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**EVALUATION OF  
PROCESS IMPROVEMENT EFFORTS WITHIN  
THE OFFICE OF RESEARCH AND  
ACQUISITIONS AND THE  
OFFICE OF AIR TRAFFIC SERVICES**

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**NAS Configuration Management and Evaluation Staff  
Program Evaluation Branch (ACM-10)**

**REPORT #2003-19**

**January 14, 2003**

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## Executive Summary

The integrated Capability Maturity Model (iCMM), developed by the Federal Aviation Administration's (FAA) Office for Information Services (AIO), provides the agency with a framework for ongoing process improvement. It integrates three single-discipline Capability Maturity Models (CMM) for Systems Engineering, Software Engineering and Software Acquisition as well as best practices and concepts from other process improvement standards such as the President's Quality Award, the Malcolm Baldrige National Quality Award criteria, and the Electronic Industries Association's Systems Engineering Capability EIA/IS 731 interim standard. The *Federal Aviation Administration Integrated Capability Maturity Model*<sup>®</sup> (FAA-iCMM<sup>®</sup>) was developed to guide the agency's improvement of its engineering, management, and acquisition processes in an integrated and effective manner.

On January 15, 2002, the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) requested the NAS Configuration Management and Evaluation Staff's Program Evaluation Branch (ACM-10) to conduct an evaluation of the impact and effectiveness of the FAA-iCMM<sup>®</sup> on process improvement within ARA and ATS.

The primary objectives of the evaluation were to determine; 1) if process improvement goals were being met and if they would continue to be met within ARA and ATS; 2) if process improvement efforts helped or hindered the fulfillment of ARA and ATS missions; and 3) if current process improvement practices needed to change and integrate with ARA and ATS business practices in order to ensure effectiveness and efficiency.

In conducting the evaluation, the team used a methodological approach that:

- Identified government and industry best practices and lessons learned related to effective process improvement efforts
- Analyzed how FAA-iCMM<sup>®</sup> process improvement was being implemented throughout the agency
- Conducted a gap analysis between the agency's process improvement practices and external best practices
- Identified 15 best practices to enhance the agency's process improvement efforts

As part of the data collection phase, the evaluation team interviewed a cross-section of individuals representing various programs and organizations throughout the ARA and ATS lines of business that had been directly or indirectly involved with FAA-iCMM<sup>®</sup> process improvement efforts. The team also collected data from organizations within

the aviation industry as well as other domestic government agencies. All of the data collected during the fieldwork phase were incorporated throughout the report.

## **Summary of Results and Findings**

Three major findings were derived from the analysis. First, process improvement goals were being met and should continue to be met within ARA and ATS. Second, the lack of measurement data on the impact of process improvement efforts made it impossible to determine if process improvement helped fulfill ARA and ATS missions. Third, there were some shortfalls identified in ARA and ATS process improvement practices that need to be corrected.

## **Recommendations**

It is recommended that the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1):

- Request that the Deputy Chief Information Officer, as the Chair of the integrated Process Group, ensure the establishment of measurable process improvement goals and a metrics program to evaluate the results of these process improvement goals on the missions of the organizations.
- Establish metric programs to evaluate the results of process improvement on the missions of the organizations under the auspices of the Chair of the integrated Process Group.

Further the team recommends that the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) re-evaluate their commitment to process improvement. If dedication to process improvement is one of the agency's current priorities, then it is recommended that the ARA-1 and ATS-1 ensure the incorporation of the best practices identified in this report (see page 14). This could be accomplished with the assistance of the Deputy Chief Information Officer, as the Chair of the integrated Process Group, in supporting process improvement and obtaining "buy-in" of all personnel for process improvement.

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## Introduction

### BACKGROUND

On January 15, 2002, the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) requested the NAS Configuration Management and Evaluation Staff's Program Evaluation Branch (ACM-10) conduct an evaluation of the impact and effectiveness of process improvement within ARA and ATS organizations.

Process improvement activity within the agency began in 1991 with a focus on software engineering. The software capability maturity model (CMM) was selected as the framework for the process improvement effort. A couple years later, the software engineering process group (SEPG) was developed to further champion process improvement efforts within the agency. It appeared that the FAA was having trouble getting executive "buy-in" for process improvement efforts. One of the first initiatives undertaken by the SEPG was to work with the Software Engineering Institute in establishing a baseline of the agency's process improvement efforts.

In 1996, the General Accounting Office conducted an audit of the FAA's acquisition practices using the Software Acquisition CMM as its framework. The audit had the positive side effect of exposing a lot more people to process improvement. Shortly thereafter, the ARA decided to consolidate the agency's process improvement efforts. It was then that the Office of Information Services (AIO) developed a single, robust process improvement model known today as the *Federal Aviation Administration Integrated Capability Maturity Model*® (FAA-iCMM®).

The FAA-iCMM® is an integration of the three separate CMMs for software, systems engineering, and software acquisition into a single reference model with consistent terminology, common improvement goals across the acquisition lifecycle, and standard process assets. Version 1.0 was released by the FAA in 1997 and Version 2.0 of the FAA-iCMM® was published in September 2002.

### OBJECTIVES

The primary objectives of the evaluation were to determine if:

1. Process improvement goals were being met and whether they would continue to be met within ARA and ATS.
  - The purpose of the ARA process improvement goal was to encourage the ARA Directors to identify and make improvements to selected process areas by implementing and institutionalizing the use of process improvement models. The improved processes would enable increased productivity,

- improvements in estimating cost and schedule, and the development of high quality solutions that would satisfy ARA, FAA and user needs
- ATS also participated jointly with ARA in working to achieve the ARA process improvement goals. In partnership with the Office of Information Services (AIO) and ARA, ATS supported efforts to achieve FAA-iCMM® capability and maturity level targets for selected teams/organizations/systems.
2. Process improvement efforts helped or hindered the fulfillment of ARA and ATS missions.
    - The ARA mission is to provide research, development, and acquisition for products and services that enable the FAA to enhance the safety and security of the NAS and satisfy current and future operational needs of the U.S. civil aerospace system for national and international operations.
    - The ATS mission is to ensure the safe and efficient operation, maintenance, and use of the current air transportation system, and to meet tomorrow's challenges to increase system safety, capacity, and productivity.
  3. Current process improvement practices needed to change and integrate with ARA and ATS business practices in order to ensure effectiveness and efficiency.
    - For the purposes of this evaluation, business practices were defined as routine planning, engineering, implementation, operation, and management activities necessary for an organization to carry out its function in an efficient and effective manner.

## **SCOPE AND METHODOLOGY**

The evaluation team focused on process improvement results using the FAA-iCMM® rather than the FAA-iCMM® itself.

In determining the impact the FAA-iCMM® process had on process improvement, the evaluation team used anecdotal data as a basis for the findings of the evaluation rather than quantitative data because of the lack of quantitative measurement data associated with process improvement. Version 1.0 of the FAA-iCMM® did not require process improvement metrics to be collected until a program achieved maturity level 3. FAA-iCMM® version 2.0 requires metrics to be collected when FAA-iCMM® maturity level 2 has been achieved. However, version 2.0 of the FAA-iCMM® will not completely replace version 1.0 until the end of fiscal year 2003.

