas, it is subordinate to cost and schedule at FSA. This attitude about product quality is not consistent with the attitude that is required to sustain a process improvement effort. It does not harness the employee motivation for producing quality software that the data indicate is present at FSA.

Additionally the discontinuity between employee perceptions of measures of success in their work place and organizational measures of success may suggest that employees do not understand how their efforts contribute to the organization's success.

Bridges (1988) asserts the importance of a clear purpose for a planned change. The purpose should align with internal organizational characteristics. In Chapter I, software process improvement was defined as those practices and procedures aimed at facilitating the consistent and predictable production of quality software. However, the purpose of FSA's SPI efforts is not as clearly defined. Employees are more apt to believe that the purpose of FSA's process improvement efforts are to satisfy a requirement from higher headquarters or DoD as opposed to increasing software quality. This dilutes employee commitment to the effort for at least two reasons: 1) they don't really know how their efforts contribute to the organization's process improvement efforts and 2) some may perceive that the process improvement effort is of limited duration, and they can endure until it passes. To the extent that employees view SPI as mandated from higher authority without acknowledging the potential benefits to the organization's performance, there will likely be greater resistance to changes involved in SPI implementation.

Dalziel and Schoonover (1988) believe that every leader who initiates a policy, program, or practice should assess the compatibility of the initiative with the current organizational practices. The mismatch between a change initiative and an organization's daily practices is a key source of resistance to change. The data in this thesis indicates that employees believe process improvement efforts are somewhat compatible with their current practices. More report compatibility than not, but a substantial minority report a difficult balance between SPI and day to day work or see neglect of important areas as a result of SPI. This concern reinforces the question of the importance of SPI goals relative to the existing performance goals of the organization. The majority of respondents believe SPI initiatives will make their jobs easier. Previous success in implementing level 2 process improvements in the MCTFS AIS is in large part responsible for the favorable perception of the benefits of process improvement. The indication is that resistance to process improvement efforts is more a function of SPI program management issues than technical issues.

Support of top management is critical at the initial stages and throughout the process of planned change. (Dalziel & Schoonover, 1988) To reinforce the new change, senior management must send consistent messages about the importance and priority of the change. (Bridges, 1991) The data indicate that members of FSA are receiving mixed messages about the priority of SPI. In discussions with respondents, the perception is that the concept of improving software processes is important to the Director. However, within the constraints of limited resources, competing priorities, and customer demands SPI initiatives are often subordinate. The data support the fact that employees are not sure that SPI is a high priority to FSA. It is recognized by most in the organization that the

Director's support for SPI is constrained by pressures from the customer and higher headquarters. Also the low level of support and buy-in for process improvement at the practitioner level indicates that practitioners are not sufficiently involved in SPI activities.

2. Implementing Process Improvements

Internal and external support mechanisms were examined in this chapter. The results indicate that internal support--senior management support, SEPGs, information and training--is more responsive to organizational needs than external support mechanisms provided by the FSO. The costs of standardization of tools and procedures may outweigh the benefits. It is logical that a smaller defined organization (i.e., a single FSA as opposed to all FSAs) allows for more focused and responsive process refinements than a larger organization.

The issue of software development tools mandated for use by the FSO was particularly problematic and has implications for technology insertion. The insertion of technology in the work environment whether it is in the form of process improvements or support tools is important enough to warrant evaluation and review. All of the successful case studies reported in Chapter II indicate that piloting of processes and tools is a key aspect of their SPI efforts. Pilot studies of specific techniques and technologies, and subsequent evaluation of the impact of the techniques and technologies prior to their widespread implementation will save time and resources in process changes that are not effective. The case studies also reported that tailoring process improvement mechanisms to locally unique requirements makes for more appropriate solutions. Tailoring and piloting may decrease the cynicism that results when employees perceive that they are being forced to use tools that are not responsive to their environment.

The data from the FSA-KC survey and the FSO Level 2 Post Implementation Review indicate that the SEPG is viewed favorably within FSA-KC. This fact offers possibilities for expanding the role of the SEPG to enhance the achievement of process improvement goals as well as other organizational goals. The added exposure of the SEPG may facilitate communication of process improvement goals and organizational buy-in. Especially at the practitioner level where the data suggests there is a need for more employee involvement and participation.

3. Sustaining the Process Improvement Effort

Sustaining process improvement efforts is a function of encouraging innovation, instilling a long-term focus on process improvement, and managing the environment. An organization's ability to improve is a function of the leadership commitment to create a culture that invites innovation and continuous learning. (Quann, 1995) As Bridges (1991) states, people naturally generate solutions to problems they've been living with. What they seldom do without encouragement and support is try their ideas. The data in the FSA-KC process improvement survey indicate that most employees believe that their ideas and recommendations for process improvement will be acknowledged and acted upon. However, the majority doesn't believe that they will be rewarded for innovative ideas. This may be remedied by more explicitly linking rewards to process improvement efforts and making the rewards more public.

Continuous software process improvement is a long-term undertaking. The results in this chapter indicate that FSA does not approach SPI with a long-term focus. An approach to process improvement that is centered on reaching a certain level ('making the grade') within a fixed timeline can be counterproductive for a number of reasons. First,

'making the grade' is not a goal that aligns with other organizational goals. Consequently, it does not create sufficient buy-in for process improvement activities throughout the organization. Additionally, trying to force change into a prefixed timeline suggests that the rate of change is not geared to organizational factors. (Dalziel & Schoonover, 1988)

As Pasmore (1988) asserts, the external environment is the ultimate judge of an organization's survival. An overwhelming theme of the results from this study is that managing customer expectations and ensuring customer support are the problematic areas of FSA's SPI effort. Specifically, the results indicate that the customer is not educated on process improvement and its benefits. Customer demands represent constraints and opportunities for the organizations that serve them. Successful organizations do more than react to the environment; they take steps to transform the environment itself to make it more conducive to their well being. (Pasmore, 1988) FSA's process improvement efforts are financed to a large extent by its customers. Therefore it is critical that the customer be educated on the benefits of process improvement.

V. CONCLUSIONS AND RECOMMENDATIONS

The intent of this thesis is to facilitate the software process improvement efforts of FSA-KC and to generalize the knowledge developed through this research to other SPI projects. In this chapter, the high points from the preceding chapters are first summarized. This is followed by discussion of the primary conclusions of this thesis and sets of recommendations: 1) for FSA, 2) for other SPI projects and 3) for further research.

A. SUMMARY

Chapter I provides background information on the state of software engineering today. Specifically, software engineering as a discipline lags behind other engineering disciplines in terms of the software industry's ability to produce quality software within cost and schedule constraints. Chapter I also discusses the challenges to implementing software process improvement initiatives. Lack of compatibility of SPI with organizational practices and goals, complexity of SPI concepts, and lack of consistent buy-in and support for SPI are among the primary challenges to a SPI effort.

Chapter II reviews three theoretical perspectives on organizational change. The work of Dalziel and Schoonover (1988), Pasmore (1988), and Bridges (1991) provide the frameworks for analysis in this study. Although their approaches differ, there is some overlap in their coverage of certain concepts. The overarching themes of the literature addressed assessing an organization's readiness for change, change implementation strategies, and sustaining change. Using this framework the software process improvement efforts of four organizations are reviewed. In many cases the success of the SPI efforts within these organizations can be attributed to the practical application of one or more of the change concepts reviewed. The change theory and the actual

implementation strategies of these organizations lead to a set of best practices. These best practices are categorized as concepts related to:

- Preparing the Organization for Process Improvement
- Implementing Process Improvements
- Sustaining the Process Improvement Effort

Strategies that prepare the organization for process improvements include examining attributes of organizational readiness (history of change, clarity of expectations, origin of idea or problem, support of top management, and compatibility with organizational goals) and scanning the environment to assess the organization's preparation for change and understand the overall context of the process improvement effort.

Effective implementation of process improvements typically include deliberate design for planned change, the use of transition management teams, treating SPI as a project, and maximizing involvement in the SPI program. These measures are designed to facilitate the acceptance of process improvement efforts by communicating a purpose and closely linking process improvements to organizational practices and goals. Additionally, these measures enhance participation at all levels of the organization to increase buy-in and support.

Concepts related to sustaining the process improvement effort include piloting, integrating process improvements within the project cycle, and personnel training in concepts of change management. The goal of these measures is to create a learning organization.

In Chapter III, the research methods are discussed, including a process improvement survey, archival material, personal interviews, and site visits that were used to assess the challenges to FSA's process improvement efforts.

Chapter IV provides results and analysis of the data obtained from the aforementioned sources. The results are analyzed and examined within the framework of the best practices discussed earlier. The results suggest that senior management at FSA could do more to prepare the organization for process improvement efforts. Specifically, clarifying current organizational goals, communicating a clear purpose for SPI and aligning SPI initiatives with organizational practices and goals are areas that need to be addressed.

The results also indicate that internal support mechanisms—senior management support, SEPGs, local information and training—are more responsive to organizational needs than external support provided by the FSO. The FSO's approach to employing technical support tools is particularly problematic. Employees expressed concern that the tools mandated by FSO do not address unique characteristics of their particular automated information systems.

The results suggest that there are mechanisms in place to encourage innovation. However, they may not well publicized. The results suggest there is a need for greater involvement in SPI at the section level.

Finally, the results suggest that FSA is not approaching SPI with a long-term focus. The emphasis on quickly making the grade is counter to the continuous process improvement paradigm. Additionally, by not educating and involving the customer in SPI activities, FSA is not addressing a significant source of resistance to SPI.

A summary of the challenges to the FSA's process improvement initiative as presented in Chapter IV follows:

- Lack of clarity and consistency of goals throughout the organization.
- Software process improvement activities are not aligned with organizational goals.
- External support mechanisms—specifically FSO provided software development tools--do not enhance software process improvement efforts.
- Lack of consistent senior management support for software process improvement.
- Lack of customer buy-in and support for software process improvement initiatives.

B. CONCLUSIONS FOR FSA-KC

Balancing customer demands, competing priorities and limited resources is a part of everyday life for the senior management of FSA. However, implementing SPI adds resistance to change, transition management, technology insertion, and other social and technical issues to the challenges. Past success in attaining CMM level 2, a qualified and respected SEPG, and a workforce that is motivated to produce quality products are assets in the FSA's drive for further process improvement.

SPI is a long-term undertaking, requiring a large investment in time and resources. The organization undoubtedly has other daunting priorities—modifications to existing automated information systems, designing new automated information systems, Y2K, etc. The leadership of FSA must evaluate their plan for implementing SPI and how it fits into existing organizational goals, priorities, opportunities and constraints. They

must involve all key stake-holders, especially customers, in the planning. By providing a well-communicated vision and a consistent commitment to continuous process improvement over the long-term they can better focus the efforts of the employees. Tom DeMarco (noted author and consultant on managing software projects) says competent software engineers inherently want to produce quality software, it is management's job to remove the obstacles.

C. RECOMMENDATIONS

In this section recommendations are organized to address three general areas: 1) FSA-KC, 2) other SPI projects and 3) further research. Each is addressed in turn.

1. Recommendations for FSA-KC

The following best practices are recommended as solutions to the challenges facing FSA-KC.

- Explicit Design for Planned Change
- Transition Management Teams
- Piloting
- Integration of process improvement activities into the project cycle
- Scanning the environment

These practices are discussed below.

a. Change Design

The nature of the Defense Finance and Accounting Service organization is to change, and to do so frequently. Its mission is to consolidate, standardize, and integrate finance and accounting procedures, operations, and systems. The mission guarantees that at all levels of the organization there will be changes in jobs, procedures, and systems.

There will be realignments and reorganizations. Under these circumstances there are two factors which are critical to sustain the momentum of the organization during times of change. The first is a solid foundation in exactly what the goals of the organization are. Clear organizational goals provide some measure or normalcy in times of chaotic change. A firm commitment to customer service and product quality is likely to survive any changes the organization undertakes.

The second factor is an explicit design for planned change. It is of critical importance that those at the upper levels in the organization be conscious of the disruptive nature of change, of the transitions necessary to successfully change, and of the value of information during times of change. An overall change design that recognizes and addresses the dynamics of change, and make senses of the changes within the context of well-established organizational goals can be of value to FSA.

The change design should include specific plans for communication, work design, piloting efforts, adjusting reward systems, providing appropriate training, and measuring performance. For example, to enhance communication the design could include mechanisms for providing clarity and visibility to organizational goals. Possible vehicles for promoting organizational goals are vision statements, newsletters, bulletin boards, and direct correspondence from leaders of the organization. The plan for work design could include assigning roles and responsibility for certain aspects of the SPI effort. While these items are common in most organizations, they may not be used to their maximum potential. The use of multiple mechanisms with a consistent theme increases the chances that the theme will be communicated throughout the organization.

Emerging changes in the organization's functions, procedures, and operations should be related to established organizational goals. The leadership of the organization should group related changes where possible, and eliminate or minimize the impact of unrelated changes. When there are simultaneously occurring change initiatives the leadership of the organization should address any apparent conflict between the change initiatives and between the changes and the organization's goals. This will mitigate the confusion on the part of the employees of balancing the new initiative with existing practices and goals.

b. Transition Management Teams

As detailed in chapter II, transition management teams (TMTs), represent one strategy used effectively in best practices as part of a planned change design. TMT's consisting of personnel representing all levels of the organization, provide a feedback mechanism for assessing the "real impact" of improvement activities, demonstrate organizational concern for the people, provide linkage across organizational levels, and assign responsibility for change implementation.

