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Final Report – Results and Recommendations From the Space Shuttle Program Systems Engineering & Integration Office Systems Engineering Process Appraisal 2004

30 April 2004

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Contract No. NAS 9-00090

Civil and Commercial Division

THE AEROSPACE CORPORATION
EL SEGUNDO, CALIFORNIA

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Executive Summary

Between 23 February 2004 and 2 April 2004, a team from The Aerospace Corporation conducted interviews with the Space Shuttle Program (SSP) Systems Engineering & Integration Office (SEIO) engineering staff in order to baseline the SEIO's systems engineering processes. The primary objective of the systems engineering process appraisal of the SSP SEIO was to evaluate and baseline the maturity of SEIO's systems engineering processes. The second objective was to make recommendations for improvement. The Aerospace Corporation, which operates a Federally Funded Research and Development Center (FFRDC) for the Department of Defense (DoD), performed the appraisal using a tailored version of the Capability Maturity Model Integration (CMMI®) model*, referred to as CMMI®-NS for NASA. Systems engineering processes were the focus of the appraisal; the Appraisal Team did not assess the quality of SEIO products.

The CMMI®-NS model was used as a guide to gather interview data from 40 SEIO personnel at Johnson Space Center (JSC), Kennedy Space Center (KSC), and Marshall Space Flight Center (MSFC). Following each set of interviews, the team met to discuss the findings and to reach a consensus as to the level of implementation in each of 103 specific practices described by the CMMI®-NS model. For each NASA location (JSC, KSC, MSFC), this data was organized by each CMMI®-NS specific practice. An implementation finding was then determined for each practice for each NASA location. These preliminary results were briefed to those personnel interviewed at each center for further comment (Appendix A). The center findings were then evolved (Appendix D) into an overall set of SEIO findings (tabulated in Section 2), and the process level results were then determined (Section 3). Over 90% of the process practices were found to be at least Partially Implemented (PI).

Fourteen Best Practices suitable for SEIO-wide implementation were identified by the appraisal team. These Best Practices are in the process areas of Program Planning, Integrated Teaming, Product Integration, Technical Solution, Configuration Management, Organizational Training, and Organizational Process Definition. These are listed in Table 1. More detail on the Best Practices can be found in Section 2.3 and in the SEIO Results and Recommendations Briefing (Appendix B).

Table 1 Best Practices

Establish standard processes	Review interface descriptions
Charter integrated teams	Survey training needs
Establish Configuration Management records	Establish training records
Define team roles & responsibilities	Select products for validation
Obtain stakeholder commitment to plans	Evaluate, categorize, prioritize risks
Establish interface descriptions	Establish a configuration management system
Design & analyze interfaces	Establish organization process asset library

The Appraisal Team also made 18 recommendations for process improvements, which are listed in Table 2.

* The CMMI® model was developed by the Software Engineering Institute of Carnegie Mellon University.

Table 2 Recommendations

Recommendation	Benefit to SSP
1. Clarify and document SEIO integration process flow from requirements development to launch, and define SEIO offices and element integrator roles, responsibilities, and products	Reduces risk that a critical integration issue might be overlooked
2. Define SEIO integration process flow from launch through landing, define SEIO office's and element integrator roles, responsibilities, products	Potentially critical performance, deficiencies, or trends are fed into the requirements process
3. Formulate an integrating Risk Management process, use across all three SEIO organizations	Provides early, aggressive, and comprehensive risk identification
4. Establish a process to determine which defects to analyze (impact, similarity, frequency, safety), to develop solutions, to define actions, and to evaluate effects of changes	Provides ability to select and analyze relevant defects, review what has been done in SSP organizations, better develop solutions, and to take action to prevent future occurrence
5. Establish and maintain an overall SEIO plan (addresses tasks, budget, products, risks, schedule, resources, stakeholder involvement)	Provides logical relationship among technical and management tasks, risk identification, budgets, schedules, data, resource and skill requirements, and stakeholder interaction, enabling better management visibility and opportunity for team coordination
6. Determine the training needs, and develop a training philosophy and plan, based upon an assessment of the integrated roles and responsibilities within the SEIO organization	Provides personnel with the necessary SEIO-specific skills and knowledge, and facilitates focused HR support
7. Conduct periodic internal SEIO integrated reviews (monitor resources, tasks, products, and schedules against the project plan)	Improves communication; creates a better, more seamless organization; reduces risk of overlooking integration issues
8. Establish more formal monitoring and accountability of contractor performance (cost, schedule, technical)	Allows the government to detect and address process and product quality issues early
9. Establish a process to analyze requirements to achieve balance of stakeholder needs and constraints	Focuses the approach to ensure that requirements are adequately balanced
10. Develop a process with criteria to analyze requirements changes (includes impact and associated risk on product performance, cost, architecture, supportability, system resource utilization, verification requirements, schedule)	Focuses the approach to ensure that impacts and associated risks are sufficiently considered when analyzing requirement changes
11. Develop a proactive joint multi-element process (technical panels, working groups, teams) to develop, analyze, and validate inter-element requirements	Improves understanding of requirements, helps to ensure a full set of inter-element requirements are thoroughly developed, analyzed, validated