The evaluation fieldwork was conducted from February 2002 through May 2002. In order to achieve the evaluation's objectives, 9 out of 45 programs/organizations identified by the Process Engineering Division (AIO-200) as implementing process improvement were selected for analysis. These programs/organizations were selected as a representative sample of the ATS and ARA lines of business. The five selected programs/organizations from within ARA were the Airport Surveillance Radar Model 11 (ASR-11) program (now transitioned to ATS as a part of the ATB

organization) and the Next Generation Air/Ground Communications (NEXCOM)<sup>1</sup> program, both within the Office of Communications, Navigation, and Surveillance Systems (AND); the Host and Oceanic Computer System Replacement (HOSCR) program and the Weather and Radar Processor (WARP) program, both within the Office of Air Traffic Systems Development (AUA); and the Laboratory Management Division<sup>2</sup> within the William J. Hughes Technical Center (ACT-400). The four selected programs/organizations from within ATS were the Air Traffic System Requirements Service (ARS) organization; the Office of Independent Operational Test and Evaluation (ATQ) organization; the AWOS (Automated Weather Observing System) Data Acquisition System (ADAS) program being supported by the Operational Support (AOS) organization; and the Standard Terminal Automation Replacement System (STARS) program from within the Terminal Business Service (ATB).

These programs/organizations were selected to provide a range of the following characteristics:

- criticality to the agency meeting its mission;
- current stages of their process improvement effort;
- organizational accessibility and support of the evaluation team's efforts to collect data;
- location within the ARA and ATS organizations; and
- current process improvement methodology.

The evaluation team rated each of the 45 programs/organizations based on the above criteria (see Appendix A for details on criteria and scoring). The team selected those with the highest scores taking into account other more specific selection criteria, such as programs that were working on improving their processes for some time (HOCSR and ASR-11), and those which had just recently integrated process improvement efforts (NEXCOM). In addition, one program was identified as having applied a large number of work hours toward process improvement (WARP), and two others were identified as being far along in their process improvement efforts and as having achieved success in process improvement (ATQ and ADAS) were included. The STARS program was also included because it is part of the ATB organization, which is a service-based organization, closer in structure to an Air Traffic Performance Based Organization than others in ARA and ATS. In addition, the ACT-400 organization was included because they had experience with both the FAA-iCMM® and the ISO 9000 process improvement model and had undertaken process improvement efforts utilizing both models. For additional details on the selection criteria, see Appendix A.

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<sup>1</sup> NEXCOM was not originally selected to participate in the evaluation. It replaced ASR-9/Mode S when it was discovered that the program was too early in its process improvement efforts.

<sup>2</sup> ACT-400 is now reorganized into various sections of the Office of Innovations and Solutions (ACB).

The evaluation team used the following methodological approach:

- Obtained and reviewed ARA Performance Plan reports.
- Collected data from the nine selected programs/organizations.
- Interviewed managers and employees who had knowledge of the process improvement efforts in each selected program/organization.<sup>3</sup>
- Sought out metric data from each organization on the results of process improvement efforts, but discovered it was not available and, therefore, were unable to obtain this quantitative data.
- Obtained and reviewed FAA-iCMM® process improvement appraisal documentation completed for each organization except ACT-400 and NEXCOM since ACT-400 switched early from using the FAA-iCMM® to the ISO 9000 model or in the case of NEXCOM was too early in their process improvement efforts utilizing the FAA-iCMM® to have had an appraisal completed.
- Researched external government and private sector organizations' process improvement lessons learned and best practices.
- Summarized data collected from the programs/organizations and then rolled the summaries up to the ARA and ATS level.
- Reviewed appraisal results and documentation.
- Analyzed the information and data collected to determine trends and findings. If there was no clear trend, the team weighted more heavily the information gathered during interviews from those individuals with the most knowledge of process improvement. Thus, if one employee was the lead or worked heavily on process improvement efforts within the reviewed organization his/her input was given more weight in the findings than those who had only superficial involvement in process improvement efforts when there was no agreement among those interviewed.
- Traced findings to the lessons learned and best practices researched from external government and private sector organizations.
- Developed conclusions and recommendations.

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<sup>3</sup> Due to union concerns no bargaining unit employees were interviewed in the ARS organization.

## Evaluation Results and Recommendations

The evaluation team conducted interviews of 40 individuals in a total of 9 programs/organizations to determine if process improvement goals were being met, if process improvement efforts helped or hindered the fulfillment of ARA and ATS missions, and if current process improvement practices needed to change and integrate with ARA and ATS business practices in order to ensure effectiveness and efficiency. The nine programs/organizations selected (based on the criteria described in Appendix A) were:

Line of Business	Organization/Program
ARA	Airport Surveillance Radar Model 11 (ASR-11) program from within the Office of Communications, Navigation, and Surveillance Systems (AND) (recently transitioned to the ATB organization within the ATS line of business)
	Host and Oceanic Computer System Replacement (HOSCR) program from within the Office of Air Traffic Systems Development (AUA)
	Weather and Radar Processor (WARP) program from within the Office of Air Traffic Systems Development (AUA)
	Next Generation Air/Ground Communications (NEXCOM) program from within the Office of Communications, Navigation, and Surveillance Systems (AND) <sup>4</sup>
	Laboratory Management Division within the William J. Hughes Technical Center (ACT-400) (now reorganized into various sections of the Office of Innovations and Solutions (ACB))
ATS	Air Traffic System Requirements Service (ARS)
	Office of Independent Operational Test and Evaluation (ATQ)
	AWOS (Automated Weather Observing System) Data Acquisition System (ADAS) being supported by the Operational Support (AOS) organization
	Standard Terminal Automation Replacement System (STARS) program from within the Terminal Business Service (ATB)

Only seven of the nine programs/organizations were implementing FAA-iCMM® process improvement model. One program (STARS) was implementing process improvement, but not based on any particular model. Another program (ACT-400) initially implemented FAA-iCMM®, but switched to implementing the ISO 9000 process improvement model.

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<sup>4</sup> NEXCOM was not originally selected to participate in the evaluation. It replaced ASR-9/Mode S when it was discovered that the program was too early in its process improvement efforts.

The evaluation team summarized the results of the 40 interviews by program/organization to determine the trends and answer the evaluation objectives. In several instances, the remarks of the individual with the most knowledge of process improvement efforts within the program or organization, e.g., the process improvement lead, was determined to be more credible and used as input to the result when no clear trend could be established from the information gathered from the interviews.

The results of the analysis support the first finding that process improvement goals were being met and should continue to be met within ARA and ATS. A description of the process improvement practices that assisted ARA and ATS in meeting their goals is provided in the finding.

A second finding is that a lack of available measurement data on the impact of process improvement efforts, made it impossible to determine if process improvement helped fulfill the ARA and ATS missions. As a result the return of investment for ARA and ATS process improvement efforts could not be determined. From the interviews, it was determined that employees were uncertain of what type of metric data to collect. It is recommended that the ARA and ATS work together with the Deputy Chief Information Officer, AIO-2, as the Chair of the integrated Process Group to establish a metric data collection methodology on process improvement efforts in order to mitigate this problem.

Finally, six shortfalls in implementing process improvement within ARA and ATS were identified and noted as the third finding. They included:

- a lack of managerial support and accountability for process improvement efforts,
- the perception that process improvement was a burden rather than a good business practice,
- little or no resources were allocated for the new requirement of process improvement,
- inconsistency of interaction between the Process Engineering Division (AIO-200) and those programs/organizations implementing process improvement,
- uncertainty of the FAA-iCMM® requirements by those that had undertaken process improvement efforts, and
- a perception that the use of FAA-iCMM® as a process improvement model was an ARA goal and did not apply equally throughout the agency.

It is recommended that ARA and ATS management re-evaluate their commitment to process improvement. If dedication to process improvement is one of the agency's current priorities, then it is recommended that the best practices identified on page 14 be incorporated into the ARA and ATS business practices.

## **FINDING 1: PROCESS IMPROVEMENT GOALS WERE BEING MET AND SHOULD CONTINUE TO BE MET WITHIN ARA AND ATS**

The finding that the process improvement goals were being met and should continue to be met within ARA and ATS was based on the ARA 2001 and 2002 performance reports and the information gathered from interviews.