FSA should leverage the trust and confidence that the organization has for the SEPG to facilitate the TMT function. Data in Chapter IV indicate possible deficiencies in employee involvement and participation at the practitioner level. Because the SEPG has direct and frequent communications with the Director they are ideal candidates to be the focal point of the transition management function. SEPG members could lead TMTs in various parts of the organization to facilitate participation, the flow of information, and feedback.

c. Piloting

Piloting techniques are used to evaluate new technologies and methods in test situations or small segments of the organization prior to their implementation organization wide. Piloting techniques can help to mitigate the problem of generic technical support tools that do not enhance local SPI efforts, for example. The procedure involves pilot studies of specific techniques and technologies on a project, analysis of results, and evaluation of whether the techniques or technologies are appropriate for use organization wide. It is important to distinguish the organization in this case as the FSA and not the FSO. With the increasing number of automated information systems within each FSA it is very challenging to design software tools that will be appropriate for all six FSAs. It is perhaps more feasible for each FSA to design its own software tools based on the unique characteristics of its automated information systems and local best practices. This approach makes the goals and characteristics of the local organization the driving element of change (McGarry et. al, 1994) and will be better received by organizational members.

d. Integration of SPI Activities into the Project Cycle

By integrating small process improvement activities within the project cycle, FSA can more closely link the process improvement efforts to the organization's business goals. This process can be reinforced with project-based metrics of performance and structured reviews of process improvement activities. Integrated into a project, the status of a process improvement activity can be evaluated as often as the project. Additionally, we "piggy-back" on the existing reward structures and motivations geared toward successful project releases. The primary benefit of this approach is that it keeps

software process improvement visible. It keeps senior management involved in the process improvement efforts. This approach establishes an atmosphere of continuous process improvement as opposed to bursts of SPI activity followed by lulls which send conflicting message about the importance of process improvement.

e. Scanning the Environment

Customer ignorance of process improvement activities has the most potential for derailing FSA's SPI efforts. Pasmore (1988) states that responses to environmental demands can take one of two forms. Reacting to the demands as they are presented or transforming the environment so as to eliminate or alter the demands. Currently FSA is taking the former approach. The customer who is not knowledgeable of the FSA's SPI program can and has made decisions that impact the organization's SPI efforts. The postponement of SPI activities within the SABRS automated information system is an example, The problem is, it is would be of most benefit to the organization to take the latter approach. The customer provides the main source of financing for SPI. Therefore, it is logical to educate the customer on SPI.

The search conference and open systems planning methods detailed in Chapter II provide techniques for understanding and assessing the demands and opportunities that the environment presents to a particular change initiative. The value of these techniques is that it forces the organization to address customer concerns and priorities as they relate to the planned initiative.

It seems that at a minimum, the organization should embark on a campaign to educate the customer representatives on the value of software process improvement. A

more ambitious goal is the education of the real customers—the United States Marine Corps and the Department of Defense—on software process improvement.

The table below summarizes the challenges and recommended solutions for the FSAs software process improvement initiatives.

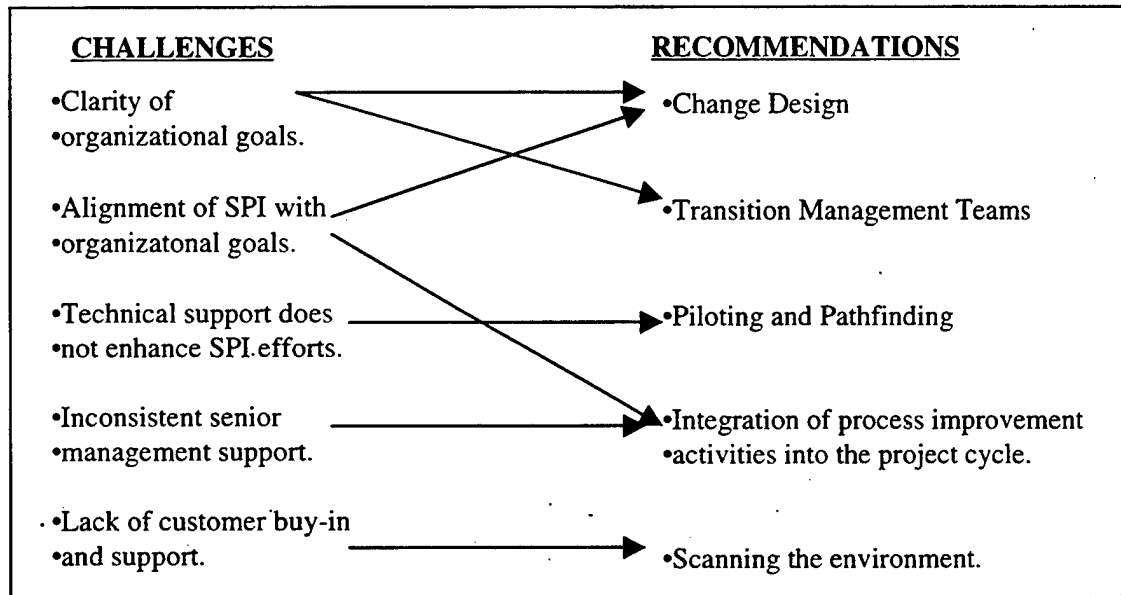


Table 5.1 FSA challenges and recommendations

2. Recommendations for Other SPI Projects

It is likely that a well-defined process will help most software development projects to succeed. By keying on the unique software characteristics of the local organization process improvement efforts will more likely lead to product improvements. Therefore it seems that the key challenge in implementing software process improvements is tailoring the effort to the needs of the organization.

Software process improvement is a process of organizational change. The CMM does not address issues of change management. Leaders seeking to implement SPI should study change theory because ultimately the job of improving processes comes down to

changing the ways that people do things. The change leader must understand and manipulate the human and organizational aspects of change.

3. Recommendations for Further Study

As noted in Chapter IV, the process improvement survey was administered without the questions regarding demographics. It was the intent of the author to request demographic data that indicates organizational level (Senior Management, Management, or Section Personnel), and the division that the respondent works in. Administering the survey with the benefit of demographic data will allow for many interesting comparisons. For example the results could be analyzed for trends and gaps across organizational levels and across the divisions within FSA. Additionally the survey could be administered at different FSAs to assess the issue on a broader scale.

APPENDIX A. PROCESS IMPROVEMENT SURVEY

21 July 98

DFAS-KC

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Software Process Improvement Survey

Attached is a Software Process Improvement Survey that each FSA employee is requested to complete. This survey contains questions about the software process improvement initiative currently taking place within the organization. The questions ask about various aspects of the organization and the process improvement effort.

Survey results will be analyzed by Captain Wendell Bazemore; a student of the Naval Postgraduate School, for the purpose of facilitating the on-going process improvement efforts.

Survey responses will not be associated with any employee. Limited demographic data will be used solely to develop pooled information for the survey categories.

William G. Head
Director for Information
and Technology

Attachment:
As stated

Demographic Data

1. Division:

KT

KD

KA

KS

KM

KI

KB

KE

Other _____

2. Role:

Senior Management (Project Officers, Division Heads)

Management (Branch Heads)

Section Personnel

3. Software Experience ____yrs.

4. Years at IT&D _____

5. Civilian Military

1. To what extent is customer satisfaction used as a measure of success at FSA?

	Not at all	Very Little	Some What	Very Much	Don't Know
Customer Satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Schedule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. To what extent is each of the following used as a measure of success in your immediate work area?

Customer Satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Schedule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Restructuring initiatives within DFAS have had a positive affect day to day operations at FSA

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Restructuring initiatives within DFAS have had a positive affect on Software Process Improvement efforts at FSA.

	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

5. Give your best estimate of the organizations current software process maturity level

- _____ Level 1. (**Initial**) Few process are defined. Success depends on individual effort.
- _____ Level 2 (**Repeatable**) Project management processes are established. Realistic project commitments are based on previous projects.
- _____ Level 3 (**Defined**) All projects make use of an organized, documented, and standardized set of activities that are institutionalized throughout the organization.
- _____ Level 4 (**Managed**) Detailed metrics are collected for both process and quality, and used to quantitatively manage software processes.
- _____ Level 5 (**Optimized**) Continuous process improvement is achieved through metrics and feedback. New ideas and technologies are constantly tested.

6. In your judgement, how much buy-in and support for process improvement is there among:

	None	Little	Some	Very Much	Don't Know
Senior Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Middle Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section Personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Recommendations/ideas for process improvement are acknowledged or acted on.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
8. Successful ideas or recommendations for process improvements are rewarded.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Not at all	Very Little	Some What	Very Much	Don't Know
9. To what extent are process improvement goals clearly stated and well understood.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
10. Regarding improving software development processes, we know what needs to be improved but we need more guidance about how to improve it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. About how much of your work-related time did you spend over the past year on process improvement related activities?	_____ % (approximate percentage)				
	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
12. Regarding the process improvement framework, there are important AIS specific areas that the CMM does not address.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Process improvement efforts detract from day to day operations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Our preoccupation with software process improvement has caused us to neglect other important issues facing the organization.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Day to day operations don't leave time for software process improvement activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Planned software process improvement initiatives will make my job easier.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Questions 17-19 relate to coordination and interaction between functional areas.					
	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
17. People identify more with their specific tasks and functions than the final product.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Everyone knows how their work will affect the work of the next person or the quality of the final product.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Boundaries between sections or departments interfere with solving joint problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20. To what extent do the following statements accurately reflect the *primary* reason for the software process improvement effort at FSA:

	Not at all	Very Little	Some What	Very Much	Don't Know
In the future a CMM level 3 certification will be required for DoD software developers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The requirement to initiate a software process improvement came from higher headquarters.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Process improvement efforts will result in FSA producing higher quality products in a more timely fashion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. To what extent is each of the following likely to cause delay or failure of the current software process improvement effort at FSA?

Process improvement goals are not integrated into currently established FSA goals.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of customer support.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time and resource constraints.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Problems matching CMM requirements to AIS specific activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Insufficient developer training and expertise.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overcome by other priorities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22. Which statement best describes your attitude towards change?

"I'm not sure how to change; besides things are going pretty well -- maybe we don't need to change."	<input type="checkbox"/>
"Everybody gets frustrated by change; but you just have to ignore the frustrations and push ahead or you wont get anything done."	<input type="checkbox"/>
"You need to change; you have to change; in fact, I'd get bored if we weren't trying out new things."	<input type="checkbox"/>
"We change so much around here that we never really master things."	<input type="checkbox"/>

23. Grade the organization (A, B, C, or D) in the following areas:

Customer Satisfaction
Product Quality
Job Satisfaction



**APPENDIX B. FSO SPI Program
Post Level 2 Implementation Review
December 1997**

<u>Respondents:</u>	FSACL	FSACO	FSADE	FSAIN	FSAKC	FSAPE
Management:	2	3	11	12	7	4
SEPG Members:	4	2	6	2	4	4
AIS Practitioners:	9	7	48	30	28	8
Support Division:	2	2	6	9	7	3
Other:				13	4	0
Total:	17	14	71	66	50	19

The Questions:

1. Please rate the senior management support at the FSO for SPI (FSO senior management includes FSO Director, Deputy Director, FSO-HQ) (average score on a scale of 1 to 5):

<u>FSA/DSE</u>	<u>Total</u>	<u>Managers</u>	<u>SEPG Members</u>	<u>AIS Practitioners</u>	<u>Support Division</u>	<u>Other</u>
FSACL	3.07	3.67	2.75	3.40	3.00 1 DK/NA	
FSACO	3.75	3.33	4	3.85	2 DK/NA 2.67	
FSADE/ DSE-MP	2.96	2.18	2.33	3.32 5 DK/NA		
FSAIN	3.15	3.7 2 DK/NA	4	3.24 9 DK/NA	2.44	2.9 3 DK/NA
FSAKC	3.63	4.00 1 DK/NA	3.5	3.21 4 DK/NA	3.33	2.67 1 DK/NA
FSAPE	3.53	3.0	4.5	3.5	3.0 2 DK/NA	

Comments:

- Senior management is providing impetus and recognition for SPI.
- Although the rating is desired, CMM principles are not supported in decisions made.
- The SPI Program could have been quicker and smoother if the customer had been brought "on board" sooner. The directors and AIS managers would have had an easier job working with their AIS Program Manager counterparts if support and direction from DFAS-HQ were more visible earlier in the program. The lesson here may be that even though we were changing FSO processes and procedures, they have an impact on customer processes and perceptions of our support. If they are opposed to our direction, they can make our progress difficult.
- As an organization, many respondents believed we were attempting to implement too many "programs" simultaneously (i.e., SPI, CMIS, metrics, LRS, FPA, etc.). These programs were competing for the same resources' time - along with developing and implementing software deliverables. Many people had "change overload." This may mean that we must be aware of the number and timing of programs/initiatives we are implementing; we have limited resources that must also product customer deliverables.
- As an organization, many respondents believed we stumbled along too much in the beginning of the program and changed directions too many times (SMS versus CMM focus,

implementing SMS task level versus procedure level, etc.). Maybe this is where piloting initiatives would benefit us.