Recommendation	Benefit to SSP
12. Set clear guidelines for decisions requiring a formal process	Identifies decisions requiring a formal process, documents formal decisions and rationale
13. Make SEIO work products available to the whole team	Keeps staff informed, shares important data, reduces duplication of effort
14. Establish a centralized action item management system to capture and track actions	Greater management situational awareness, increases possibility that critical issues are addressed
15. Establish consistent guidelines for government review of non-developmental items	Provides a better way to evaluate potential commercial products and services to ensure requirements are met and limitations are acceptable
16. Provide guidance for resource priority and reconciliation	Facilitates project adjustments, may increase productivity
17. Establish skills guidelines for team and working group assignments	Improves integrated team performance, provides basis to plan the organization's resource and training needs
18. Implement the Strengths and Best Practices throughout SEIO	Enables SEIO to improve process performance at low implementation cost and provides a strong base of processes which have a record of working well

Appraisal findings are contained in Section 2 of this report, while Section 3 documents the results of the findings and Section 4 describes the ensuing 18 specific recommendations.

Contents

Figures

Tables

1. Introduction

The primary objective of the systems engineering process appraisal of the Space Shuttle Program (SSP) Systems Engineering and Integration Office (SEIO) was to evaluate and baseline the maturity of SEIO's systems engineering processes at Johnson Space Center (JSC), Kennedy Space Center (KSC), and Marshall Space Flight Center (MSFC). The secondary objective was to make recommendations for improvement throughout SEIO.

Systems engineering processes were the focus of the appraisal; the Appraisal Team did not assess the quality of SEIO products. The results and recommendations of this process baselining effort can be applied by SEIO to improve its systems engineering processes as the Shuttle Return To Flight (RTF) effort progresses.

The systems engineering process appraisal of the SSP SEIO began in December 2003, when The Aerospace Corporation's SEIO Appraisal Team was briefed by the SEIO Manager and Deputy Manager. Following the December meeting, the appraisal team members read the Columbia Accident Investigation Board (CAIB) report and tailored the CMMI® model by adding and deleting selected Process Areas. The Appraisal Team used this information to:

- Tailor the CMMI® model to create a CMMI®-NS (-NS for NASA SEIO) model,
- Create a survey form to send to all engineering personnel working in SEIO facilities at JSC, KSC, and MSFC, and
- Create a set of over 103 questions to ask of the interviewees.

In February 2004, the Appraisal Team traveled to JSC and interviewed NASA SEIO engineering personnel and selected United Space Alliance (USA) managers assigned to SEIO at JSC. Following a week of determining the preliminary JSC findings, three members of the team traveled to KSC and interviewed NASA SEIO engineering personnel and a selected USA manager assigned to SEIO at KSC. The KSC preliminary findings were completed the following week. In March 2004, four members of the team traveled to MSFC and interviewed NASA SEIO engineering personnel and a selected USA manager assigned to SEIO at MSFC. In all cases (JSC, KSC, and MSFC), interviewees consisted of NASA civil servants and selected USA managers; no other contractor personnel were interviewed. When a USA manager was interviewed, a NASA employee was present. All told, a total of 36 NASA SEIO engineering personnel and four USA managers assigned to SEIO were interviewed at the three locations.