The purpose of the ARA FY 02 process improvement goal was to encourage the ARA Directors to identify and make improvements to selected process areas by implementing and institutionalizing the use of process improvement models. The improved processes would enable increased productivity, improvements in estimating cost and schedule, and the development of high quality solutions that would satisfy ARA, FAA and user needs. ATS also participated jointly with ARA in working to achieve the ARA process improvement goals. In partnership with the Office of Information Services (AIO) and ARA, ATS supported efforts to achieve FAA-iCMM® capability and maturity level targets for selected teams/organizations/systems.

ARA's FY 01 performance report stated that 86 percent of the process improvement teams had met their process improvement milestones, the number of process improvement teams extending their process improvement capability increased by 52 percent, and the number of process improvement teams achieving increased process improvement maturity levels increased by 20 percent. In addition, ARA's FY 02 second quarter performance report stated that 85 percent of the process improvement teams had met their planned milestones, 88 percent of the process improvement teams had extended their process improvement capability, and projects took a multi-year approach to process improvement and concentrated on increased capability versus maturity level. The evaluation team was unable to obtain specific data on the performance results for the ATS continuous process improvement goals and relied on the data obtained from the interviews that indicated ATS was meeting their goals.

The evaluation team also found that among the people interviewed from the nine programs/organizations (HOCSR, WARP, NEXCOM, ASR-11, ACT-400, ADAS, ARS, ATQ and STARS):

- All indicated that their processes were documented. All emphasized in particular that the documentation of processes assisted employees and managers in understanding their roles and responsibilities and ensured that corporate knowledge would not be lost if individuals left the organization.
- All indicated that they implemented structured processes that were tailored to suit their organization's needs and that the tailoring was important to their process improvement efforts.

- Six (HOCSR, WARP, ACT-400, ADAS, ATQ and STARS) indicated that they actively engaged a majority of employees in at least some part of their process improvement efforts.
- Five (ARS, ATQ, ACT-400, ADAS and STARS) perceived that management actively supported process improvement efforts. This appeared to be key to successfully and effectively implementing process improvement based upon the results of the interviews and the investigation of best practices of external organizations.
- Four (ARS, ATQ, ACT-400 and ADAS) indicated that management accountability was incorporated into business practices as a result of process improvement efforts.

In addition, some of the ARA and ATS business practices assisted the programs/ organizations in effectively and successfully implementing process improvement. The evaluation team found these business practices utilized by the people interviewed from the nine programs/organizations (HOCSR, WARP, NEXCOM, ASR-11, ACT-400, ADAS, ARS, ATQ and STARS):

- Eight (HOCSR, WARP, NEXCOM, ASR-11, ACT-400, ARS, ATQ and STARS) indicated that general FAA-iCMM® or in-house specific training was provided to educate employees and indicated they found the training useful to implementing process improvement. Although ADAS stated they also received process improvement training, they did not believe it was useful.
- Seven (HOCSR, WARP, ASR-11, ACT-400, ADAS and ATQ) indicated that process improvement action plans and process description documents were leveraged from one program or organization to another. Specifically, four of five ARA (HOCSR, WARP, and ASR-11, ACT-400) programs/organizations leveraged documentation written at a higher organizational level or obtained from the integrated Engineering Working Group (iEWG) members. Two of four ATS (ADAS and ATQ) programs/organizations leveraged documentation obtained from the Process Engineering Division (AIO-200) or informally from other outside organization employees working on process improvement.
- Four of the seven programs/organizations that implemented FAA-iCMM® process improvement (HOCSR, ADAS, ATQ and ARS) indicated that they used their appraisal results to identify weaknesses in processes. (ATB/ STARS did not have an appraisal because they were not implementing FAA-iCMM® process improvement and ACT-400 was not included since it implemented the ISO 9000 process improvement model which requires certification, not an appraisal.)

- All indicated that process improvement working groups were created at the program level although these working groups varied in structure from the very formal to the informal. The work groups in ACT-400, ADAS and ARS were very formal; they were less formal in ATQ; and informal in STARS, HOSCR, WARP, NEXCOM and ASR-11.

The more formal working groups provided a chain of command and assigned roles that gave structure and provided more peer review to the processes. Within ARA, the iEWG, which provided leadership and technical expertise in managing and implementing process improvement initiatives, gave more structure and broader peer review than programs/organizations with informal groups. The iEWG also helped those programs that had insufficient number of employees to apply on process improvement.

## **FINDING 2: LACK OF MEASUREMENT DATA ON THE IMPACT OF PROCESS IMPROVEMENT EFFORTS MADE IT IMPOSSIBLE TO DETERMINE IF PROCESS IMPROVEMENT HELPED FULFILL THE ARA AND ATS MISSIONS**

During the interviews and data collection, repeated attempts were made to obtain quantitative metric data that might provide some evidence on the return on investment of ARA's and ATS' process improvement efforts and whether these efforts helped fulfill the ARA and ATS missions. For all nine programs/organizations metric data was unavailable for determining the results from implementing process improvement.

However, during the interviews some of the respondents did state that they thought process improvement helped ARA and ATS meet their missions.

The ARA mission is to “provide research, development, and acquisition for products and services that enable the FAA to enhance the safety and security of the NAS and satisfy current and future operational needs of the U.S. civil aerospace system for national and international operations.”

The ATS mission is to “ensure the safe and efficient operation, maintenance, and use of the current air transportation system, and to meet tomorrow's challenges to increase system safety, capacity, and productivity.”

Even among the organizations at or approaching FAA-iCMM® maturity level 3 there was no metric data available that could show process improvement efforts resulted in quantifiable return on investment. Version 1.0 of the FAA-iCMM® did not require process improvement metrics to be collected until a program achieved maturity level 3. FAA-iCMM® version 2.0 requires metrics to be collected in order to achieve FAA-iCMM® maturity level 2. However, version 2.0 of the FAA-iCMM® will not completely replace version 1.0 until the end of fiscal year 2003.

Despite the lack of hard data, some anecdotal evidence from the interviews indicated that process improvement did have a positive impact on fulfilling the mission of ARA and ATS. Specifically, some interviewees from seven of the nine programs/organizations (HOCSR, WARP, ASR-11, ACT-400, ARS, ATQ and ADAS) stated that processes were streamlined, standardized, and documented and that this in many cases resulted in a better understanding of everyone's roles and responsibilities. It was, however, not possible to determine the return on investment (ROI) since the program/organization was unable to quantify the impact of process improvement. Consequently, the evaluation team was unable to provide quantitative information on ROI for management to use in establishing process improvements among its many priorities.

The evaluation team concluded that if processes were streamlined, standardized and documented less time would be needed to complete the work or relearn a process and

the repeatable process can be performed in less time, with less effort. The team also determined that if roles and responsibilities were clearer to both managers and employees the work could be accomplished more effectively and efficiently since time did not have to be spent deciding who did or was responsible for a procedure. The anecdotal information gathered was not sufficient to lead the team to conclude that process improvement was specifically helping ARA and ATS meet their missions.

Ideally, the type of data that should be collected needs to be determined and plans for capturing the data need to be made from the beginning of process improvement implementation efforts. One of the reasons given for metrics not being collected, especially among those interviewed who were most committed to process improvement, was a lack of understanding of what type of data should or could be collected that would provide information on the results of implementing process improvement. Individuals stated that practical help, both in determining the types of metrics, collecting metrics and in other areas of process improvement, was not always available to those working on process improvement.

**Recommendation:**

It is recommended that the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1):

- Request the Deputy Chief Information Officer, as the Chair of the integrated Process Group, ensure the establishment of measurable process improvement goals and a metrics program for evaluating the results of these process improvement goals on the missions of the organizations.
- Establish metric programs to evaluate the results of process improvement on the missions of the organizations under the auspices of the Chair of the integrated Process Group.