- Could have provided better control and oversight, funds, and training. A detailed plan would have been nice. The "just do it" attitude hasn't gotten us very far in the time the program has been in progress.
- I believe that they support the SPI project primarily because it is initiated from the FSO HQ level. However, being so far removed from the actual day-to-day work, I'm not sure they are aware of the impacts of the SPI efforts.
- They do not seem responsible for the amount of time spent doing all the administrative tasks. The actual work takes second place to all the reporting and auditing.
- A great deal of effort was put into the initiative, unfortunately it was not well planned out in the very beginning. A heavy price was paid in later efforts due to this. Also, customer and FSA personnel buy-in to the basic principles of SPI was never achieved.
- Comments from FSAs are ignored by FSO. Experience of FSA SEPG members is not utilized by the FSO.
- From my perspective, it seemed to be adequate although I was not actively involved with FSO Senior Management.
- FSO Senior Management support: I believe that the FSO staff have consistently demonstrated a real commitment towards achieving SPI objectives. Mr. Burke's visit was an indication as to the significance in which the FSO views SPI activities.
- I don't know who FSO managers are or what they do.
- Mr. Burke has always presented a reasonable presence on SPI matters. Others in the FSO hierarchy became too focused on achieving the grade rather than building the necessary framework for continued improvement.
- The executors of SPI at the FSO HQ level approach SPI as a top-driven program to be imposed rather than harnessing and focusing the grass roots desires and ideas for improvement.
- I've seen too many examples of FSO's SPI office abandoning processes, like CCBs for the SMS or CMIS, because of time pressures.
- I haven't seen much direct support.
- Often, FSO HQ does not provide feedback to comments or concerns from the FSA.
- Lack of commitment based on resources and funding.
- I haven't had direct contact, but support appears to be very good.
- No complaints here. We knew the SPI program was backed up fully, all the way to the top.
- SCEs would be more believable if done by external teams.
- Policy statements, SMS support, workshops were beneficial.
- At an AIS level, FSO support is not evident.
- At the AIS level, support of the FSO senior management is not clearly evident.
- Why not bring in advisors experienced in SPI who can work with us regularly.
- Barely visible in the background.
- Not aware of FSO involvement.
- We see no evidence of their involvement.
- I really do not know how the powers work to rate.
- I don't see any support from FSO.
- Inconsistent, overpowering, and burdensome at times, then absent and lacking.
- Support by FSO has not been visible to me other than a memo stating their support.
- Time was allotted and classes were held with good presentations.
- Do not know what they have done.
- Not being privy to the thoughts of FSO senior management, I cannot answer this question.
- Have not been involved yet in any training.
- Unknown.
- I don't know who these people are.
- I had no contact at this level.

- Not sure if senior management actually understands what the full ramifications (such as the amount of documentation) actually are.
- Initial support appeared to be marginal - it improved once realized that success depended on team effort.
- Their views/support do not reach my level.
- Changes in direction - no clear vision - training and funding haphazard.
- FSO senior management is viewed as being a proponent of SPI and understanding the need for FSO activities and applications to implement a SPI program.
- SPI has proceeded with a "Report Card" mentality. Little commitment to REAL process improvement beyond a few assessments.
- The Program is supported from the top down.
- FSO senior management provided continuous vocal and administrative support to the SPI effort.
- FSO management has spearheaded the SPI program from the beginning, providing initial funding for improvement initiatives/training.
- Not enough funding/people to correctly implement at FSA level.

2. Please rate the senior management support at your FSA for SPI (Site senior manager includes the Director and Deputy Director) (average score on a scale of 1 to 5):

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	3.69	4.	3.25	3.8	3.75	-
FSACO	3.86	3.67	4	3.86	4	-
FSADE/ DSE-MP	3.58	4.0	2.83	3.57	3.67	
FSAIN	3.35	3.58	4	3.52	2.67	3.16
FSAKC	3.63	3.86	4.00	3.73	3.29	2.67
FSAPE	4.06	4.25	3.75	4.17	4.00	1 DK/NA

Comments:

- Program is supported by local management
- Need more active sponsorship earlier and more frequently by the Division Chiefs and Directors (i.e., regularly scheduled status updates from all managers involved with SPI, requiring action and results, etc. - in addition to the Director's all-hands meetings). The lesson here may be that Division Chiefs and Directors also need education on implementing change in an organization.
- Seems like we are still looking for ways not to do things rather than better ways to do things.
- Once again, I believe that senior management supports the SPI effort because of where it originated. However, at the local level, we could use more support in the area of resources to perform plus support the procedures and process.
- Senior management participated in SPI as requested by FSA personnel.
- FSA management keeps SPI an elevated concern.
- They need to remain proactive instead of reactive. It would help provide a clearer understanding and buy-in for the entire organization and hopefully less resistance.
- I believe that FSA Senior Management has consistently placed SPI activities at the top of the FSACL priority list. The high priority given to SPI objectives helped to communicate throughout our organization senior management's commitment towards achieving Level 2.
- Additional support was made available from the systems support division for some tool development.

- While the FSA management did not fully embrace improvement efforts initially, they consistently provided resources and openly supported the program.
- SPI became much more important when others looked like they would achieve Level 2 first and when this became a performance evaluation item.
- Support was consistently high, often at the expense of developmental efforts.
- Consistently try to educate us on what is happening and issues we need to learn about.
- Seems to support this effort positively.
- SCEs would be more believable if done by external teams.
- Hesitant to pay for effort, and some lack of direction - perhaps including quality in estimates would improve this.
- Too much emphasis on Level 2 and not enough on improving our business.
- Seems that FSA management lost site of goal - process improvement. Goal is now receiving Level 2 with no concern given to whether any improvement was realized. Mostly lip service.
- Hardly any training - not resourced.
- Seem to want the certification level, but not the quality.
- Seem to support process-driven activities, training, documentation.
- Concern is with reaching Level 2, not improving process.
- The people from division level down are exceptional. The higher FSA levels are sufficient.
- I don't see any support from senior management.
- Supported efforts but occasionally lacked answers.
- Support has not been visible, but they have not been a hindrance either.
- There was sincere desire to achieve Level 2 of CMM.
- Do not know what they have done.
- Not being privy to the thoughts of FSA senior management, I cannot answer this question.
- Have not been involved yet in any training.
- Constant emphasis by senior management on SPI.
- Support is there only because they were told it has to be there, not because they believe in the process.
- We were date-driven by director. Not ready for evaluation, but had to have one when he said, not when we were ready.
- Bob and Joe have very strong support for SPI, and I feel this has helped our organization.
- Conflicting goals - crisis management - no support of SPI personnel - no awards, rewards, acknowledgment - no funding - no training - no people - but it still must be in place (SPI and technical issues).
- FSAPE senior management has taken an active role with implementing a successful SPI program.
- Provided resources for SPI.
- Funding has been provided, but the previous Deputy Director provided minimal support to SPI and SEPG activities.
- Director supports SPI, but could participate more actively. Previous Deputy Director primarily supported only in the last year.
- A couple of "booster" meetings would have been helpful. At least as much as for CFC!
- We were dedicated to achieving Level 2.

3. Please rate the information related to improvement activities that was made available to you:

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	3.56	3.67	3.75	3.40	3.50	-
FSACO	3.79	4.33	4	3.43	4	-
FSADE/	3.08	2.73	2	3.41	2.5	

DSE-MP				1 DK/NA		
FSAIN	3.13	3.75	3	3.27	2.44	2.75
				3 DK/NA		1 DK/NA
FSAKC	3.61	3.86	3.5	3.72	3.43	2.67
				3 DK/NA		1 DK/NA
FSAPE	3.94	3.75	4.0	4.0	4.0	

Comments:

- Handbook and branch meeting weekly topics were most helpful.
- The SMS training was of little value and the SMS is not user friendly and is difficult to read. The AISs started achieving "real" progress when they relied more internally to train themselves (likely on their documented processes, procedures, and mechanisms). Our lesson may be two-fold:
 - 1) The FSO standard processes might be more readily understood with fewer words - more graphics and more templates
 - 2) Guidelines are needed. However, more enthusiastic participation occurs when people have more control in their direction.
- The information was sufficient but what was really necessary was insight to the information that was available.
- Our main information for SPI was the SMS. This document was often difficult to understand plus difficult to tailor to our system. In one specific case, the SMS did not address a necessary CM CMM component in enough detail to determine what was needed.
- Information, when provided, was good. However, communication of information was sporadic and not very timely. This was a great source of frustration to those who tried to further the SPI initiative.
- The SEPG is extremely well run and organized. Information is always disseminated to all concerned as soon as it is received.
- Early on we were kept fairly current and then little by little, I began to slow until currently we receive no information at all.
- The CMM, SMS manuals and the vast array of training materials helped to establish a sound foundation for developing and revising our software development processes.
- FSO HQ was inconsistent in providing information. While it improved over time, many important issues are still not communicated to ALL affected individuals.
- I feel well informed in all areas of improvement activities. SMD and particularly Pam Cromley did an excellent job of getting the word out and keeping everyone informed.
- Information was good but sometimes came to us in a round about way.
- SMS too big, bulky and dulled down way too far into the software development procedural routine. When emphasis shifted to following the CMM, much more relevant and user friendly.
- SPI documents made available, plus sharing of information within FSA.
- The SMS is all I am aware of.
- Not sure what information was made available. If not sure about that, it means that communication may be breaking down.
- SMS was supposed to get us to Level 2 - It did not.
- Seem to be behind the curve, trying to catch up. Forcing, hurrying the process will not improve it.
- Haven't seen any material of this nature.
- Can't get the materials.
- It is overwhelming. Umpteen versions of multiple documents. The tail wags the dog. I cannot keep track.
- Co-workers seem to be saddled with responsibility of supporting/establishing SPI efforts with little or no support from senior management.
- Generally tempered with pragmatic solutions.
- Certainly was plentiful.

- Too wordy. Would be more helpful to have visual materials to relate information.
- It was presented in a way that we do our work.
- Each of us given our own copy of guide to follow.
- Have not been involved yet in any training.
- Unknown.
- Enough information has been given to have a basic understanding, but not enough to do the work correctly.
- SEI has it down to a science.
- New information hard to get - need news flashes, bulletin board, or a formal distribution system starting with FSO.
- The SEI information proved quite helpful.
- FSO provided excellent information through UPDATE, SPICON and Email.
- Interaction with other FSAs and the FSO has been invaluable to the SEPG.
- Normal workload doesn't allow us to keep up with this information on a regular basis.
- Meetings were held and reading material made available.
- Report was very good.

4. The most significant improvement caused by SPI efforts was:

- estimating process
- use of repeatable processes for SCM and project management
- documented, accessible, well-understood processes and procedures (improvements in approach center more on the CMM versus SMS)
- reviews helped identify questions and issues earlier
- tracking has improved
- better support for firm fixed prices and schedules
- better control
- the set up of the CM' - with so many pieces and parts involved in any given release, it is really nice to have a central area of control
- Better tracking and oversight
- metrics, better collection of data for oversight and reporting
- institutionalizing the practice of having programmers document the location of their changes plus putting those changes on a release PDS. If any programmer is not available on implementation day, any other programmer can locate the program changes plus implement them
- the stabilizing and reliability obtained in the customer testing region. We now are aware of all changes being operated on, all changes being tested as a package. Also, baselining of requirements and software was beneficial.
- enhancement of project management activities.
- system releases and bounding of requirements.
- getting a large number of employees to at least learn about SPI and getting them to accept and work in a release mode.
- management has an effective way to show all work effort related to a particular release.
- a sense of organization about what is in a release and when it will be implemented. This begins with early planning and builds from there.
- better control with configuration management. Clearer picture of the status of projects with PM tracking and oversight process
- I think it organized procedures and provided a clear and concise way of doing business along with the establishment of data archive and feedback thus providing continued support for future projects
- project planning activities are better defined and communicated:
 - software development activities have become more uniform
 - software requirements
 - system components (CIs) are more accurately defined and documented

- the project release cycle allows more time for requirements, programming and testing to all do a better job
- implementation activities have been improved and better documented
- communication has been improved through the FSA as well as with our customers
- It has enhanced our coverage for implementing changes when people are out by creating a more formal procedure, although we were addressing that as a risk before.
- documentation of processes and centralizing of paperwork
- A unification of effort within the targeted system. SPI helped break down some boundaries while addressing a common issue. The same type of coming together has begun at the FSO level.
- Institution of standard, formal estimating methods, and a more formal process for negotiating, scheduling, and tracking system releases.
- Bringing structure into a chaotic environment. Documenting and producing processes was greatly needed.
- Attaining Level 2.
- Single point of entry.
- In the requirement management area.
- PANAPT
- Getting people to think outside "the box" of their world and focus their collective energies in a united front to increase the quality of software developed and maintained for their customers. Discussion and action to improve processes.
- Passing information to practitioners needed to achieve Level 2.
- More control over projects, errors caught earlier in the process.
- Processes in place that force us to pay more attention to the products earlier in the life cycle.
- A heightened awareness of the flow of work and more accurate measuring of SCRs.
- Repeatability! Manageability! Consistency!
- Openness to process and improvement and therefore change - improved communication resulted in quality products.
- Developing standard procedures for AIS
- Communication and coordination
- Establishment of a goal/direction to work toward - through group efforts, definition of how we would reach goals
- Communication outside division boundaries has increased
- Documented procedures
- Getting CMM process underway with several AISs reaching the Level 2 plateau
- People organized in their jobs - they are more accountable - SPI requires everything to be documented and followed
- Awareness, assessment, training
- Don't know
- The knowledge of the SEI's CMM process improvement
- Getting the requirements from the customer in writing
- Systematic development/maintenance efforts - repetitive
- Repeatable processes used by everyone
- Reviews seem to catch errors earlier
- We will meet Level 2 requirements
- Getting clearer requirements for change requests - improving understanding between user and support groups
- Documenting many of the procedures already in place - providing more uniform adherence
- Standardized and repetitive processes have increased productivity - better understanding among branches, functionals, and technicals - improved communication between FSA centers.