For each NASA Center, a Preliminary Findings/Fact Finding video teleconference (VTC) was held approximately two weeks after the corresponding interviews were completed. The purpose of each VTC was to present the Appraisal Team's preliminary findings and obtain feedback/clarification from the interviewees. For this reason, the VTC attendance was limited to the people who were interviewed.

The effort ended on 30 April 2004, when the results and recommendations were briefed to the SEIO in a VTC.

The CMMI® model, developed by the Software Engineering Institute of Carnegie Mellon University, consists of 471 Specific Practices in 25 Process Areas. The tailored CMMI®-NS

model is a scaled-down version consisting of 103 Specific Practices in 16 Process Areas. The 16 Process Areas selected for use in the CMMI®-NS model are:

Project Management:

- Project (Program) Planning
- Project (Program) Management
- Contractor Management
- Risk Management
- Integrated Teaming

Engineering:

- Requirements Development
- Requirements Management
- Technical Solution
- Product Integration
- Verification
- Validation

Support:

- Configuration Management
- Decision Analysis and Resolution
- Causal Analysis and Resolution

Organizational Process Management:

- Organizational Training
- Organizational Process Definition

The purpose of each appraisal was to identify the existence and use of processes. Instead of providing a numerical rating, a Blue/Green/Yellow/Red scoring system was used for scoring purposes. Specifically, the appraisal was looking to see if the process exhibited the following characteristics:

- Do processes exist?
- Are they used?
- Are they documented?
- Do others know about them?
- Are they reviewed by management?
- Are there adequate resources to perform the processes?
- Is there process training?

Two non-model questions were also asked at the end of every interview. While outside the model, the answers to these questions were used to gain employee insight into what's working and what's broken in SEIO. The questions were:

1. Except for people, what are the strengths of this organization?
2. If you were allowed to, what would you change about this organization (except for your pay or perhaps your boss)?

A key element in achieving interview success was the ground rule that in preparing the findings, there would be no attribution to an individual or organization. In determining the findings, coming up with the results, and making the recommendations, the Appraisal Team ensured that there was no attribution to a specific SEIO individual.

As a result of the appraisal, 14 Best Practices were identified and 18 specific recommendations (Section 4) were developed. All of these results were then briefed (Appendix B) to the SEIO for consideration in their process improvement efforts. It is up to SEIO to decide which Best Practices and recommendations to implement, what the priority should be, when and how the improvements should be implemented, and who in SEIO should do it. The focus should

be on improving selected SEIO processes; the appraisal has been documented in a manner to enable potential future appraisals to determine the improvements which have been accomplished since this baseline was established.

2. Findings

The Appraisal Team has spent hundreds of hours interviewing 36 SEIO personnel and four USA managers at three NASA Centers, reviewing an extensive amount of documentation, and interpreting the subsequent findings to make 18 specific recommendations for process improvement. The findings provided in this section form the basis for the results and recommendations contained in Section 3 and 4 of this report respectively.

2.1 Strengths Summary

In the assessment of the SEIO operations, there were 31 instances where practices were found to exceed the CMMI®-NS model requirements. These practices, found in 14 of the 16 process areas, were identified as strengths. In those cases where the practices were exemplary and especially worthy of consideration for SEIO-wide implementation, they were further identified as "Best Practices". However, all of the strengths are good examples for consideration in any process improvement effort. These strengths are presented by process area in Table 2.1, with the Best Practices identified by the bold type. The lack of any identified strength (none) simply means that nothing was found that exceeded the model.

Table 2.1 Process Strengths

Process Area	Strengths
Program Planning (PP)	• **Chartered tech panels, formal integration plans, and signed internal agreements commit the stakeholders** o CWCs identify resource needs, formally commit stakeholders
Program Management (PM)	o There is clear guidance for issue resolution (PRACA, RCNs, LCNs, IFAs, integrated hazards)
Risk Management (RiM)	• **Continuous Risk Management process provides guidance to evaluate, categorize, and prioritize risks** o NSTS 37366 Appendix B, Continuous Risk Management, provides Risk Management guidance
Contractor Management (KM)	o None
Integrated Teaming (IT)	• **Team charters are clearly defined and centralized in NSTS 07700** • **Team roles/responsibilities are specified in Program Directives** o SSEIG was established to integrate the technical panels
Requirements Development (RD)	o Requirements are established by the PRCB and are maintained in numerous NSTS documents
Requirements Management (ReM)	o Commitment to requirement changes is part of the board process with stakeholders
Technical Solution (TS)	• **Interface definition process clearly defined, well-documented, executed** • **ICDs provide design guidance in addition to requirements to ensure compatibility**