It is also suggested that the integrated Process Group develop a means for providing practical assistance to those trying to collect process improvement metric data. More emphasis should be placed on plans to collect metrics from the implementation stage of an organization's process improvement efforts.

### **FINDING 3: SOME SHORTFALLS IDENTIFIED IN ARA AND ATS PROCESS IMPROVEMENT PRACTICES NEED TO BE CORRECTED**

During the interviews and data analysis, the evaluation team identified six shortfalls in the implementation of process improvement within ARA and ATS. These shortfalls were then compared and ranked with external best practices of other government and private sector organizations that attempted implementation of process improvement. Below is a list of the detected gaps among the nine programs/organizations (HOCSR, WARP, NEXCOM, ASR-11, ADAS, ARS, ATQ and STARS).

- Three (WARP, NEXCOM and ASR-11) lacked managerial support and accountability for process improvement efforts contributing to negative employee sentiment for process improvement.
- Three (WARP, NEXCOM and ASR-11) had the perception that process improvement was an additional burden rather than a good business practice. Personnel stated that in their opinion process improvement efforts detracted from important tasks and that process improvement would not improve how they conducted business.
- All cited a lack of additional funding and staffing for process improvement efforts. Personnel stated that they considered process improvement to be a new requirement, very labor intensive, and that the programs did not have the resources to initiate process improvement since they were operating under budgets established prior to the addition of the process improvement requirement.
- Six (HOCSR, WARP, NEXCOM, ASR-11, ADAS and ATQ) listed inconsistent interaction with AIO-200. Some personnel stated that it was difficult to get the type of assistance needed because AIO-200 did not understand the programs. Personnel also stated there was inconsistency in expertise and assistance provided by AIO-200 during implementation of the FAA-iCMM® or during appraisals.
- Four (HOCSR, WARP, NEXCOM and ASR-11) were uncertain of the FAA-iCMM® requirements and expectations during implementation of the model and during the appraisal process. Some personnel did not know what generic practices or artifacts were and did not understand how particular process areas applied to their organization. Further, interviewees stated that they were unable to obtain practical guidance in implementing process improvement and misinterpreted questions or terminology used during the appraisals.
- Two (WARP and NEXCOM) perceived unequal application of the requirement for FAA-iCMM® process improvement throughout the agency. Personnel stated

they thought the use of the FAA-iCMM® for process improvement was an ARA goal instead of an agency goal because they did not see non-ARA programs/organizations participating in process improvement efforts using the FAA-iCMM®.

From the review and analysis of best practices used by external organizations, 15 were selected as particularly relevant for integration into ARA and ATS best practices. (See Appendix C for a list of additional best practices identified during the evaluation.) It should be noted that the application of these practices might vary among the programs and/or organizations. The following is a list of these 15 best practices.

- Define program product goals before initiating process change.
- Conduct Executive/Program Management Process Awareness training.
- Ensure management “rolls up their sleeves” and participates in process improvement efforts.
- Create a process management group to determine how to conduct return on investment analysis on process improvement efforts.
- Conduct trend analysis of process improvement efforts.
- Assess the return on investment derived from process improvement.
- Conduct a “year-end” process review.
- Establish a management steering committee per project.
- Develop a yearly process improvement plan.
- Establish an agency process infrastructure.
- Establish process improvement discussion forums.
- Develop a standard set of training courses designed to provide all personnel with the information needed to function effectively.
- Establish an Internet accessible library of process-related assets for use throughout the agency.
- Ensure funding and resources are provided for process improvement efforts.
- Treat process improvement as a program.

The six shortfalls previously identified as major impediments to successful and effective implementation of process improvement were corroborated by observations from lessons learned of other government and private sector organizations that had implemented process improvement. Some of these lessons learned are listed below.

- Management should be convinced of the value of process improvement.
- Management commitment should come from all levels.
- Upper management should clearly emphasize the priority of process improvement.
- Middle management should give active and visible support to process improvement and the internal groups that implement it.

- Separate funding should be provided to ensure process improvement efforts receive the attention and support it deserves.
- Reasons for implementing process improvement should be known by all to ensure “buy-in.”
- Process improvement should be viewed as a standard business practice.
- Organization’s goals for implementing process improvement should be viewed as improving the way the organization conducts business, not as a means to achieve a specific maturity level.
- Visibility of process improvement efforts should be maintained to keep personnel aware of process improvement goals.
- Process improvement policy and requirements should be clear and concise.

Finally, the team observed another example of shortfall corroboration from the internal best practices review of ACT-400. Specifically, planning and leadership were demonstrated as instrumental to the success of implementing process improvement in that organization. Originally ACT-400 was reviewed by the evaluation team to assess its process improvement experience and whether the use of ISO 9000 model instead of FAA-iCMM® made any difference to the success of process improvement implementation. The evaluation team concluded that it did not make a difference. ACT-400 took steps prior to implementing process improvement: they identified a need to improve quality and benchmarked external quality management systems to determine if implementing the ISO 9000 process improvement model would be more beneficial than the FAA-iCMM® process improvement model. Prior to implementing ISO 9000, they projected benefits from the proposed use of process improvement based on benchmarking and presented this to management and employees to ensure both parties’ support and “buy-in.” The evaluation team determined that management understood the importance of managerial and employee “buy-in” and the need to constantly reinforce the objectives of process improvement efforts and their projected benefits to the employees.

**Recommendation:**

It is recommended that the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) re-evaluate their commitment to process improvement. If dedication to process improvement is one of the agency’s current priorities, then it is recommended that the ARA-1 and ATS-1 ensure the incorporation of the best practices listed above. This could be accomplished with the assistance of the Deputy Chief Information Officer, as the Chair of the integrated Process Group, in supporting process improvement and obtaining “buy-in” of all personnel for process improvement.

**Suggestion:**

It is suggested that one approach to improving the ARA and ATS process improvement efforts is to regard process improvement as analogous to a formal program. In essence, process improvement implementation should have approved goals, baselines, schedules, progress reviews and tracking. This should help to ensure necessary resource allocation for funding and staffing. In addition, expectations would be clearly communicated; thereby, ensuring managerial and employee support and participation. Furthermore, it would define the process improvement goals and determine the appropriate metrics for assessing process improvement results.

## Appendix A: Evaluation Organization Selection Criteria

A representative set of diverse ARA and ATS organizations were selected for review of their process improvement efforts based on the “Evaluation Selection Organization Methodology” that was created by the ACM-10 evaluation team. According to this methodology, all candidate programs/organizations from ARA and ATS were judged and scored based on the following five characteristics:

- Business criticality
- Current state of process improvement efforts
- Organization accessibility
- Organization location
- Current process improvement methodology

Rating organizations using these five characteristics ensured that the selected programs/organizations would have a varying level of business criticality, be at various points within the process improvement efforts, be relatively accessible and supportive of the team’s efforts to collect data, and would be following FAA-iCMM® or other process improvement methodologies.

The evaluation team rated all candidate organizations on each of the five characteristics. Each characteristic was rated on a scale from one to three, where a one was considered to be low and a three was considered to be high. Each organization’s ratings were compiled and the candidate organization list was narrowed down to 10 organizations. The team further narrowed the organizations and ensured the selection of those that were representative of all aspects of process improvement efforts within ARA and ATS.

The table below states the rationale of choosing each of the nine programs/organizations that participated in the Process Improvement Evaluation.