- Producing a better product the first time
- Crucial procedures needed to make changes are thoroughly defined/documented - work more orderly and repeatable
- Quality
- More knowledge about what affects a project's progress - increased communications among technical, environmental, management, etc., members
- Improved our awareness that most of what we do is already Level 2 and repeatable - enhanced quality
- More documentation and tracking of software changes
- Documentation on the project
- Standardization
- Gets entire team involved in development efforts
- Proposed/actual implementation of SMS and development of CMM to bring every AIS up to Level 2 and beyond
- Documenting on going towards processes and procedures
- Awareness of need to document processes
- A focus on documenting processes and then improving them
- Have not been involved with any SPI efforts to date
- Don't know
- Better quality
- Better impact analysis
- Good planning efforts which includes start to end management - good training plan - good communication
- Process definition
- Formal reviews
- Management of requirements and project management improved drastically
- On schedule - on budget
- Strengthen the team effort and document our procedures
- Reduction in errors/problems in the finished product
- Testing procedures
- Communications
- Requirements and design are more completely documented
- Getting business practices documented - established standards for all software engineers to follow and a guide for reference
- Worked as a team and all are doing the same way now
- Proactive instead of "fireman" efforts for a highly active production system
- Documentation of existing processes and insurance everyone understands and uses the processes
- The micromanagement of processes has caused potential problems to arise and be fixed before they become a major issue
- Uniformity in process
- Documentation of processes and projects - we can teach others more easily, move personnel, and review processes for problems or improvements
- Business processes which had been used for some time were documented. Employees were made aware of current approaches for evaluating system development projects.
- Discipline in developing software, scheduling, sizing.
- More working-level people were made aware of need for process improvement.
- An awareness of process improvement and I truly believe a desire by practitioners to improve.
- Two major AISs achieved Level 2 on first evaluation.
- More process awareness, more team orientation, better communication.
- The roles and responsibilities of other SEPG members are known and understood.

- Development of training plans.
- Documentation of the DCPS process.
- More individual involvement in the total process.
- The current release of the software is a much better and cleaner product than would have been possible without SPI.
- Opened communication between different levels.
- Consistent methods for handling both routine and emergency SCRs.
- Better Quality Assurance and development of a software process handbook for easy access to materials/procedures used throughout the project.
- People are more process oriented.
- Better communications on the project, better understanding of goals and objectives and better quality product.
- Regimented software engineering practices implemented - a standard, organized, measured method of work.

5. The most significant negative impact caused by SPI efforts was:

- increased release time and ability to make changes quickly
- emphasis placed on process at the expense of "nuts and bolts" of producing software
- too much paperwork
- need more customer commitment and support of SPI. The program is too costly and important to FSO not to gain strong, active, early commitment starting at the top of the DFAS management chain.
- The various support tools were not very user-friendly (CMIS, SMS Survey Tool, LRS). We needed more top-down customer management support of CMIS.
- Too much additional (and sometimes duplicated) paperwork and meetings (preparing for and developing status reports to be reviewed by multiple levels of management - from branch chief up to FSO-HQ director).
- Lines of code projections - I really don't know how our projects were estimated prior to SPI, but we appeared to get things done within budget.
- Increase in costs
- The perception that not achieving the next level after the first audit is a failure. A plan that did not emphasize success or failure but long-term improvement would have avoided a lot of negativity and bad feelings that resulted from the assessment.
- The overhead. A tremendous amount of overhead has been added to our day-to-day business operation. At times the process overshadows plus inhibits the implementation of a quality product.
- There is too much administrative overhead, i.e., too many forms to fill out, too many checklists, etc. All these processes have not produced a better quality product.
- Staff morale
- Sense of frustration due to lack of buy-in to the basic principles of SPI. This affected proponents and detractors of SPI alike.
- Cost too high, cost to implement and maintain
- The amount of time spent on determining how to implement the CMM, even though we started with the SMS
- COST, COST, COST! FSO has an unreasonable view on funding for implementation, especially for small systems.
- There is a huge "overhead" and much of this has minimal pay-back. There are many things we are doing just because they are necessary to be Level 2.
- Increase in cost for SPI efforts
- The general feeling is of an overwhelming additional workload from the required record-keeping and tracking of projects. Many feel it is unproductive and taking away

time that should actually be spent programming and is in fact jeopardizing not only the project, but the entire organization.

- The negative side is that software modifications require a greater amount of time to complete.
- SPI has added a great deal of overhead with little value added
- Paperwork gets in the way of the actual projects.
- Time-consuming up front.
- Resulted in duplication of effort, entering similar information into several systems.
- A lot of effort was spent formalizing processes without improving them. Addressed the "book" solution rather than the needs of the AIS. Changes were imposed rather than drawn from the AIS. There's a lot of resistance at the practitioner level in those areas where they do additional work without apparent benefit.
- With the pressure on to make SPI-related deadlines, competition for resources within the FSA has been bitter. While I have heard some very positive comments from some developers, many still see SPI as a drain on their dwindling time.
- I did not detect any negative impact caused by SPI efforts. Every effort made toward improvement is a positive effort.
- That it was implemented nearly concurrently with fee-for-service and was used as a "standardization mechanism."
- Great time involved doing process meetings when a mission is time-critical. It appears at times we could be better served just doing our job rather than attending meetings.
- Initial resistance, however, it seems most employees can see a benefit now.
- Stress due to unclear requirements.
 - Manpower decreased when specialists were lost to create/coordinate SPI and this has increased the workload on the remaining heroes.
- There must be a commitment to the time involved in order to reap the quality benefits.
- Confusion caused by lack of good examples of what documents and procedures should be developed.
- Money and time - I have not seen any return on the SPI investment yet
- Lack of available training to be more efficient in our efforts
- Monetary investment has shown minimal improvement - significant number of high-salaried employees devoted to SPI. Significant overhead has not shown ROI - too much \$\$, too little improvement
- SEPG that existed early on was not a help - their attitude negatively impacted SPI
- Impression that projects served FSA staff and through them the FSO instead of the other way around
- FSO preaches SPI - no support given to local SPI efforts
- Amount of time spent on activities, juggling priorities (SPI versus customer satisfaction)
- Don't know
- Impact on morale caused by the half-hearted implementation
- Generated many forms, steps and procedures which add a lot of time to completing the work.
- Adjustments of overhead
- Functional community not receptive to SPI
- Customer complaints
- Tremendous overhead costs - affects productivity
- A proliferation of paperwork and requirements without any clear goals or direction
- Time involved to make even small changes
- Time spent seemed excessive - archival of documentation is excessive - find another way of providing evidence

- Making changes to processes after an AIS placed in production caused some confusion & duplicate efforts
- Morale problems - insufficient information received at lower levels - people think this involves major changes in how they work, but this isn't true for everyone
- Takes longer to get the job done
- Sometimes, especially for simple changes, SMS slows the completion of work tasks too much
- Increased amount of time it takes
- Requested changes can no longer be accomplished quickly - spend much more time documenting and waiting for other people to finish their steps
- Increased time allotted for release
- It takes much longer to make changes in software and minor improvements are not made
- Added paperwork that needs to be charged to a customer who already doesn't have enough money to get job done
- Significant amount of time expended in reviews and documentation
- Amount of upfront time expended to implement SMS and CMM
- No interaction to determine what the processes are and what doesn't work or needs improvement
- Confusion as to what projects to apply SPI/SMS standards
- Documentation was distributed and expected to be followed, but no formal training was held
- Extra paperwork
- Many SCEs have required additional funding to complete SPI activities
- Lack of "proactive" support from senior management
- Morale
- The amount of documentation required to satisfy the requirements
- Expensive to implement - costly record keeping
- Customer has claimed slower turnarounds for impacts and releases
- The layers of extra work and bureaucratic red tape that are necessary to meet SPI requirements often seem to be a make-work waste of time, especially for small changes/SCRs
- The reduction on production because of the time spent on doing documentation in support of SPI efforts - SPI requires 2 or 3 times the amount of time spent on documenting each step or phase - more attention on meeting SPI level than on our job
- Terrible cost - too much documentation
- Time required
- Lateness in getting procedures on how to do tasks - with no initial direction, much was done without guidance
- Time/\$\$ to develop all processes/procedures - could have used a Level 2 AIS's stuff and gotten there quicker with less \$\$ - share stuff - director needs to realize SPI takes time and shouldn't be rushed or date-driven
- Customer/functional staff not willing to get it done "now" - moving train and getting it painted syndrome
- Effort to follow SMS as the methodology for reaching CMM Level 2
- Cost and time
- Lip service by senior management - suspension of staff functions indicates non-support of SPI effort - no management support - too many lies - our heroes are dropping like flies - they just give up
- Overburden on AIS staff - unrealistic or uncompromising dates and goals were set without input from the AIS - we are understaffed in some areas, and this makes it worse.

- Some "game-playing" on the part of managers who focus on appearance of improvement rather than real improvement.
- Additional time to develop various plans and products.
- The initial impact was the vast quantity of paper generated, however, as we progress, that should level out.
- Initial perception was of "program" to be forced on projects.
- Feeling that the reviews and comments associated have negatively affected the teamwork attitude the system developers need.
- Time required to fill out forms, develop/maintain documentation reduces the amount of work that can get done from one update release to another even though the "old" way might have resulted in a 10% rework and re-release.
- Delay of a Release was caused by the preparation of the SCE.
- The additional meetings and paperwork are very time-consuming and lengthens the time to complete work.
- Increased response time for handling emergencies caused by need to follow procedure.
- Upkeep of the Business Handbook is added workload.
- Good initiatives start out but without proper funding/value are quickly overcome by events.
- More paperwork.
- Very time-consuming - cost/benefit still undetermined. Customers leery.

6. Please rate the training you received on SPI Initiatives:

<u>FSA/DSE</u>	<u>Total</u>	<u>Managers</u>	<u>SEPG Members</u>	<u>AIS Practitioners</u>	<u>Support Division</u>	<u>Other</u>
FSACL	3.56	3.67	3.5	3.6	3.5	
FSACO	3.43	3.67	4	3	4	-
FSADE/ DSE-MP	3.00	3.18	1.6	3.13	2.83	
FSAIN	3.14	3.27	2	3.38	2.67	2.9
		1 DK/NA	1 DK/NA	1 DK/NA		3 DK/NA
FSAKC	3.54	3.57	3.5	3.68	3.57	2.33
				3 DK/NA		1 DK/NA
FSAPE	3.75	3.75	3.75	3.50	4.50	
					1 DK/NA	

Comments:

- SPI training was at appropriate time/level
- More specific training is needed (how the AIS will specifically perform the processes/procedures versus the what in the SMS; how to implement the SMS/CMM (perhaps from the SEPG); how to translate the CMM/SMS into tangible mechanisms (checklists, forms, etc.)
- "Shadow consulting," change agent training and more descriptions of specific benefits for each KPA versus general benefits of SPI were needed.
- Customer at the site level needed "education" on SPI benefits - both generally and by KPA.
- Senior managers (division chiefs and directors) could have benefited from training related to implementing change in organizations
- Received a lot of training that gave a lot of information, but very little insight. Could have been better.
- Training was received on each KPA. This training was provided by FSO. I personally received some excellent training from an outside vendor, FASTRAK for

CM. Perhaps some sharing among AISs or visits to see the process in action would have been helpful. There has been no training since approximately 2 years ago.