Process Area	Strengths
Product Integration (PI)	• **ICDs provide design guidance in addition to requirements to ensure compatibility** o There is a documented interface definition process, accurately executed IAW detailed instructions
Verification (VER)	o MVP provides detailed top-level guidance (but no imagery) o MSFC HDBK 2221 defines a verification process o "Top X" type review provides excellent incremental verification process o Verification roles/responsibilities are defined in NSTS 08117
Validation (VAL)	• **Imagery is provided for flight performance validation** o SEIO is reintroducing up-to-date empirical validation o Multi-laboratory approach is used for image analysis
Configuration Management (CM)	• **Formal, integrated CM processes are consistently used** • **There is a comprehensive CM record system** • **Specific guidance (MFSC Shuttle Propulsion Configuration Management Manual) used to augment SSP CM process** o Board process enables significant SEIO influence o Complete data (including backups) is rapidly and widely accessible for all (approved/disapproved) actions
Decision Analysis & Resolution (DAR)	o Issue Sheets used for Shuttle Environmental Assurance (SEA) issues to identify and analyze risks/alternative approaches
Causal Analysis & Resolution (CAR)	o None
Organizational Training (OT)	• **KSC Training Office does an annual survey and feeds results and training schedule to MK-SIO for implementation** • **ISO 9000 training records (Personal Development Plans) exist, current**
Organizational Process Definition (OPD)	• **There is a well-documented set of organizational standard processes for all NASA centers** • **MSFC has an online process asset library of policies, standards, processes, work instructions, plans templates, and process aids**

Note – **Bold** indicates Best Practice

2.2 Weaknesses Summary

In the assessment of the SEIO operations, there were 34 instances where practices with significant deficiencies were found with respect to some aspect of a CMMI®-NS model process requirements. These deficiencies, found in 15 of the 16 process areas, were identified as weaknesses. These weaknesses are presented by process area in Table 2.2.

Table 2.2 Process Weaknesses

Process Area	Weaknesses
Program Planning (PP)	o There is no project plan or equivalent defining the overall work effort o Could find no comprehensive data management structure for internal products o There is no documented process guiding reconciliation of resources
Program Management	o Could find no process for ***system level*** review of ***integrated*** SEIO

Process Area	Weaknesses
(PM)	activities o There is no process to monitor informal work products or data
Risk Management (RiM)	o Found no evidence that programmatic, integration (technical), or non-safety related risks are identified, prioritized, mitigated, documented
Contractor Management (KM)	o The government conducts periodic but inconsistent review of contractor work products to detect issues early o Found no consistent process to track contractor issues, risks, performance o The process for review of non-developmental items is inconsistent o No evidence that sustainment products are tracked or issues identified
Integrated Teaming (IT)	o Found no documented guidance on technical qualifications for team assignments
Requirements Development (RD)	o Found little evidence that requirements are proactively identified and elicited o Requirements are not analyzed to achieve balance (e.g., for risks, cost, schedule) or validated with any comprehensive techniques o Operational concepts for products are not being maintained and executed
Requirements Management (ReM)	o Requirements traceability is performed downward, but not upward o Could find no evidence that requirements are analyzed for risk, supportability, and resource impacts
Technical Solution (TS)	o Element integrators have major interface responsibilities, but could find no evidence of a documented process identifying their specific roles or responsibilities from requirement definition through verification
Product Integration (PI)	o SEIO's responsibility in establishing the integrated test environment is not clearly defined o No evidence was found of any verification role for the element interfaces MSFC is responsible for developing o No evidence was found of defined role in ensuring the adequacy of elements when integrated (NSTS 08117 defines no specific SEIO role)
Verification (VER)	o Found no evidence that JSC interviewees clearly understood SEIO responsibilities identified in NSTS 08117 o Found no evidence of process that ensures that products are selected for verification based on risk (verification activities appear to be based upon reported anomalies instead of performance criticality) o Found no evidence of a documented internal product verification process
Validation (VAL)	o Model validation is not current with design o Use of expanded flight instrumentation beyond the next flight appears uncertain o No evidence found that MP71 has any plan or process for validating the MSFC elements o Other than for photo analysis, no evidence was found of a definition of the SEIO role in validation of SSP elements
Configuration Management (CM)	o Found no evidence of a CM system for internal SEIO products
Decision Analysis & Resolution (DAR)	o Found little evidence of documented, consistent processes or guidelines in formal decision-making for:

Process Area	Weaknesses
	•Applying evaluation criteria •Selecting evaluation methods •Identifying alternative solutions
Causal Analysis & Resolution (CAR)	o No evidence of a documented, consistent process in causal analysis for: •Selecting defect data •Analyzing causes •Implementing action proposals o No evidence that causal analysis data is recorded in a readily available and easily usable manner
Organizational Training (OT)	o Found no evidence of a significant management priority for training •No evidence of strategic planning •No evidence of consistent tactical planning •No evidence of a work-based needs assessment •No evidence of need-to-training traceability o Found no evidence of feedback that enables training assessment (e.g., supervisor based training guidance) o Found no evidence of internal training capability (other than Center level facilities)
Organizational Process Definition (OPD)	o None

2.3 Concerns Summary

In the assessment of the SEIO operations, there were 15 instances where there was an observation that something not strictly covered in the CMMI®-NS model could "fall through the crack" and impact SEIO operations. These observations, found in 9 of the 16 process areas, were identified as concerns to ensure that they would not be overlooked. These concerns are presented by process area in Table 2.3.

Table 2.3 Process Concerns

Process Area	Concerns
Program Planning (PP)	o None
Program Management (PM)	o Lower level action items may not surface or follow formal procedures o Many staff not aware of ongoing activities throughout SEIO
Risk Management (RiM)	o There is no consolidated risk reporting process that captures all identified risks and ensures upper management visibility o Element risk processes appear to operate independently without an integrated risk perspective
Contractor Management (KM)	o For RTF the government has suspended its contractor management duties to attend to fire drills o System performance evaluations done as a prime responsibility of other organizations may inhibit SEIO from ensuring user evaluation
Integrated Teaming (IT)	o Unchartered teams may not follow a disciplined procedure o The SSEIG may not have visibility into and fully integrate unchartered teams into the technical areas

Process Area	Concerns
Requirements Development (RD)	o None
Requirements Management (ReM)	o None
Technical Solution (TS)	o No evidence that an overall disciplined interface control process is applied at the integrated system level except for element interactions involving "hard" (e.g., mechanical/electrical) interfaces
Product Integration (PI)	o There is no evidence of an integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts the respective responsibilities and interactions o There is no SEIO integrator for the Orbiter element
Verification (VER)	o Found no integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts the respective responsibilities and interactions
Validation (VAL)	o Found no integrated "launch-to-landing" validation plan or process
Configuration Management (CM)	o None
Decision Analysis & Resolution (DAR)	o None
Causal Analysis & Resolution (CAR)	o Some work products (e.g., briefings, working materials) are kept on individual computers and not openly distributed on a shared drive o The causal analysis process may not be followed by all element leads
Organizational Training (OT)	o None
Organizational Process Definition (OPD)	o None

2.4 What People Are Saying – Greatest Organizational Strengths

As part of the appraisal, the Appraisal Team asked each interviewee two non-model questions. While outside the model, the answers to these questions provided insight into what works and what doesn't in SEIO. The first question, which dealt with SEIO organizational strengths, was "Except for people, what are the strengths of this organization?".

The answers to this question can be grouped into six general categories:

1. Leadership: The SEIO organization is represented by good, effective leadership which is characterized by management fortitude with a vision for and focus on mission success.
2. Technical Depth: SEIO is characterized by strong technical depth, tribal knowledge, and diversity of experience. SEIO is a "well motivated mob" with an attitude of pride, spirit, and dedication.
3. Management Commitment: SEIO has seen a renewed commitment from the top. The people see themselves as value-added; they feel they now have the ability to ask questions / influence the program. They take an independent look at technical problems from a system perspective. SEIO is a small, responsive organization; not a bureaucracy.
4. Processes: SEIO has well-established processes – they are standard and documented. It has a sound requirements process and board structure, and strong configuration management processes. Plus, the Tech Panel structure is the backbone of the Space Shuttle Program.