<b>Organization</b>	<b>Rationale</b>
AND NEXCOM	ASR-9/Mode S Service Life Extension Program (SLEP) was originally chosen to participate in the evaluation because it had recently commenced its FAA-iCMM® process improvement efforts. The program was scheduled to undergo its first FAA-iCMM® appraisal in September 2002 on the Project Management, Risk Management, and Measurement/Analysis Process Areas. The program was also chosen because it received all “green lights” during its most recent status review. During the interview process it was determined that ASR-9 was too early in its process improvement efforts and the Next Generation Air/Ground Communications (NEXCOM) was chosen to replace ASR-9 since it was also in the implementation stage of process improvement, but far enough along to provide some data on the process improvement efforts.
AOS-540/ADAS	AOS-540/ADAS was chosen to participate in the evaluation because it was relatively far along in its FAA-iCMM® process improvement efforts. In August 2001, this organization achieved FAA-iCMM® Maturity Level 2 accreditation.
ATQ	ATQ was chosen to participate in this evaluation because it was far along in its process improvement efforts. This organization achieved FAA-iCMM® Maturity Level 2 accreditation in September 2000. In August 2001, it underwent a questionnaire-based appraisal by the AIO for the Peer Review and Training Process Areas in Capability Level 3.
ACT 400	ACT 400 was chosen to participate in the evaluation because it was one of the few organizations to have achieved ISO 9001 accreditation within either ARA or ATS and was known to be a success. The organization has also positioned itself through its participations with other Technical Center organizations to become certified at FAA-iCMM® Capability Level 2 in Configuration Management and Equipment Transition.

<b><u>Organization</u></b>	<b><u>Rationale</u></b>
AUA WARP	WARP was chosen to participate in this evaluation because it was relatively far along in its FAA-iCMM® process improvement efforts. In March 2000, this organization underwent a formal FAA-iCMM® Maturity Level 2 appraisal by the AIO, however this organization was not compliant in all process areas. In October 2000, the organization underwent an appraisal of those process areas that were non-compliant during the first appraisal. WARP was also selected because the project had spent a large number of work hours on process improvement.
ATB STARS	STARS was chosen to participate in this evaluation because it was the only acquisition within the ATB organization that has participated in process improvement and scored high in the selection criteria rating. ATB also has an organizational structure that is similar to one projected for the new ATO organization.
AUA HOSCR	HOSCR was chosen to participate in this evaluation because it was relatively far along in its FAA-iCMM® process improvement efforts. In September 2001, this organization achieved FAA-iCMM® Maturity Level 2 for Capability Level 2.
ARS	ARS was chosen to participate in this evaluation because the organization as a whole had fully embraced FAA-iCMM® process improvement. In April 1999, the AIO conducted a full FAA-iCMM® Maturity Level 2 appraisal of the organization, however only 2 process areas were judged to be compliant.
AND ASR-11	ASR-11 was chosen to participate in this evaluation because it was far along in their process improvement efforts. In March 2000, this organization underwent a formal FAA-iCMM® Maturity Level 2 appraisal by the AIO, however this organization was not compliant in all process areas. In October 2000, the organization underwent an appraisal of those process areas that were non-compliant during the first appraisal. ASR-11 was also selected as an additional AND organization to be more representative of an AND program since the other AND program selected was in the implementation stage of process improvement.

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## **Appendix B: Additional Improvement Considerations**

The tables on the subsequent pages describe the improvements and suggestions that the team identified during the evaluation and provided to further assist those wanting additional areas to focus for improvement other than the best practices recommended in finding three. In column one the following table depicts these improvement considerations. The objectives in column two identify the main goals for the improvement consideration. Column three identifies suggestions on how to achieve the objectives in order to implement the improvement considerations. Appendix C also includes these improvement considerations tied to the external best practice, source and a description of the best practice.

## IMPROVEMENT CONSIDERATION

## OBJECTIVES

## SUGGESTIONS

### 1. COMMUNICATE PROCESS IMPROVEMENT GOALS, BENEFITS, AND EXPECTATIONS

- ▶ Communicate clearly goals, benefits, and expectations of process improvement efforts at all levels of the agency
- ▶ Standardize mission of process improvement throughout the agency
- ▶ Develop and communicate business case for implementing process improvement
- ▶ Ensure managerial and employee support for process improvement efforts
- ▶ Monitor progress of process improvement efforts against process improvement goals

- ▶ Ensure process improvement goals align with organizational mission
- ▶ Develop a yearly process improvement plan at the program and directorate level
- ▶ Augment current process awareness training for all levels of management to include the business case for conducting process improvement
- ▶ Designate a member of their staff to work with individual programs and directorates during their process improvement efforts
- ▶ Re-evaluate the roles and responsibilities of working groups within the process organization infrastructure
- ▶ Treat process improvement as a program (i.e. plan, track, and enforce milestones)

### 2. CONTINUE METRICS CAPTURE

- ▶ Capture key metrics across the acquisition and program lifecycle
- ▶ Use metrics to generate a program baseline prior to initiating process improvement efforts

- ▶ Continue to identify and define best practice metrics that will help evaluate the benefits derived from process improvement efforts
- ▶ Capture best practice metrics

### 3. EVALUATE BENEFITS OF PROCESS IMPROVEMENT EFFORTS

- ▶ Assess the effectiveness of process improvement efforts within programs, directorates, lines of businesses, and the agency as a whole
- ▶ Evaluate Return on Investment (ROI) derived from iCMM process improvement program based on metrics captured

- ▶ Determine how to calculate and define ROI in order to evaluate the effectiveness of process improvement efforts
- ▶ Conduct ROI analysis on process improvement efforts using metrics captured
- ▶ Conduct trend analysis of completed process improvement efforts to track the impact of specific process changes at the directorate and line of business level

IMPROVEMENT CONSIDERATION	OBJECTIVES	SUGGESTIONS
<p>4. INCREASE VERTICAL AND HORIZONTAL COMMUNICATION</p> 	<ul style="list-style-type: none"> <li>▶ Communicate and review current process improvement initiatives throughout all levels within the agency</li> <li>▶ Facilitate discussion about process improvement practices, issues, and concerns between managers and practitioners</li> </ul>	<ul style="list-style-type: none"> <li>▶ Provide regular agency-wide process improvement bulletins via email to communicate and review current process improvement efforts</li> <li>▶ Establish process improvement discussion forums and brown-bag lunches that are open to all individuals to communicate and review process improvement efforts</li> </ul>
<p>5. CAPTURE LESSONS LEARNED DURING PROCESS IMPROVEMENT</p> 	<ul style="list-style-type: none"> <li>▶ Share process improvement lessons learned by internal programs as well as external agencies during process improvement efforts</li> <li>▶ Reuse experiences to improve process improvement implementation</li> </ul>	<ul style="list-style-type: none"> <li>▶ Document and share lessons learned during internal process improvement efforts</li> <li>▶ Collect, document, and share external best practices from other government agencies and commercial industry</li> </ul>
<p>6. IMPLEMENT KNOWLEDGE REPOSITORY</p>	<ul style="list-style-type: none"> <li>▶ Implement knowledge repository where all insight, best practices, and completed process documentation can be retained</li> <li>▶ Facilitate the sharing and reuse of process documentation</li> <li>▶ Provide forum for programs and directorates to collaborate during process improvement efforts</li> </ul>	<ul style="list-style-type: none"> <li>▶ Establish a browser-based library of process-related assets for use throughout the agency to facilitate the sharing of documentation, best practices and lessons learned during process improvement efforts               <ul style="list-style-type: none"> <li>• Should allow for the uploading and downloading of process documentation</li> <li>• Should provide a collaborative environment (i.e. bulletin board) where programs and directorates can provide and solicit feedback on process documentation</li> <li>• Should be similar to the AMS FAST web site</li> </ul> </li> </ul>

**IMPROVEMENT  
CONSIDERATION**

**OBJECTIVES**

**SUGGESTIONS**

7. **ALLOCATE  
RESOURCES TO  
PROCESS  
IMPROVEMENT  
EFFORTS**

- ▶ Ensure adequate staffing and funding is available for process improvement efforts

- ▶ Identify the scope of process improvement efforts to determine the necessary funding and staff
- ▶ Identify the source of funds for process improvement efforts
- ▶ Allocate resources to process improvement efforts during investment analysis process (i.e. prior to JRC approval)