- Training was received 3 years ago. Nothing since.
- Training provided was okay. The problem was that due to inadequate up-front planning, the training needed by some was not provided until much too late, e.g., TWG members working on process definition.
- Training received varies greatly and not necessarily at the working level.
- Outside vendor training has been excellent.
- Overall in-house coupled with vendor training proved very beneficial.
- The training received was very complete. It was extremely helpful in providing a thorough comprehension of what was required for each KPA.
- Training provided by SEI and other vendors was extremely beneficial. Training provided by the FSO was weak.
- Some good/some bad to average in the middle. For the most part, internally developed training was good/FSO-developed training was bad.
- Working primarily on Requirements Management - requested but could never get formal training on this KPA - feel it caused a lot of wasted time.
- Initial overview training was dull, dry, boring. Didn't like being read to from a book that I had in front of me. Learned more by being involved with a local working group and the later training sessions given by the Change Agents and other groups.
- It took several sessions to get it all straight in mind, but I think I finally got there.
- Explaining evaluation system helped tremendously.
- Need more whys and theory versus reading CMM/SMS - Gini provided good review of SMS/CMM
- STC good as a starting point, but flat overall - could have been more insightful and less text - vendor training very good - should have KPA experts within FSA facilitate training
- Vague information - sessions would usually degenerate into complaining about the proponent agencies
- Very little training was available - no money in budget
- Several requests made for vendor training in CM and SQA, but all denied due to lack of funds.
- Had to obtain own - STC training very poor
- Training from Learning Tree emphasized testing - training from FSAIN staff was simply a reiteration of CMM/SMS - my time better spent in reading primary source - training from STC (ENSCO) was very good
- CMIS class done well, however, without specific examples of using it in real life, I don't see what to do with it
- Still waiting
- Never received training
- I have not received any training for SPI
- I have been trained elsewhere, no training here
- When you don't get the material, you cannot learn as much
- We have some very talented people in our organization
- Am not asking for more - I learn by putting down on paper in words I understand, clarifying and freedom to study - my learning is slow but sure - it is not good for in-house training
- All theoretical, not practical - learned in class - not used in work place = soon forgotten
- Occasionally too detailed and long
- Continuous training or awareness sessions are very important and should be done more frequently
- Training received at various times, but nothing implemented yet
- I like the SPI demo on software

- Much redundancy bordering on overkill, but the SMS process was well explained
- These topics need to be scrutinized to make more understandable
- Many handouts were given, and several classes covered what was needed to achieve Level 2
- After given the training, don't use for months, if ever
- Don't think I received any formal training, and any informal training was not tagged as SPI
- Could not attend class
- Need training for all contract personnel
- Need specific training in the assigned AIS
- Needed more CMM training up front
- Extremely dry and boring usually
- Unable to rate for no basis for evaluation
- Need more
- Training given and then expected to get it done right away - How do you roll over your environment when you are always in a 50 hour work week in 40 hours before SPI
- Training I received was totally inadequate - training needs to focus on system specific rather than organizationally
- STC staff has been dedicated and committed to delivering quality training - tough mission
- Why cancel the STC training group?
- While my training was good, we are having difficulty getting training for CM and QA personnel as well as other SPI training for SCE
- The training provided a good understanding of the SPI program and evaluation process.
- Some areas: sizing, tracking, oversight, seemed shallow.
- Received valuable extra training from SEI due to SEPG and SCE evaluator role.
- FSO training was sufficient, but SPI conferences were exceptional.
- Training was ample and conducted by personnel very knowledgeable of SPI.
- Have only received in-house training.
- Limited access to within Activity Level 2 systems documentation for guidance and to knowledgeable personnel for documentation development. We had to start from scratch even though our Activity had a Level 2 System.
- We only had it before the CMM audit.
- I feel that the training I have received on SPI has been beneficial. We also have a SPI bulletin board. Local training was very good.

7. Please rate the SEI support you received on SPI Initiatives:

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	3.64	3.67	4	3.25	3.67	
FSACO	3.46	4	4	1 DK/NA 3.4	1 DK/NA 4	-
FSADE/ DSE-MP	2.91	3	2.5	2 DK/NA 3.03	1 DK/NA 2.4	
FSAIN	3.05	3.67 3 DK/NA	3. 1 DK/NA	3.06 8 DK/NA	2.83 3 DK/NA	2.56 4 DK/NA
FSAKC	3.45	3.17 1 DK/NA	3.25	3.95 6 DK/NA	2.57	2.67 1 DK/NA

FSAPE	3.67	4.0	3.67	3.2	4.0
			1 DK/NA	1 DK/NA	

Comments:

- SEI was very helpful
- Not much contact by AIS personnel with SEI - some by ccmil
- Support at the SCEs was excellent
- More direct, hands-on support from SEI at the site level (shadow consulting, etc.) would have been beneficial. The lesson here may be that the SEPG and site needs more consultation support to facilitate quicker and easier SPI implementation. This doesn't have to be full-time, but periodic consultation at critical stages.
- Did not have much interaction with the SEI personnel. I know that some SEI reps came here to help us with reaching Level 2 in the area of PM. However, I cannot rate the support given.
- SEI has been very cooperative with lending support.
- Very beneficial when the opportunity arises that one-on-one communication is possible. At other times, when an issue is raised with hopes of comments from SEI, that is a little tougher to accomplish.
- SEI's support was not extremely visible to me. I would have to say that the majority of our support came either from the FSO or FSA level.
- What we were told we had to do to become Level 2 in PM did not mesh with what other AISs were doing who were Level 2. Do not agree with SEI opinion expressed that "you cannot do too much ..." - in this case PM, but seems to be a common theme.
- The shadow consulting we received was invaluable.
- Rozum was knowledgeable and ready to assist when needed.
- SEI who? NO, actually, it was good at times, but often resulted in confusion from the mixed messages that were received.
- Support has always been very helpful.
- I have never been clear on the scope of the SEI agreement. Would they have helped me on my initiatives if I had asked them? I felt SEI was very short on concrete advice - they were more like a stereo-typical therapist, answering "well, what do you think you should do?" to every question. We'd have been better off on our own.
- My position as practitioner didn't put me into contact with SEI.
- Don't know if any support received at project level
- Available to answer questions and analyze solutions - early on, wished more direct answers
- None, other than having a copy of the CMM
- Never had direct contact with SEI
- Hardly ever here - never got direct answers
- I have not received any SEI support
- Not aware of SEI involvement
- I have not received any SEI support
- I believe some SEI support could be very helpful to the effort
- Learned from others in the office and trial and error
- Written materials only, no explanation
- I have had no contact with SEI
- Co-workers and branch chiefs are supporting effort without much senior management help
- Too academic
- Not aware of what they have done
- I personally know of no SEI actions although they would have taken place at a different level
- Questions were answered in a timely manner

- Not much
- Have not read CMM
- Unknown
- More SPI support would be helpful - they should monitor our practices more closely and give us guidance on what improvements need to be made
- They were afraid (so it appeared) to give yes or no answers when it came to procedural questions
- What does SEI stand for?
- I have no contact at this level
- Much has been left to the users of the procedures to guess at
- SEI members were learning processes and were inflexible in implementation of the SMS
- They've been at our beck and call and have always responded/supported us
- Too many flip-flops on how we do our business
- We haven't had any yet on our project
- SEI support helped to clarify terminology and facilitate the crosswalk from current practices to the CMM.
- SEI provided continuous on-site and off-site support that was a significant factor in improving software engineering practices to Level 2.
- They were very helpful in zeroing in on what needed to be done for an assessment.
- SEI sent a representative to do an evaluation prior to the SCE. His input proved to be critical in many areas.
- We had one sit-down session with an outside SEI person in the 8-12 month process.

8. Please rate the FSO support activities to SPI Initiatives (These activities include training, FSO SPI conferences, SMS workshops, and process definition.):

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	3	3	3.2	2.75		
FSACO	3.73	3.33	3	2.83	1 DK/NA	-
				2 DK/NA		
FSADE/ DSE-MP	2.75	2.4	2.2	2.9	2.8	
FSAIN	2.82	3.38	2.	2.96	2.43	2.4
		4 DK/NA	1 DK/NA	7 DK/NA	2 DK/NA	3 DK/NA
FSAKC	3.12	2.67	2.5	3.48	2.8	2.67
		1 DK/NA		5 DK/NA	2 DK/NA	1 DK/NA
FSAPE	3.0	3.0	4.0	2.25	4.0	
			2 DK/NA	2 DK/NA	2 DK/NA	

Comments

- As an organization, it seems we focused too much on the SMS and should have focused on the CMM sooner.
- There seemed to be a communication gap in getting information from the various FSO SPI conferences, etc., to them.
- The value of the SPI conferences was questioned when the main agenda was status reports versus sharing solutions, setting direction, resolving issues. The VTC is an excellent format for status reports. However, face-to-face is more beneficial when synergy is required (i.e., setting direction, alternative approaches, and resolving issues/obstacles).
- Although I only experienced some training plus one SPI conference, I know that there was plenty of support activities for SPI by FSO.

- Process definition activities of TWGs did not provide for equal input by all participants when they were initially advertised as such. FSO TWG participants did not contribute meaningfully to TWG process definition activities.
- Training provided was fine. Support and process definition were very sketchy at times and not very conscientious.
- I would have to say that support shown by the FSO was extremely high considering the training dollars allocated.
- Poor direction and metrics and FPA leads to useless work and data that in some cases we know is meaningless. Important one day and not the next. Adds more overhead.
- Only the training that was contracted was worthwhile. Training on the tools and on the individual KPAs was poor.
- FSO needs to take a more team approach, not dictatorial.
- The process definition efforts were marginal at best. Processes were dictated rather than created with the input of all FSAs.
- Reading slides and the SMS to software engineers is insulting. SPI conferences shared little useful information for their costs.
- Felt we were being "force fed" processes/tools.
- Other than selected members of the Steering Group, I really felt we were pretty much on our own.
- Not involved
- Gini did great - miss SEPG newsletters - Anita did great job on maintaining and soliciting feedback on SMS updates
- Never attended any of these except training
- Never attended any of these and did not know they were available
- Would have done better if each FSA pursued Level 2 on own
- Not sure that I have been involved with these FSO activities
- I have not received any training or support of this nature
- Look at the committees charged with developing SPI materials
- No money for training or attendance
- I have had unit test, SQA, and PM - one exceptionally good contractor instructor - keep this man - have not been to conferences or workshops
- Non-existent
- Definitely went extra mile on training - we had many individual training courses and special class prior to rating - class was tailored for our system and was very helpful
- Really hard to judge because of the difficulty of the tasks
- Haven't attended any for a long time
- Except for basic/overview training, who gets to attend/participate in their activities
- Support is good but could be better if classes were given more often and were not so long - ideal is 1.5 hours
- My experience here is limited to formal training that was funded by the FSO
- SMS is rarely talked about until an impending meeting, then it is the most important issues we have
- Classes and booklets were given to everyone in the division
- At first, FSO was active - now dropped out of sight
- I have not been involved
- Not directly involved
- The training needs to be geared around system specific processing
- What FSO activities? None to speak of - when they did come in, it was as dictators and giving wrong information - FSO lost credibility in many people's minds
- Over-definition of some processes, not enough on others (policies for Web, MTMO, oracle, etc.) would prefer leadership and strategic planning to micromanaging
- Good at first, but seems to be losing steam.

- These were very helpful to SEPG members, but not sure how valuable to practitioners.
- FSO provided leadership and budget support for the SPI program. Without this support, very little would have been done.
- Training was mostly to explain terminology and “read” the KPAs, not “how to” on development of policies/procedures.

9. Please rate the tools provided by FSO for SPI Initiatives (Tools include LRS, CMIS, and SMS Survey Tool.):

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	2.75	2.67	3	3	2.25	
FSACO	2.79	3	3	2.57	3	-
FSADE/ DSE-MP	2.16	2.09	1.83	2.24	2	
FSAIN	2.64	2.44	2.	2.96	2.25	2.42
		3 DK/NA	1 DK/NA	3 DK/NA	1 DK/NA	1 DK/NA
FSAKC	2.70	1.86	1.75	3.07	3.00	2.00
				1 DK/NA	2 DK/NA	1 DK/NA
FSAPE	3.41	3.25	4.25	3.00	3.33	

Comments

- FSO SPI Tools help get the job done but are not user friendly and can be cumbersome.
- Overall approach to employing support tools seemed disjointed. The tools with the least support are CMIS and the SMS Survey Tool. It appears that what people want is an integrated tool set for each of the functions. For instance:
 - a) A single integrated tool set that performs CM control/migration and status accounting, and CI inventory. CMIS does only 2 of these.
 - b) A single integrated tool set that helps track hours and other project management activities.
- A possible alternative is to purchase COTS that are somewhat tailorable.
 - Need to purchase standard CM, test, and project estimation tools.
 - Concerned that tools being used have not all implemented and reached CMM Level 2. CMIS could not provide a CM plan, for example.
 - LRS and CMIS are good tools to use. The Survey Tool was basically useless a year ago when it was needed.
 - I do not use CMIS. LRS is fine. SMS survey tool I cannot recall what this was. Again, the tools duplicate processes like estimating and PM activities and are not necessarily designed for the AIS.
 - LRS is very prone to breakdown. The SMS survey tool became less useful as the focus shifted from SMS to the CMM compliance.
 - Sometimes the release of the tools to accomplish SPI initiatives is difficult to determine.
 - SMS Survey Tool is the most beneficial of these tools; however, the tool would be more useful if it would be based entirely on the CMM.
 - Tools are very poor. If we are to proceed with this effort, we are definitely in need of additional automated tools. We cannot be expected to support a Level 2 or 3 organization with archaic tracking devices.
 - AISs expected to adopt to tools developed for AISs in different environments (i.e., CMIS). Trying to force round pegs into square holes. Attempts to use LRS for metrics in ways it is inadequate for.