5. Element relationships: SEIO has good relationships with the elements. The SEIO staff can go anywhere and ask questions, and not be denied access. Furthermore, staff members are present in the elements down to the working level.
6. Program legacy: There is the legacy of the Shuttle program; a history of SEIO support.

2.5 What People Are Saying – What Should Be Changed

The second of the two non-model questions dealt with what should be changed within SEIO. The question was "If you were allowed to, what would you change about this organization (except for your pay or perhaps your boss)?"

The answers to this question can be grouped into seven general categories:

1. Define roles and responsibilities. Interviewees indicated a need to know what they're supposed to be doing, or be provided with a list of what they're supposed to do. They also expressed a need to be grounded in and understand their responsibilities; they are unsure of what JSC wants. They would like to have a handbook describing how to do element integration.
2. Improve SEIO's organizational structure and staffing: SEIO is too ad hoc. Interviewees indicated a desire to bring Systems Engineering & Integration (SE&I) to where the hardware is, and to establish a more formal chain-of-command with an accompanying documented organizational structure. In addition, there are very few advancement/promotion opportunities in SEIO. Finally, while SEIO has had trouble recruiting, it needs to appropriately staff a couple of key positions, plus up manpower in general.
3. Improve communications: There is a need for two-way communications. People don't get many occasions to meet with upper management. Interviewees indicated a need to improve communications skills, improve management training, and have more face-to-face meetings.
4. Provide more training: SEIO should get more aggressive regarding training. SEIO needs to spend the time needed to get people up to speed; invest in people. There should be an official and effective mentoring program. This is hard to do, as SEIO is missing middle managers.
5. Documented processes: More documented processes are needed. SEIO needs to get back to recognizing that "processes" are not a curse and introduce/restore more processes.
6. Stop the frantic pace: The current pace is ridiculous pace; it's parallel in all directions, causing people to be uncertain if each issue is being treated adequately. More time is needed to work the unknowns rather than spending time in meetings. SEIO is in a total chaos mode; firefighting, fighting brushfires.
7. Turn back the clock: SEIO needs to restore what has been lost – "trust". There is a desire that SEIO return to the way it functioned before. Some interviewees would stop everything and define jobs, reorganize, document roles, hire additional staff, and improve communications.

2.6 Process Findings

This section presents a summary of composite SEIO appraisal findings, structured by

goals (indicated by a •) and practices (indicated by a ►) for each of the 16 process areas contained in the CMMI®-NS model. Summary findings (indicated by ***boldface italics)*** are stated for each practice, with an indicator following each statement showing a Best Practice ***(B)***, a Strength ***(S)***, a Weakness ***(W)***, or a Concern ***(C)***. "Strengths" listed include observations found to both meet the model requirements and those that exceed the model requirements. For more details refer to the appraisal worksheets in Appendix C and D.

2.6.1 Project (Program) Planning

The purpose of Project Planning is to establish and maintain plans that define project activities. For the appraisal, the phrase "Program Planning" was used rather than "Project Planning" because to SEIO, "Project" refers to the SSP projects.

Project (Program) Planning addresses three Goals and ten Practices:

- Goal 1: Establish program office estimates and keep them current
  - ► Establish a top-level work breakdown structure (WBS) to estimate scope of the project

    A Work Breakdown Structure (WBS) is not being used in SEIO. (W) However, Propulsion Systems Integration Project Organizational Work Instruction MP-OWI-01 used by MP-71 was found to be an acceptable alternative. (S)
  - ► Estimate project effort and cost for work products and tasks based on estimation rationale

    The documented Program Operating Plan (POP) process is followed. (S)

- Goal 2: Develop program plans and keep them current
  - ► Establish and maintain the project's budget and schedule

    The documented POP process is followed for budget development and the Return To Flight (RTF) schedule paces current work. (S)
  - ► Plan for the management of project data

    Although there is a Shuttle Flight Operations Contract (SFOC) plan for contractor data, there is no plan for managing government data. (W)
  - ► Plan for necessary resources and needed knowledge and skills to perform the project