8. **IMPROVE PROCESS  
IMPROVEMENT  
TRAINING**

- ▶ Implement and commit to a structured and comprehensive training program for process improvement efforts
- ▶ Ensure managers and employees understand how to apply process model
- ▶ Ensure managers and employees have a thorough understanding of process improvement efforts

- ▶ Develop a standard set of practical training courses that are designed to provide all personnel with the information needed to initiate and sustain process improvement
  - Conduct process tailoring workshops to ensure managers and practitioners understand how to apply the process model so that it meets their organizational objectives
  - Conduct process area training to ensure practitioners understand the objective of each process area

9. **MONITOR  
COMPLIANCE TO  
PROCESS MODELS**

- ▶ Ensure continued adherence to process requirements
- ▶ Evaluate process maturity

- ▶ Conduct periodic process maturity self-assessments to monitor compliance to the process models
- ▶ Submit regular process improvement status reports to the lines of business leads and AIO
- ▶ Task a working group within the process organization infrastructure to conduct regular re-validation assessments to ensure adherence to process requirements
- ▶ Increase the frequency of re-validation assessment by a working group within the process organization infrastructure

## Appendix C: External Best Practices

The evaluation team contacted other government agencies as well as private industry for information about their process improvement efforts. The objective of this data collection was to determine how other organizations implemented process models. The evaluation team documented the relevant results as best practices.

The following table is a list of the improvement considerations from Appendix B and the corresponding best practices that can be implemented to achieve the improvement consideration. Another table with a brief description of each best practice follows this matrix. The evaluation team considered a number of best practices, however only those that are directly applicable to one or more of the improvement considerations are included in this appendix.

Improvement Considerations	Source	Best Practice
Communicate Process Improvement Goals, Benefits, And Expectations	Raytheon Electronic Systems	<ul style="list-style-type: none"> <li>Establish a process organization infrastructure</li> <li>Conduct a 'year-end' process review</li> <li>Ensure involvement by the line managers in process improvement efforts</li> </ul>
	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>Designate a senior-level official to oversee process improvement efforts</li> </ul>
	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>Define product goals before initiating process change</li> </ul>
	Tinker Air Force Base, Oklahoma	<ul style="list-style-type: none"> <li>Establish a management steering committee</li> <li>Develop a yearly process improvement plan</li> <li>Ensure that management "rolls up their sleeves" and participates in process improvement efforts</li> </ul>
	Scott Air Force Base, Illinois	<ul style="list-style-type: none"> <li>Treat process improvement as a program</li> <li>Designate member of Process Improvement Group to work with project team</li> <li>Implement rewards program for those who participate in process improvement efforts</li> </ul>
Continue Metrics Capture	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>Develop a metrics program</li> </ul>
	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>Use metrics to generate the baseline prior to initiating process improvement</li> </ul>
	Raytheon Electronic Systems	<ul style="list-style-type: none"> <li>Establish a metrics program to evaluate the effects of process improvement</li> </ul>
Evaluate Benefits of Process Improvement Efforts	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>Create a Process Management Group to conduct ROI Analysis on process improvement efforts</li> </ul>
	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>Produce a baseline of process and practices prior to initiating process improvement</li> <li>Conduct trend analysis of completed projects</li> <li>Assess the return on investment derived from the process improvement program</li> </ul>
	Process Impact	<ul style="list-style-type: none"> <li>Process improvement should start with an assessment</li> </ul>
	Scott Air Force Base, Illinois	<ul style="list-style-type: none"> <li>Conduct pre-assessment of process maturity</li> </ul>
Increase Vertical and Horizontal Communication	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>Report periodically on process improvement progress</li> </ul>
	Raytheon Electronic Systems	<ul style="list-style-type: none"> <li>Provide regular process improvement bulletins</li> </ul>
	Scott Air Force Base, Illinois	<ul style="list-style-type: none"> <li>Establish process improvement discussion forums</li> </ul>

Improvement Considerations	Source	Best Practice
Capture Lessons Learned during Process Improvement	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>• Share lessons learned during process improvement efforts</li> <li>• Implement a comprehensive benchmarking program</li> </ul>
	Raytheon Electronic Systems	<ul style="list-style-type: none"> <li>• Capture lessons learned</li> <li>• Develop a benchmarking program</li> <li>• Incorporate a set of “best of the best” practices into process documentation</li> </ul>
	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>• Develop an organizational infrastructure to capture experiences and collective learning</li> </ul>
Implement Knowledge Repository	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>• Establish a library of process-related assets for use throughout the company</li> </ul>
	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>• Reuse experiences to improve subsequent tasks</li> </ul>
	Raytheon Electronic Systems	<ul style="list-style-type: none"> <li>• Develop a process repository</li> </ul>
	Scott Air Force Base, Illinois	<ul style="list-style-type: none"> <li>• Develop an online Process Asset Library (PAL)</li> </ul>
Allocate Resources to Process Improvement Efforts	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>• Dedicate resources to process improvement efforts</li> </ul>
	Raytheon Electronic Systems	<ul style="list-style-type: none"> <li>• Identify a source of funding for process improvement efforts</li> </ul>
	Tinker Air Force Base, Oklahoma	<ul style="list-style-type: none"> <li>• Ensure that funding is provided for process improvement efforts</li> </ul>
Improve Process Improvement Training	Bull HN	<ul style="list-style-type: none"> <li>• Increase training time</li> </ul>
	Hughes Aircraft Company	<ul style="list-style-type: none"> <li>• Conduct Process Tailoring Workshops</li> <li>• Conduct Executive/Program Management Process Awareness Training</li> </ul>
	NASA Software Engineering Laboratory	<ul style="list-style-type: none"> <li>• Develop a standard set of training courses to provide all personnel with the information needed to function effectively</li> </ul>
Monitor Compliance to Process Models	Motorola GED	<ul style="list-style-type: none"> <li>• Each project performs a quarterly CMM self-assessment</li> </ul>
	Tinker Air Force Base, Oklahoma	<ul style="list-style-type: none"> <li>• Develop an independent Quality Assurance function</li> <li>• Conduct annual process audits</li> </ul>

## DESCRIPTION OF BEST PRACTICES

<p><b>Best Practice: Establish A Process Organization</b> <i>Organization: Raytheon Electronic Systems</i> Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations Description:</p> <ul style="list-style-type: none"><li>• Raytheon's process organizational infrastructure consisted of four entities: an executive committee to provide direction and oversight, working groups specializing in each of the major process areas involved in process improvement, task teams to develop the actual process changes that achieve the improvements, and an SEPG manager to monitor and coordinate day-to-day progress.</li></ul>
<p><b>Best Practice: Conduct a 'Year-End' Process Review</b> <i>Organization: Raytheon Electronic Systems</i> Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations Description:</p> <ul style="list-style-type: none"><li>• Each year, Raytheon conducts a 'year-end' process review to determine what process improvement activities the organization needs to plan for the coming year. They then derive an implementation plan for the upcoming year, consistent with the long-range objectives of the initiative and satisfying the needs that have just been identified.</li></ul>
<p><b>Best Practice: Ensure Involvement by the Line Managers in Process Improvement Efforts</b> <i>Organization: Raytheon Electronic Systems</i> Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations Description:</p> <ul style="list-style-type: none"><li>• Raytheon believes that it is essential to involve the line managers in process improvement activities. They were able to convey to their staff the importance of process improvement efforts to the organization's future. They explained to their staff that it was acceptable for them to spend time on process improvement because it was considered to be a part of their job.</li></ul>
<p><b>Best Practice: Designate a Senior-Level Official to Oversee Process Improvement Efforts</b> <i>Organization: Hughes Aircraft Company</i> Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations Description:</p> <ul style="list-style-type: none"><li>• Assign one member of the Process Improvement Group to work with the team to determine how the processes can be tailored to suit the project's needs.</li></ul>
<p><b>Best Practice: Define Product Goals Before Initiating Process Change</b> <i>Organization: NASA Software Engineering Laboratory</i> Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations Description:</p> <ul style="list-style-type: none"><li>• A set of product goals should be defined before implementing process change to ensure that any change in process will not negatively impact the product.</li></ul>
<p><b>Best Practice: Establish a Management Steering Committee</b> <i>Organization: Tinker Air Force Base, Oklahoma</i> Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations Description:</p> <ul style="list-style-type: none"><li>• The Management Steering Team was composed of the division chiefs and the branch chiefs. They met every month to provide direction and focus to the ongoing improvement efforts.</li></ul>