- LRS is the best of the bunch. CMIS was a bad decision based on a lack of knowledge of what was needed. It was proven not to be the universal tool as was advertised. The SMS Survey Tool provided no benefit.
- CMIS = poor performance/not adaptable to large systems.
- These tools are poorly integrated, difficult to use, and are an insult to us as a software development organization.
- They all have that awkward, home-grown feel. Probably would have been better to find tools that suit the needs rather than enforcing tools to fit needs that were never envisioned when they were developed.
- LRS is probably the best of a bad bunch. Has anyone besides me been appalled at the amount of money this place has spent on CMIS? We should have bought COTS, then built the SCM function around it, instead of having everyone keep trying to change the tool to match existing practices.
- CMIS is old and outdated. Written by individuals for specific site and everyone is expected to use. CCB process has broken down. LRS is not designed for a large organization. Lots of problems with software.
- LRS and CMIS should talk to each other and the SMS survey tool was cumbersome and an exercise in futility of status reporting for no purpose other than HQ had a tool!
- It appeared CMIS tool was picked without study of methodologies at sites.
- PANAPT is best.
- It seems like a lot to fill out to keep track of what you are doing.
- LRS for entering time and don't use CMIS
- Could have used more definition on overhead categories - SMS survey good to maintain checklist when first implementing - could not load new version as too big - CMIS helpful but need tools for TDR status, version control, sizing, library controls
- CMIS needs something like a tiger team, not endless meetings, in order to implement
- Input correct time into LRS, then maybe we can use it as a tool to measure progress - CMIS needs a library system to be effective
- Only training received was on CMIS
- LRS times not entered correctly to provide accuracy - CMIS only as good as data - better if linked to library system/LRS
- CMIS very good - LRS sufficient - survey tool inadequate
- CMIS is nice report tracking tool but just adds duplicate effort and does not control software movement and versions
- Only involved with CMIS to limited extent - it controls documentation and approvals but does nothing for physical configuration management
- Have only taken CMIS training and not using it as part of my duties at this time
- What do the tools names have to do with SPI? We need to implement Designer 2000 as a process tool
- LRS is good - No CMIS training - SMS: next version should be much shorter
- Multiple data entry is insufficient
- We have LRS - we use OSED, not CMIS
- LRS: eeny, meeny, miny, mo, what should I charge the customer for today? CMIS: "user friendly" not an attribute of this exercise in futility. SMS Survey Tool: Have not seen nor do I know what it is/does.
- LRS and CMIS are poor - data collected may be useful at FSO but are of no worth to me - both impractical. SMS OK
- New LRS pending - has been delayed again. CMIS is not functioning yet.
- Never see anything happen because of surveys. Not using CMIS yet. LRS is OK but not very useful. Need report that will give summary total of how many hours were against a specific SCR.
- These tools were very much needed and make our jobs easier
- CMIS could be improved
- OSED is a great tool - LRS seems to be very good also.

- On-line (LAN) tools are used by everyone in the division - LRS, CMIS, Word, Excel, ccmil are a few tools used
- They helped
- CMIS very good
- SMS and LRS are functional for what they are designed to do
- We've had CMIS training, but haven't started to use it yet
- LRS is hard to use - New CMIS is needed - Training
- LRS and CMIS proved invaluable. The survey tool provided little value
- LRS is used, and it is on the network.
- Does not provide what we need at the developer's level
- CMIS does not add value to our processes but makes them more cumbersome because of additional procedures
- Couldn't use CMIS due to inadequate environment. LRS cumbersome and needs to be more user-friendly. Data not always accurate.
- Still trying to get there.
- We were tasked to perform mission with tool incapable of meeting requirements
- LRS is a joke - no one enters correct information for it to be of any value. CMIS is okay. SMS survey tool is a joke.
- You must be joking - not user friendly - not compatible - no interface - redundant
- LRS has been co-opted by business management people and is virtually useless as a source for software metrics.
- Both LRS and CMIS were significant factors in our achieving Level 2. These tools provided cost and effort data as well as manage and teach the requirements.
- All three of these tools were extremely useful, if used, to assist in managing and tracking.
- Tools are valuable but there needed to be more standardization across FSO for usage.
- CMIS vital for CM portion.
- They do not provide for cross-walking as each is structured so differently.
- LRS and CMIS were part of our practice before SPI came along. I don't know what the SMS Survey Tool is.
- Familiar with tools, but not with FSO support.
- Most tools used are standalone. A greater improvement to the software process would be a more integrated unit. There is no link between CMIS and LRS. There is no link for CMIS and our Version Control System. Each piece acts alone.
- LRS and CMIS are Very Good. SMS is Inadequate.

10. Please rate the local SEPG support you received on SPI Initiatives:

<u>FSA/DSE</u>	<u>Total</u>	<u>Managers</u>	<u>SEPG Members</u>	<u>AIS Practitioners</u>	<u>Support Division</u>	<u>Other</u>
FSACL	3.94	4	4.25	3.8	3.75	
FSACO	3.85	4.33	4.5	3.43	4	-
FSADE/ DSE-MP	2.89	2.81	2.8	3.0	2.33	
FSAIN	2.96	3.4	2.0	2 DK/NA	2.14	2.5
		2 DK/NA	1 DK/NA	4 DK/NA	1 DK/NA	3 DK/NA
FSAKC	4.07	4.29	4.00	4.2	3.71	3.33
			3 DK/NA	3 DK/NA		1 DK/NA
FSAPE	4.00	3.75	5.00	4.0	4.0	
				3 DK/NA	1 DK/NA	

11. Comments on local SEPG support:

- SEPG was helpful in implementing SPI initiatives
- Wide range - from 'absolutely no value' to 'only reason the organization made any progress'
- Need to ensure the SEPG is knowledgeable, experienced and can give examples of mechanisms to the AISs. The "standard" mechanisms could come from either the site or FSO level, but people need to have samples of mechanisms to translate the CMM into workable processes. The lessons here may be:
 - a) Formulating and implementing a training/education agenda for SEPG
 - b) Network frequently with other organizations implementing SPI, in order to share approach, lessons learned, and sample.
 - c) Obtain consultants periodically at key points in implementing the SPI program

for

both the FSO-HQ and local site levels.

- CM and SQA provide excellent support for AIS and for SEPG members.
- All local SEPG members were very helpful and informative. They were always willing to help research the answers to questions.
- They are very helpful.
- In some areas, the support was exceptional, but others it was marginal.
- The SEPG is very well run and members are knowledgeable about their areas of expertise. If asked, they've provided valuable information to all.
- SEPG has assisted in crosswalks review of implementation plans and assessments.
- Again, this is somewhat reflective of the FSO support received.
- I believe that the SEPG group was instrumental as far as serving as a liaison between the FSO and the FSA.
- Sometimes overzealous in requiring artifacts that have no value to the AIS. Apply procedure for the sake of procedure regardless of any benefit.
- I don't think that the SEPG has ever realized that a group is as powerful as people let it be. For example, if they'd have sent out a few directives "from now on, everyone must ..." instead of trying to get everyone to embrace their philosophy, they'd probably gotten a lot of stuff implemented. As it is, people feel they had a choice and some chose no.
- The local SEPG's support was the key to the successful SPI implementation at FSAKC.
- Our SEPG was ALWAYS there to solve problems and answer questions.
- Very hard-working and conscientious.
- Without them, there is no Level 2.
- Can't say enough good things about our SEPG Team.
- It seemed to me the SEPG assisted SMD personnel. I didn't realize until later this was actually a SEPG function. Also, I am not aware of all the efforts of the SEPG, only those that directly involved me.
- I get SPI news almost every month and Word of Week. SEPG does excellent work. Make better organization for designers, programmers, and testers. Saves US Government a lot of money.
- Our SEPG Team has made a valiant effort, but had only received a lukewarm welcome.
- Could be more proactive, leading the way, bringing the practitioner needs and ways to meet them to management, rather than limiting their efforts to what they feel they can talk management into.
- Once AIS is educated, SEPG should act as consultants, not implementation project managers. SEPG needs to attend conferences and spread new ideas for support.
- I am not familiar with the SEPG.
- Don't have an SEPG anymore.
- This group needs more PR to let the rest of the world know who/what they are/do.

- No visible SEPG.
- Early on, they treated software engineers as if inferior. Took credit for work they did not do.
- I have not received any local SEPG support.
- Support is lacking.
- None.
- Not aware of SEPG support. Just started working with SPI/KPA teams.
- I am too far down the chain of command to have contact.
- What SEPG?
- I consider them overhead.
- Occasionally spread too thin and occasionally impractical with uncooperative attitude.
- Always ready to answer questions and to do what they can to help us understand and set goals for SPI.
- Any questions are answered in this area.
- Not much too.
- Unknown.
- Our division reps keep us very well informed about SPI activities.
- I don't know what SEPG is.
- More SEPG support will be helpful. They should closely monitor our practices and give us guidance on what improvements need to be made.
- Very supportive.
- Not properly staffed.
- What does SEPG stand for?
- No contact
- There has been little or no support shown
- Provided support when requested
- Good effort but failed
- Never supportive. Always dictatorial and combative
- No SEPG - inadequate when we did have one. The process has become a total joke in our FSA. The other FSAs are doing it better. Ours has done a complete turnaround on our vision and methods.
- SEPG is currently understaffed and undertrained through no fault of their own. Goes back to management (FSO/FSA) support.
- Local SEPG provided support as requested to project SPI staff.
- I thought the support was quite good, once an AIS was receptive to it.
- All members were very knowledgeable and cooperative. They continued to go out of their way to facilitate a project's improvement.
- We have a very knowledgeable and helpful SEPG. They have assisted me and provided guidance concerning procedures.

12. Please rate the effectiveness of the SCE process:

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	3.13	2.67	3.5	3	3.25	
FSACO	3.43	3.67	3.5	3.14	4	-
FSADE/ DSE-MP	3.45	3.8	3.5	3.41	2.67	
FSAIN	3.91	4.17	3.5	4.2	3.67	2.57
					3 DK/NA	6 DK/NA
FSAKC	3.48	2.86	4.0	3.70	3.43	2.67
				5 DK/NA		1 DK/NA
FSAPE	3.94	3.5	4.25	4.00	4.00	

1 DK/NA

Comments:

- Most comments centered on the accuracy of the assessments and the help provided by the final findings reports. The assessments were viewed as professional, fair, and accurate even when the findings/results did not result in a CMM Level 2 rating.
- Could have been better and more consistent if the process had been documented.
- The SCE team members were very professional. It's believed that the SCE process was not uniformly applied between FSAs.
- I do not feel the SCE criteria have been applied consistently. Credibility is lacking.
- Never been involved in actual SCE
- What is an SCE?
- Do not know what "SCE" is
- What's the SCE process?
- What is SCE?
- Not done yet

13. Please rate how well the SCE findings helped in action planning for future improvements:

<u>FSA/DSE</u>	<u>Total</u>	<u>Managers</u>	<u>SEPG Members</u>	<u>AIS Practitioners</u>	<u>Support Division</u>	<u>Other</u>
FSACL	3.56	3	4	3.6	3.5	
FSACO	3.31	4.33	3.5	3.5	3.5	-
				1 DK/NA		
FSADE/ DSE-MP	3.64	3.91	3.6	3.59	3.33	
				7 DK/NA		
FSAIN	3.85	4.17	3.5	4.11	3.75	2.43
					5 DK/NA	6 DK/NA
FSAKC	3.47	3.00	3.75	3.73	3.29	2.67
				6 DK/NA		1 DK/NA
FSAPE	3.81	3.25	4.0	3.8	4.33	
				1 DK/NA		

Comments:

- Most comments centered on the accuracy of the assessments and the help provided by the final findings reports. The assessments were viewed as professional, fair, and accurate even when the findings/results did not result in a CMM Level 2 rating.
- Answer relates only to improvements relating to achieving Level 2.
- Not evaluated yet
- Identified weak areas
- Don't know what "SCE" is
- Not done yet

14. Comments on assessments and related activities:

- SCE tied everything together and helped identify areas needing improvement
- SCE findings were too vague
- Most comments centered on the accuracy of the assessments and the help provided by the final findings reports. The assessments were viewed as professional, fair, and accurate even when the findings/results did not result in a CMM Level 2 rating.
- The assessments were helpful in identifying weak areas in our processing. The IP was helpful in getting an insight of how the workers viewed the process.