<p><b>Best Practice: Develop a Yearly Process Improvement Plan</b>  <i>Organization: Tinker Air Force Base, Oklahoma</i>  Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations  Description:</p> <ul style="list-style-type: none"> <li>• The Quality and Process Improvement focal point presents a yearly process improvement plan. The plan scopes the efforts to the level of funding available. It also gains agreement on the yearly goals and helps with the assignment of resources. The status is reported at meetings throughout the year, using the same set of metrics that are required of any project.</li> </ul>
<p><b>Best Practice: Ensure that Management “Rolls up Their Sleeves” and Participates in Process Improvement Efforts</b>  <i>Organization: Tinker Air Force Base, Oklahoma</i>  Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations  Description:</p> <ul style="list-style-type: none"> <li>• During process improvement efforts at Tinker Air Force Base, the Branch Chiefs took on process documentation editing duties. This visibly demonstrated the importance of the process improvement efforts.</li> </ul>
<p><b>Best Practice: Treat Process Improvement as a Program</b>  <i>Organization: Scott Air Force Base, Illinois</i>  Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations  Description:</p> <ul style="list-style-type: none"> <li>• Create deadlines for process improvement efforts and enforce them. Track process improvement efforts similar to the way programs are tracked.</li> </ul>
<p><b>Best Practice: Designate Member of Process Improvement Group to Work with Project Team</b>  <i>Organization: Scott Air Force Base, Illinois</i>  Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations  Description:</p> <ul style="list-style-type: none"> <li>• Assign one member of the Process Improvement Group to work with the team to determine how the processes can be tailored to suit the project’s needs.</li> </ul>
<p><b>Best Practice: Implement Rewards Program for those who Participate in Process Improvement Efforts</b>  <i>Organization: Scott Air Force Base, Illinois</i>  Improvement Consideration: Communicate Process Improvement Goals, Benefits, and Expectations  Description:</p> <ul style="list-style-type: none"> <li>• Recognize the efforts of all personnel involved in process improvement with public recognition, award ceremonies, or compensation time. This helps demonstrate management’s commitment to the process improvement effort.</li> </ul>
<p><b>Best Practice: Develop a Metrics Program</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Continue Metrics Capture  Description:</p> <ul style="list-style-type: none"> <li>• Hughes instituted standard metrics to summarize the cost, schedule, maturity, quality, and productivity performance indicators at the division and company levels. These measures form the basis of the continuous process improvement efforts.</li> </ul>
<p><b>Best Practice: Use Metrics to Generate the Baseline Prior to Initiating Process Improvement Efforts</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Continue Metrics Capture  Description:</p> <ul style="list-style-type: none"> <li>• In the SEL, measurement is not viewed as a process element that is added as an organization matures, but rather a vital element from the start of any improvement program. An organization must use measurement to generate a baseline understanding of process that will form the basis of the improvement program.</li> </ul>

<p><b>Best Practice: Establish a Metrics Program to Evaluate the Effects of Process Improvement</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Continue Metrics Capture  Description:</p> <ul style="list-style-type: none"> <li>Raytheon developed a metrics program to measure and evaluate the effectiveness of the process improvement efforts. Metrics provide an objective estimate of the effects of process improvement efforts.</li> </ul>
<p><b>Best Practice: Create a Process Management Group to conduct ROI Analysis on Process Improvement Efforts</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Evaluate Benefits of Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>Hughes created a Process Management, Assessment, and Standard Tool body during its process improvement efforts. This group was charged with determining how to measure benefits of common processes.</li> </ul>
<p><b>Best Practice: Produce a Baseline of Processes and Practices prior to Initiating Process Improvement</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Evaluate Benefits of Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>The SEL produces a baseline of development processes and practices against which change can be measured as process modifications are applied.</li> </ul>
<p><b>Best Practice: Conduct Trend Analysis of Completed Projects</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Evaluate Benefits of Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>The SEL conducts trend analysis of completed projects to track the impact of specific process changes on the environment as a whole.</li> </ul>
<p><b>Best Practice: Assess the Return on Investment Derived from the Process Improvement Program</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Evaluate Benefits of Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>The SEL produces a baseline of development processes and practices against which change can be measured as process modifications are applied.</li> </ul>
<p><b>Best Practice: Process Improvement Should Start with an Assessment</b>  <i>Organization: Process Impact</i>  Improvement Consideration: Evaluate Benefits of Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>An assessment in the beginning of process improvement helps identify problem areas and establish a baseline understanding of current practices.</li> </ul>
<p><b>Best Practice: Conduct Pre-Assessment of Process Maturity</b>  <i>Organization: Scott Air Force Base, Illinois</i>  Improvement Consideration: Evaluate Benefits of Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>Conduct an initial internal assessment of an organization's process maturity prior to implementing a process model.</li> </ul>
<p><b>Best Practice: Report Periodically on Process Improvement Progress</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Increase Vertical and Horizontal Communication  Description:</p> <ul style="list-style-type: none"> <li>The status of the project's process improvement efforts and SEPG-coordinated process deployment efforts were regularly tracked and presented to sponsors and senior management. This provided them with clear visibility into the progress of the improvement efforts.</li> </ul>

<p><b>Best Practice: Provide Regular Process Improvement Bulletins</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Increase Vertical and Horizontal Communication  Description:</p> <ul style="list-style-type: none"> <li>• Process improvement bulletins were used to review the activities of the current phase (what went well and why, what needs to be improved upon, etc.). It was also used to track activities planned for the next phase (what training is necessary; is process tailoring necessary based on the results of the previous phase, etc.).</li> </ul>
<p><b>Best Practice: Establish Process Improvement Discussion Forums</b>  <i>Organization: Scott Air Force Base, Illinois</i>  Improvement Consideration: Increase Vertical and Horizontal Communication  Description:</p> <ul style="list-style-type: none"> <li>• The Air Force Base developed several forums for communicating the progress of process improvement efforts in the form of a monthly teleconference, online bulletin board, and brown-bag lunches. These efforts helped familiarize the personnel with the process improvement efforts and kept them informed on an ongoing basis.</li> </ul>
<p><b>Best Practice: Share Lessons Learned during Process Improvement Efforts</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Capture Lessons Learned during Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>• Hughes held a series of monthly video teleconference meetings to discuss lessons learned. This was done to raise the process proficiency throughout the organization. These teleconferences were often supplemented by occasional face-to-face working sessions.</li> </ul>
<p><b>Best Practice: Implement a Comprehensive Benchmarking Program</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Capture Lessons Learned during Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>• Hughes implemented a comprehensive benchmarking program designed to share knowledge with other companies in order to find best practices. The results of these exercises were incorporated into future process improvement activities.</li> </ul>
<p><b>Best Practice: Capture Lessons Learned</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Capture Lessons Learned during Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>• Each project captured lessons learned during the early phases of the process improvement efforts. These lessons learned were then incorporated into the later phases of the efforts.</li> </ul>
<p><b>Best Practice: Develop a Benchmarking Program</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Capture Lessons Learned during Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>• In order to ensure that Raytheon has the “best” processes, they developed a benchmarking program. Raytheon benchmarked processes from other companies to find process elements that they can incorporate into their processes.</li> </ul>
<p><b>Best Practice: Incorporate a Set of “Best of the Best” Practices into Process Documentation</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Capture Lessons Learned during Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>• Raytheon’s process documentation was comprised of internal best practices as well as tenets from existing process models such as CMM, ISO 9000, and DOD-STD-2167A.</li> </ul>