- The lessons learned were helpful for the next projects. SCE process should have been documented to provide more consistent evaluations. The success/failure perception was overemphasized.
- The SCE pointed out the same areas of improvement which we knew were weak. I think the SCE should be done by outside people, outside the FSA, not by peers at other centers.
- Current teams are working well.
- The assessments are a good measure of implementation progress.
- Some inconsistency among the team members possibly due to misunderstanding of the actual organization's process or possible pressure from other team members to rate otherwise.
- The assessments were very helpful in evaluating our progress and in preparation for the SCE.
- Credibility is not what it should be.
- The SCE findings were very accurate and quite useful in developing programs to change processes.
- It was extremely frustrating to go through the process, for the extended visit and have the team decide they could not give us a rating. Not apparent guidance when a stalemate occurs between members of an evaluation team.
- While painful at times, the SCEs drove home the CMM concepts and helped pull the FSA together. Because the results were focused at Level 2, the findings only addressed small improvements.
- Don't think they were done fairly across the board. Some systems appeared to be under tighter scrutiny than others.
- The "pass or die" attitude wasn't the fault of the SCE process. There were hard feelings about the SCEs. The concept of having in-house assessors was good, but in practice it was a losing situation - unless the site passed - then you could be pals. How many sites followed their "recommendations for improvement" to implementation once they got Level 2? Findings were good, but I doubt the level of follow-through.
- Interpretation of some CMM elements are vague and leaves too much discretion to the assessment team members.
- Need to have time to operate at Level 2 and iron out procedures/processes before proceeding to Level 3.
- They take too much time and resources if they're only to be used to establish a grade. They'd be very worthwhile if they were used to focus and plan improvement efforts.
- Still waiting for this assessment. Questionnaire should have been postponed 60 days.
- Can feel political and competitive at it's worst. Can feel worthwhile and instructive at its best.
- The findings I read were more about the SMS, not CMM.
- Headed in right direction, but still a lot to do.
- Dates set for an AIS evaluation are often set outside the AIS and do not consider need to implement, train, improve and institutionalize the processes for the AIS.
- The extra forms, steps, and procedures should add much cost and waste to work
- Very good for efforts to be applied
- None of constructive value
- These are enlightening and beneficial - Determine the extent of the SPI understanding
- Assessments of immeasurable value
- SCE helped me identify where I was lacking knowledge of the process, so I could work on improving my awareness in these areas
- The first assessment was a little confusing as to what was needed. The second one was much better.

- Weaknesses were pointed out and explained.
- The questions sometimes seem vague and obscure. Maybe they need more explanation, or to use fewer unknown/forgotten acronyms
- No SCE yet
- Some questions on SCE were value - more probably misinterpreted
- Pointed out weaknesses for you to improve upon before next assessment
- Question qualification and experience of assessors - Prefer to contract out to an organization experienced in assessments
- Too many of the assessors had hidden agendas. Revenge, getting even, etc.
- Assessments by trained personnel are fair and objective. Much goes into the process. Strengthens, and weaknesses are clearly defined. Other information provided for future improvement.
- Assessment was conducted in an impartial and professional manner.
- Assessment was a stressful time.
- Assessments helped set direction and identify soft areas in our software engineering processes.
- Provided areas where improvements could be made.
- Very thorough.
- Assessment was very fair.
- They have been conducted in a professional manner. It is a very good practice to interview workers separate from managers.

15. Please rate the usefulness of the System Modification Scenario as a process definition:

FSA/DSE	Total	Managers	SEPG Members	AIS Practitioners	Support Division	Other
FSACL	2.56	2	2.5	2.8	2.75	
FSACO	2.92	2.67	3	2.86	3.5	-
FSADE/ DSE-MP	2.56	1.9	1.67	2.83	2.67	
FSAIN	3.07	3.17	2.	3.17	2.88	2.91
			1 DK/NA	1 DK/NA	1 DK/NA	2 DK/NA
FSAKC	3.16	2.17	2.00	3.58	3.43	2.67
		1 DK/NA		4 DK/NA		1 DK/NA
FSAPE	3.21	3.0	3.25	4.33	2.33	
				3 DK/NA		

Comments:

- SMS is too detailed
- SMS is oriented to another site's process and doesn't impact daily work
- SMS is too bulky, complicated, difficult to read and follow. It should have more graphics. Templates for various mechanisms (SDP, SCM Plan, SQA Plan, status meeting agenda/minutes, checklists for SQA and/or CM audits, etc.) would have been helpful, but not the detailed expansive how-to narrative procedures. It appeared to be too detailed where it wasn't needed (how to set up a meeting) and not detailed enough where it was needed (what should be done in a baseline audit, what should be the outputs - even a sample of minimum information on a template).
- Conflicting direction on what had to be implemented in the SMS (i.e., task level versus procedure level) was frustrating and time-consuming. Most respondents' comments agreed that task level (the what) is the appropriate level for implementation. Lessons here may be getting more consultants early and at critical SPI program milestones at both an FSO-HQ and site level to help guide the direction and point out pitfalls to avoid.

- Sufficient for projects to use as a template to tailor their own process.
- I think the SMS is useful as a process definition for new development. It is not useful as a process definition for modification.
- I believe that the SMS is adequate for new development, but for maintenance, it is overkill.
- Had the communication and planning by FS senior management been better up front, the product, SMS, would have been better. Also, if the various FSA TWG members truly had equal input, the product would have been better received.
- The SMS is a good policy guideline, but since the assessments are based on the CMM, it is rather redundant or confusing. Procedures are totally tailored in any case; therefore, the SMS is generally superfluous.
- Adherence to the SMS resulted in consistent failure. Inadequacies relate directly to survey (question #1).
- Despite the fact that we are one "FSO," we are many different systems (size, platforms, sites) with many different customers. It is very difficult to put this in one book.
- I consider the SMS sufficient as a starting point. To some, areas of the SMS were misleading - example, estimation.
- It's fine as an overall FSO policy, but not quite as useful as a software process definition tool. The CMM better defines the necessary goals and should be stressed more.
- The SMS is an extremely detailed manual. In the early stages, it was quite confusing as to which manual to use in pursuing Level 2 objectives (SMS versus CMM).
- Goes way overboard on creating an inadequate amount of overhead which does not enhance or add value to the system goals. Too rigid in requiring too much.
- Too hard to follow, repetitive, and inadequate in reaching Level 2. Some parts were useful but as a whole the document went into too much detail.
- Some pieces of the SMS were useful in improvement activities once you could find them. The format structure and inflexible nature of the document made it unwieldy and practically impossible to use. An organizational process must be flexible enough for each project to tailor it to its specific needs, customers, etc.
- Not bad to use as a starting point or template, but still required a lot of other work to get to Level 2. Too many CMM areas not covered. NOT USER FRIENDLY!
- As with anything written by a lot of people, then compiled together, the document is uneven - some places have too much detail - others not enough. It's better than its reputation would suggest, but I find it criminal that FSO ignored the problem that implementing the SMS did not make the site CMM Level 2.
- The SMS is difficult to follow, is too procedurally based, and tries to mandate standardization.
- Lots of good information, not the easiest document to read.
- The SMS tended to get too far into the day-to-day operations on some areas. This appeared to stem from the SMS author FSA's frame of reference to their local system and didn't seem to take the basics into account such as the difference in size of a local or FSO-wide AIS versus service-specific pay related systems.
- Too big, bulky, way too much detail. Outline the intended function and the results you desire (CM - version control, etc.) and then step back and let the individual activities fulfill these processes according to their specific needs. Audit periodically by FSO.
- At first, seemed painful and redundant. After working with it, could see the elegance. Good procedures model, but will not get an AIS versed in CMM or to Level 2.
- "PTR" in SMS should be changed to Program Trouble Report to match CMIS terminology.
- It needs to be flexible. Not every project is the same. What works for one may not be cost-effective for another.
- Haven't worked with this much.

- FSO/FSA management focused too much on SMS for reaching Level 2. Lost site of CMM. Evaluations against CMM.
- Could have developed own procedures faster.
- Too repetitious. Too cut and dried. Leaves no room for tailoring to the AIS. Seems to put a straight jacket on the CMM.
- I have one
- Explains overall process, but each project must devote resources to interpret document, and train the team.
- A hindrance to higher levels. Not CMM-compliant. Replace with generic SDP that addresses process
- Most of it should make us more inefficient.
- Incomplete. Should be tied completely to CMM.
- Why do we not follow the book instead of making up our own version? How does CMM fit in?
- Probably would be very good if properly managed and people had some idea of how it worked and it could be explained clearly and sensibly.
- It required a lot of interpretation and translation in order to be useful.
- Too many things at once. Oversold as the cure-all. Didn't fit well with production support or system development.
- SMS is a good tool. Proved to be helpful in understanding CMM. However, CMM is what rated against. Differences in interpreting the two documents caused problems. CMM is what we must master.
- It is totally relevant to my job.
- Usefulness depends on implementation within the project. If implementation is poor, SMS is seen as a detriment.
- I think the overall process is a sound concept, but it is difficult to implement within.
- SMS covers what is needed to define, fix, and change our software. It does seem wordy but covers the SMS
- If all facets are adhered to, and the customers, who do not fall under the SMS umbrella, understand what we are doing, SMS can and will be an excellent tool. If not, it will be an exercise in futility.
- Lacks CMM requirements to meet Level 2.
- Needs to be formatted for use by all involved and contain the information necessary to implement, i.e., checklists, timelines, process flows, etc.
- For our AIS, we are instructed to also follow Military Standard 498.
- Needs to be interpreted for clarity.
- Found it to be very beneficial as a starting and reference point for standardized procedures.
- Good for complex changes, complicated and too involved for most (shorter, simpler) SCRs
- This increase paperwork. Slow down processing. Increase possible mistakes because of added steps. Increase uncertain for trying to learn so many processes.
- Very good concept. Implementation time is not sufficient to ensure not just compliance, but sufficient knowledge of the process is acquired to be successfully repeatable
- There is no documentation on how to use the process. There has been little "buy in" by the end user of the process.
- Format useful as checklist for tasks/subtasks to perform. Some terminology is difficult to understand.
- Doesn't have CMM stuff in it. Evaluations are based on CMM. SMS won't get you there.
- What can be said for something that slows the process to its crawl.
- Version 3 was a better product than Version 4.
- It's awfully big and cumbersome.

- Too many options.
- The DCPS project uses the high level steps identified in the SMS.
- Presentation method not effective. Some very good concepts and practices contained therein but needs to be supplemented with graphics and other presentation techniques to communicate better.
- It provided good procedural assistance where we were short. Initially, the format was an obstacle to usefulness. Much better now.
- The SMS contains all the processes for Level 2, some at more level of detail than others.
- The process tends to bog down in minute details that sometimes don't seem to pertain to the work at hand. It does, however, allow for exceptions when necessary.
- Too hard to follow, read, implement, and not realistic.
- Too lengthy to use effectively.

16. Please list any additional comments on Software Process Improvement:

- SPI seems to be an academic exercise for systems phasing out
- Not convinced that SPI is worth the cost in time and resources
- Change agents and sponsors at the local level need training and regular periodic consultation support
- The SMS needs to be more streamlined and graphical with templates
- The SPI program process (and the SEPG) should provide more samples of what the procedures and plans should contain early on (versus after-the-fact evaluations by SEPG and SCE teams - pointing out the shortcomings).
- Develop SPI infrastructure early (PAL; samples; training of sponsors, change agents, and development staff; streamline status reporting method and format; identify related metrics - usable for site and HQ).
- Work out strategy and tactics so people aren't overloaded with changes (CMIS, SPI, Metrics, FPA, etc.)
- Perform pilots to work out kinks in the process
- FPA as a sizing mechanism is not cost effective for already established AISs, and does not help in comparing estimated to actual during development
- Positive aspects:
 - documented procedures
 - SQA processes and reviews
 - justification for FFPs and schedules
- I think we have gained some bit of control over our processes - however, the cost for this bit of improvement has been great. Increased time and paperwork have overshadowed the benefits gained and to be gained by SPI. Unfortunately, many of the benefits of SPI are masked, even totally hidden under the amount of process and documentation required to reach level.
- I was taught and believe that in the face of the inevitable consequences, it is better to say nothing than complain.
- As we move toward Level 3, emphasis on the SPI program needs to be renewed. Currently, inactive TWGs need to be reactivated and/or other TWGs started. SEPG/TWG representatives need an opportunity to rotate out of the duty or to state an interest in continuing in the same or a new SPI role.
- Must address cost of the program and as budgets get cut, this will be a bigger issue.
- SPI is a worthwhile initiative but sometimes it seems to take more time than the actual work. Perhaps with repetition, the extra time will be mitigated. Currently, it is too labor intensive.
- There is a great value in implementing disciplines of CMM, however, an objective evaluation of Level 2 implementation including cost effectiveness should be conducted before any other systems begin. This is especially true for smaller systems where all resources are tight.

- With current and future budget restraints looming on the horizon, personnel maintaining smaller projects feel that with additional SPI requirements levied on them may mean the demise of other projects. An overall FSO plan needs to be developed for SPI small system implementation guidance.
- SPI ideas have helped our organization to take the steps needed to improve our aged software development activities and procedures. DRAS software development procedures and activities have undergone a complete renovation. I do not believe that this level of change could have occurred in such a short time without an effort like SPI.
- Most of the objectives of SPI we were already doing in a less formal manner with a record of very few production problems. SPI has added elaborate procedures and formal documentation of every interim minor step taken for the sake of proof. We have just as many production problems now and we are just as dependent, if not more so, on expert individuals. SPI was also forced on us in a timeframe which did not allow institutionalizing or developing more automated tools. It was a much more painful process that it had to be. In summary, there is a tendency for SPI to become self-perpetuating as processes become more complicated, causing more human error and thus requiring more oversight and more procedures.
- Future process improvement efforts need to include the entire organization to succeed. The improvements that survived the push for the grade did so because the projects were involved in their development. This increased the buy-in and acceptance between the projects have a stake in the improvements. Most of the changes forced downward are struggling. Some are failing. The same will be true of future efforts, if more effort is not made to involve all affected parties. History is destined to repeat itself.
- I think the SCE process is very good. The team had to review and refine vast amounts of data. To be able to complete this task in such a short time is really an accomplishment. I thought there should have been more guidance as to what was passing and what was not instead of relying on personal opinions.
- The need for local Director support is great. The need for training in many support areas is also great.
- My belief is that some processes should be put in place to help improve our software development. We have done that for the most part. However, I believe that we need to eliminate some "paper shuffling" to allow for more effective time management in performing software development.
- Much more effort needs to be focused on fixing current process problems. Practitioner support is vital to successful change, and many practitioners are seeing too little improvement for too much work. Note: this is not about misplaced focus. This is about too narrow a focus. Both executive/management and practitioner needs need to be met, not one at the expense of the other.
- I believe we'll all be better off if we can get everyone to ask "How can I help to make this happen?" instead of "Why do I have to do this? a.k.a "Not another initiative."
- This is truly a great improvement and step in the right direction for the future.
- Too many "Chiefs" doing the work and not enough "Indians' involvement."
- Really need FSA director and division chief understanding. Direction and support to move up the maturity model. It makes all the difference. SPI takes time and cooperation plus special environment to take hold.
- Software shops, like SRD1, should not be required to do PCA. SRD1 does not produce any hardware. We should not hesitate to use the term "not applicable" when it is appropriate.
- We need more emphasis on measuring our progress. If we don't measure, we will never know whether SPI/CMM is working effectively and efficiently.
- Glad to see effort initiated, but need more open communication and involvement across the board. Worst thing we could do is let someone write procedures without

active involvement from those who must follow them. Standardization and repeatability great, but only if done so they are workable and efficient.

- SPI program managed by dates instead of ensuring processes correct. AISs given deadlines that don't consider many difficulties, risks, uniqueness. Hope FSO/FSA management would focus on improving processes which will improve products, but they continue "I'd rather have it on time" philosophy.
- Process was like blind leading blind until about Oct 96.
- Making slow progress. Seem to be going through motions, not really learning how to improve project. Much more cross functional involvement needed. No sense improving process if customer not brought in and continues to expect fire drill responses.
- Continue to improve - to be the best.
- I am very uncomfortable with all of this. I will do as ordered or requested to do.
- If our customers see this system as a money-consuming, time-wasting albatross, how soon will it be before we're sent packing and they're hiring an outside source to do the same job we could have done for them but cheaper with less demand for paperwork and absurd activities.
- Must happen
- Still several people who do not "buy in" to SPI program. Important for those involved in SPI to not criticize or bad-mouth program. More positive reinforcement might help.
- Just beginning program. Only morale problems so far. All general information does is make people feel they've got a lot to change. Smaller meetings geared to specific processes are better. Management should get everyone involved earlier in the process. People need to be better informed.
- There should be more work on streamlining the SPI process. Perhaps newer tools or better ways to conduct meetings could be developed. Since language and software differ for each mission, it is hard to have the same tools everywhere, but more examples might help.
- If I've done SPI activities, they've not been designated as such, so I don't know when I've done them.
- It obviously is being done by some people because I've heard of it, but if I'm involved, or it trickles down to my level, I'm not aware of it. In other words, I do what I'm told to do, but nothing has ever been presented as "supporting SPI"
- We are getting a lot of help and usefulness out of SMS. This is due to internal development only, not based on help or guidance from outside our branch.
- More specific training on reviews, audits, follow-up, writing plans.
- It appears that the push/support from the FSO is going away. I'm not sure what the value added is to going to Level 3, however, it is worth getting our AIS to Level 2.
- The jury's still out.
- Level of documentation should be reduced. Cost should be considered to ensure return on the investment in a relative or reasonable amount of time.
- Need more training. Need more involvement from FSO/SEPG. Need to have AISs that have reached Level 2 give their documents/processes to FSO/SEPG to give to other AISs trying to get to Level 2 instead of every AIS doing the same thing over and over.
- One problem exists and will continue to exist at all levels - if you develop a new system and use SPI from day 1, you will build a great AIS. As long as we are required to keep up with maintenance and new development on current AISs to the tune of a more than full work week for our limited resources, SPI implementation will take too long. Please understand what I see - SPI is the only way to go. Upper management must find and develop a better way for us to get there.
- Allow systems to satisfy the CMM without using SMS. I understand most of the FSAs did not use the SMS for their methodology. Why is FSAIN different?
- Overall, I believe there has been a high level of success. Everything can be improved. This process indicates an organization's maturity.

- In order to get SE and middle managers really on board, they need to have a say in how and when. Need process not date driven. Need recognition for positive behavior (we still reward heroes). How many people have received awards/recognition for following the process or involvement in SPI. Need proper training. Need FSO and FSA senior management support, not just words but real action, money, compromise. Management needs to lead and set the example (i.e., plan and track those plans). No crisis management.
- There is a subtle danger in believing a particular rating is the end of the story and that the hard work of improvement is behind us. A good example is the fact that few of the projects rated Level 2 practice configuration management with the rigor required to be truly effective.
- Continued software improvement requires corporate level policy and guidance. Although work has been done, additional work must be completed to allow FSO activities to advance in maturity.
- The whole SPI effort, more than anything else, helped establish a unifying sense of being across the FSAs and the FSO and brought us in common business and engineering processes.
- Needs to be managed through all projects with a corporate-wide vision versus individual projects or sites.
- This project was already utilizing the basic concepts of the SMS. The processes were repeatable and a relatively clean product was released to users. Utilizing the SMS required our group to generate a paper trail that was not previously in place, and hold regular formal status meetings. Communication between levels was improved.
- It seems to me that FSAPE should have SPI documented with all its "standards" for system development/maintenance and each application system should only need unique or addendum documentation requirements.
- SPI is very important and can lead to many benefits in areas of cost savings and customer satisfaction. It must be treated seriously and funded/staffed at an appropriate level to make it effective at each FSA.

APPENDIX C. INTERVIEW QUESTIONS

Initial Interview Questions for FSA-KC

- Why is SPI important to FSA?
- What incentives are there for you to support SPI?
- How can the SEPG help you?
- What are the anticipated hardspots in achieving CMM level 3?
- What incentives are there for you to adopt SPI initiatives?
- Are there external factors that enhance or detract from the effectiveness of SPI efforts?

Interview Questions for Director, FSA

- What is the mission of FSA?
- What can software process improvement do for FSA?
- What incentives are there for key management to champion SPI?
- What is the mission of the SEPG?
- What are the anticipated hardspots in achieving CMM level 3?

Follow-up Interview Questions for FSA-KC

- What concrete observable outcomes will result from the current process improvement efforts?
- Do the proposed changes make the employees' job easier or harder?
- Are the changes technically familiar to members of the organization?
- Was input from the section/branch personnel included in the formulation of the process improvement plan?
- What specific parts of the organization provide the most opportunity for increases in efficiency and quality?

- What systems need improving, (example technological systems, management systems, management practices, or organizational structures)?
- The most important thing to the leadership of FSA is..
- Whats does the director (FSA) say about SPI? What does he do?
- What does the center director say about SPI? What does she do?

Interview questions for Customer Representatives

- What are your initial impressions on software process improvement?
- Have you been briefed on SPI?
- Will SPI initiatives help you? In what way? Are you willing to pay for SPI efforts?

LIST OF REFERENCES

- Bridges, W., *Managing Transitions: Making the Most of Change*, Addison-Wesley, 1991.
- Card, D., "Understanding Process Improvement", *IEEE Software*, v. 8, pp. 102-103, July 1991.
- CDA DITSO-KC, Software Process Assessment Final Findings Briefing, 11 June 1993.
- Dalziel M. M. and Schoonover S. C., *Changing Ways: A Practical Tool for Implementing Change Within Organizations*, AMACOM, 1988.
- Department of the Air Force, Software Technology Support Center, *Guidelines for Successful Acquisition and Management of Software Intensive Systems*, 1996.
- Defense Finance and Accounting Service, Message, Subject: Draft FSA Realignment Plan, 3 March 1998.
- Douglas, E. L., and Cox G. M., "Implementing the Capability Maturity Model for Software Development," *Hewlett-Packard Journal*, pp. 1-11, August 1996.
- Dr. John Odmundson, *Handouts and Notes from Naval Postgraduate School, Software Engineering and Management*, IS4300, October 1997.
- Financial Systems Activity-Kansas City, Directors Goals and Commitments, October 2 1997.
- Financial Systems Activity- Kansas City, FSA-KC Overview, December 1997.
- Financial Systems Activity, Kansas City, FY 98 Customer Service Level Agreement Between Defense Finance Accounting Service Financial Systems Organization and United States Marine Corps, 5 December 1997.
- Financial Systems Organization, Marine Corps total Force System software Capability Evaluation Final Findings Presentation, 20 September 1998.
- Financial Systems Activity-Kansas City, Partial Software Capability Evaluation for Marine Corps Total Force System, Final Findings Report, February 14 1997.
- Hadden Rita, "Simple Ways to Succeed at Software Process Improvement." [<http://www.cris.com/~Cbodn/spi.htm>]. April, 1998.
- Humphrey, W. S., Snyder, T. R., and Willis, R. R., "Software Process Improvement at Hughes Aircraft," *IEEE Software*, pp. 11-23, July 1991.

Kness, Steven, P. and Satake, Mark, S., "A Level 5 Organization Looks at the Personal Software Process." [<http://stsc.hill.af.mil/CrossTalk/1997/oct/level5.html>]. May 1998.

Kotter, J., *Organizational Dynamics*. Addison-Wesley, 1981.

Lowry, M. D., "Software Engineering in the 21st Century", *AI Magazine*, Fall 1992.

Pasmore W. A., *Designing Effective Organizations: The Sociotechnical Systems Perspective*, John Wiley & Sons Inc., 1988.

Paulk M. C. and others, *The Capability Maturity Model: Guidelines for Improving the Software Process*, Addison-Wesley, 1995.

Quann, E. I., "Maturing Our Software Industry, Transforming the Workplace into a Learning Organization," paper presented at the Software Engineering Process Group Conference, Boston, Massachusetts, 23 May 1995.

Real Decisions Corporation, *Strategies for Improved Performance*, 1996.

Software Capability Evaluation for Marine Corps Total Force System, Final Findings Report, Oct 18, 1996.

Software Engineering Institute, *Process Maturity Profile of the Software Community, 1997 Year End Update*, May 1998.

Software Engineering Institute, CMU/SEI-95-TR-008, *Moving on Up: Data and Experience Doing CMM-Based Process Improvement*, by W. Hayes and D. Zubrow, August, 1995.

Software Engineering Institute, CMU/SEI-95-TR-009, *After the Appraisal: A Systematic Survey of Process Improvement, its Benefits, and Factors that Influence Success*, by D. R. Goldenson and J. D. Herbsleb, August 1995.

Software Engineering Institute, CMU/SEI-95-TR-017, *Raytheon Electronic Systems Experience in Software Process Improvement*, by T. Haley and others, November, 1995.

Software Engineering Institute, CMU/SEI-94-TR-22, *Software Process Improvement in the NASA Software Engineering Laboratory*, by F. McGarry and others, December, 1994.

Software Engineering Process Group, FSA-KC, *Software Process Improvement*, 25 March, 1998.

Wise Cindi, "Senior Management Actions Critical for Successful Software Process Improvement." [<http://www.processinc.com/execactn.html>]. April, 1998.

Yamamura, G., "Reflections on a Journey to SEI SW-CMM Level 5." paper presented at the Software Engineering Process Group Conference, Chicago, Illinois, 9-12 March 1998.

INITIAL DISTRIBUTION LIST

	No. of Copies
1. Defense Technical Information Center 8725 John J. Kingman Rd., STE 0944 Ft. Belvoir, VA 22060-6218	2
2. Dudley Knox Library Naval Postgraduate School 411 Dyer Rd. Monterey, CA 93943-5101	2
3. Director, Training and Education MCCDC, Code C46 1019 Elliot Rd. Quantico, VA 22134-5027	1
4. Director, Marine Corps Research Center MCCDC, Code C40RC 2040 Broadway Street Quantico, VA 22134-5107	2
5. Director, Studies and Analysis Division MCCDC, Code C45 3300 Russell Road Quantico, VA 22134-5130	1
6. Marine Corps Representative Naval Postgraduate School Code 037, Bldg. 234, HA-220 699 Dyer Road Monterey, CA 93940	1
7. Marine Corps Tactical Systems Support Activity Tactical Advisory Branch Attn: Maj J. C. Cummisky Box 555171 Camp Pendleton, CA 92055-5080	1
8. Dr. Susan P. Hocevar, Naval Postgraduate School Code SM/Hc 555 Dyer Rd. Monterey, CA 9393-5101	1

9. Dr. Mark E. Nissen.....	1
Naval Postgraduate School	
Code SM/Ni	
555 Dyer Rd.	
Monterey, CA 93943-5101	
10. Director, FSA-KC	1
1500 E. 95 St.	
Kansas City, MO 64127	
11. SEPG FSA-KC.....	2
1500 E. 95 St.	
Kansas City, MO 64127	
12. Wendell Bazemore	
1500 SE Princeton Circle	
Lee's Summit, MO 64081	1