<p><b>Best Practice: Develop an Organizational Infrastructure to Capture Experiences and Collective Learning</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Capture Lessons Learned during Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>The SEL supported the reuse of experiences with an organizational infrastructure dedicated to developing, updating, and supplying upon request synthesized experiences and competencies.</li> </ul>
<p><b>Best Practice: Establish a Library of Process-Related Assets for Use Throughout the Company</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Implement Knowledge Repository  Description:</p> <ul style="list-style-type: none"> <li>Hughes developed an electronic process-related library to encourage sharing and reuse within the organization. The library contained process artifacts and training materials.</li> </ul>
<p><b>Best Practice: Reuse Experiences to Improve Subsequent Tasks</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Implement Knowledge Repository  Description:</p> <ul style="list-style-type: none"> <li>The SEL focuses on continually using experiences, lessons, and data from previous projects to enhance their processes. The underlying principle is to reuse experiences to improve subsequent tasks. This reuse of experiences is the driving element for change and improvement in processes.</li> </ul>
<p><b>Best Practice: Develop a Process Repository</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Implement Knowledge Repository  Description:</p> <ul style="list-style-type: none"> <li>A process repository was created to capture project and process data. The data captured was used during root cause analysis. It was also used to identify specific recommendations for local process improvement as well as general improvement to the standards.</li> </ul>
<p><b>Best Practice: Develop an Online Process Asset Library (PAL)</b>  <i>Organization: Scott Air Force Base, Illinois</i>  Improvement Consideration: Implement Knowledge Repository  Description:</p> <ul style="list-style-type: none"> <li>Scott Air Force Base created an online process asset library so that information could be seamlessly shared throughout the organization. The PAL contained all process documentation.</li> </ul>
<p><b>Best Practice: Dedicate Resources to Process Improvement Efforts</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Allocate Resources to Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>The SEL ensured that process personnel dedicated to their process improvement responsibilities were not involved in the production or acquisition of software. This ensured continuity and objectivity in process improvement activities and the availability of resources for building, maintaining, and sustaining the process improvement program.</li> </ul>
<p><b>Best Practice: Identify a Source of Funding for Process Improvement Efforts</b>  <i>Organization: Raytheon Electronic Systems</i>  Improvement Consideration: Allocate Resources to Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>In order to ensure that process improvement activities received the attention and support it deserved, management allocated substantial funds to the effort. The funds were then managed like they would be for any other project.</li> </ul>

<p><b>Best Practice: Ensure that Funding was Provided for Process Improvement Efforts</b>  <i>Organization: Tinker Air Force Base, Oklahoma</i>  Improvement Consideration: Allocate Resources to Process Improvement Efforts  Description:</p> <ul style="list-style-type: none"> <li>The Air Force provided Tinker Air Force Base with money to implement process improvement. This funding was used to pay for labor, training, and travel. Receiving funding was essential because it allowed process improvement to be tracked and managed at the same level as any other workload. It also helped facilitate the use of “key” people on the improvement efforts.</li> </ul>
<p><b>Best Practice: Increase Training Time</b>  <i>Organization: Bull HN</i>  Improvement Consideration: Improve Process Improvement Training  Description:</p> <ul style="list-style-type: none"> <li>To ensure that the individuals within the organization understood the new processes, training time for personnel was increased to 67 hours per person per year.</li> </ul>
<p><b>Best Practice: Conduct Process Tailoring Workshops</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Improve Process Improvement Training  Description:</p> <ul style="list-style-type: none"> <li>Hughes conducted Process Tailoring Workshops to help the programs map the “new processes” to their current processes.</li> </ul>
<p><b>Best Practice: Conduct Executive/Program Management Process Awareness</b>  <i>Organization: Hughes Aircraft Company</i>  Improvement Consideration: Improve Process Improvement Training  Description:</p> <ul style="list-style-type: none"> <li>Hughes designed a training program specifically for executives to ensure their support of process improvement activities. This training provided data on ROI, while providing an overview of common processes. It also linked the process improvement activities to goals, defining the potential impact of the process improvement efforts.</li> </ul>
<p><b>Best Practice: Develop a Standard Set of Training Courses to Provide All Personnel with the Information Needed to Function Effectively</b>  <i>Organization: NASA Software Engineering Laboratory</i>  Improvement Consideration: Improve Process Improvement Training  Description:</p> <ul style="list-style-type: none"> <li>All SEL personnel attended a standard set of training courses that discussed the SEL process improvement concepts, software development methodology, management approaches, standards, and organizational guidelines. This core set of courses reflected the process improvement approach and in general all the experiences of the SEL.</li> </ul>
<p><b>Best Practice: Each Project Performs a Quarterly CMM Self-Assessment</b>  <i>Organization: Motorola GED</i>  Improvement Consideration: Monitor Compliance to Process Models  Description:</p> <ul style="list-style-type: none"> <li>Each project performs a quarterly CMM self-assessment to evaluate the maturity of their processes. If a process is considered to be weak, action plans are implemented prior to a formal CMM assessment.</li> </ul>
<p><b>Best Practice: Develop an Independent Quality Assurance Function</b>  <i>Organization: Tinker Air Force Base, Oklahoma</i>  Improvement Consideration: Monitor Compliance to Process Models  Description:</p> <ul style="list-style-type: none"> <li>Tinker Air Force Base created an oversight function to ensure process adherence and the gathering of best practices.</li> </ul>

**Best Practice: Conduct Annual Process Audits**

*Organization: Tinker Air Force Base, Oklahoma*

Improvement Consideration: Monitor Compliance to Process Models

Description:

- To ensure that programs adhered to process requirements, annual process audits were implemented. These process audits were led by the Quality and Process Improvement Focal Point and supplemented by personnel from the programs.

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## Appendix D: Acronyms

ACM-10	NAS Configuration Management and Program Evaluation Staff, Program Evaluation Branch
ACT-400	Laboratory Management Division of the William J. Hughes Technical Center
ADAS	AWOS Data Acquisition System
AIO	Office of Information Services
AIO-200	Office of Information Services, Process Engineering Division
AND	Office of Communication, Navigation, and Surveillance Systems
AOS	Communications, Flight Service, Weather, and IRM of the Operational Support Directorate
ARA	Office of Research and Acquisitions
ARA-1	Associate Administrator for Research and Acquisitions
ARAMT	Associate Administrator for Research and Acquisitions Management Team
ARS	Air Traffic System Requirements Service
ASR-11	Airport Surveillance Radar Model 11
ATB	Terminal Business Unit
ATQ	Office of Independent Operational Test and Evaluation
ATS	Office of Air Traffic Services
ATS-1	Associate Administrator for Air Traffic Services
ATSMT	Associate Administrator for Air Traffic Services Management Team
AUA	Office of Air Traffic Systems Development
AWOS	Automated Weather Observing System
FAA	Federal Aviation Administration
FAA-iCMM®	FAA integrated Capability Maturity Model®
HOCSR	Host and Oceanic Computer System Replacement
iEWG	integrated Engineering Working Group
ISO 9000	International Organization for Standardization 9000
NAS	National Airspace System
NASA	National Air and Space Administration
NEXCOM	Next Generation Air/Ground Communications
ROI	Return On Investment
SEPG	Software Engineering Process Group
STARS	Standard Terminal Automation Replacement System
WARP	Weather and Radar Processor