    The Ground Imagery Plan and Collaborative Work Commitments (CWCs) are indicators of planning for needed project skills. (S) However, there was little other evidence of SEIO skills planning. (W)
  - ► Plan the involvement of identified stakeholders

    NSTS 07700 Directives (NSTS 07700, Volume II Book 2), CWCs, Integrated Teaming Agreements (ITAs), and Shuttle Integration Plans (SIPs) evidence strong stakeholder involvement planning. (S)
  - ► Establish and maintain the overall project plan content

    There is no SEIO project plan defining the work effort. (W) the Management Plan for Space Shuttle Upgrades – Program Integration (NSTS 47008) presents an outline for an SEIO project plan (S), but it has not been maintained. (W)

- Goal 3: Establish commitments to the program plan and keep them current
  - ► Review all plans that affect the project to understand project commitments

SFOC Surveillance Plan and Product Development Plans (PDPs) have been suspended. (W)

► Reconcile the project plan to reflect available and estimated resources

ITAs, SFOC augmentation, and Ground Imagery Plan are methods to reconcile resources. (S) However, there is no documented process or plan to guide this. (W)

► Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution

Chartered tech panels, formal integration plans, and signed internal agreements commit the stakeholders. (B)

2.6.2 Project (Program) Management

The purpose of Project Management is to provide an understanding of the Project's progress so that appropriate corrective actions can be taken when the Project's performance deviates significantly from the plan. For the appraisal, the phrase "Program Management" was used rather than "Project Management" because to SEIO, "Project" refers to the SSP projects.

Project (Program) Management addresses two Goals and seven Practices:

- Goal 1: Monitor actual performance and progress of the program against program baselines
  - ► Monitor project issues, risks, status, execution, funding, and expenditures against project plans

    Top X, tech panels, and working groups regularly review status and progress. (S) There is no documented process guiding project status review. (W) Many reported they are not aware of ongoing SEIO activities. (C)

  - ► Monitor commitments against those identified in the project plan

    Top X, tech panels, working groups, and the Space Shuttle Engineering Integration Group (SSEIG) accomplish monitoring of agreements and commitments. (S)

  - ► Monitor the management of project data against the project plan

    There is a strong institutional management of formal project data (S). However, there is no plan to control SEIO data nor is there widespread data sharing. (W)

  - ► Monitor stakeholder involvement against the project plan

    Top X, SSEIG, Integration Control Board (ICB), Program Requirements Control Board (PRCB), tech panels, and working groups ensure that stakeholder interaction regularly occurs. (S)

  - ► Conduct periodic and milestone reviews

    There is no integrated SEIO progress review. (W)

- Goal 2: Manage corrective actions to closure
  - ► Collect and analyze issues, and determine corrective actions necessary to address issues

    Integrated hazard reports, the Problem Reporting and Corrective Action (PRACA) process, Launch Commit Criteria Change Notices (LCNs), In Flight Anomalies (IFAs), Unexplained Anomalies (UAs), and Shuttle Environmental Assurance (SEA) Issue Sheets are all methods to collect, analyze and manage issues. (S)

► Take corrective action on identified issues and managing them to closure

Top X, tech panels, working groups, ICB, and Program Requirements Change Board (PRCB) manage corrective action. (S) Lower level actions may not surface or follow formal procedures. (C)

2.6.3 Risk Management

The purpose of Risk Management is to identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives. This includes both SEIO and Contractor risks.

Risk Management addresses three Goals and eight Practices:

- Goal 1: Prepare for risk management
  - ► Determine risk sources and categories

    NASA Program and Project Management Processes and Requirements (NPG 7120.5B), Methodology for Conduct of Space Shuttle Program Hazard Analysis (NSTS 22254), Space Shuttle Upgrades Management Plan (NSTS 37400 Vol 1), Program Description and Requirements Baseline (NSTS 07700), and Requirements and Procedures for Certification of Flight Readiness (NSTS 08117) provide documented guidance for risk management. (S) All offices are not proactive. (W)
  - ► Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort

    Risk Management Procedures and Guidelines (NPR 8000.4) and SEA Issue Sheets guide how risks are categorized. (S) Programmatic and integration risks are not identified and addressed. (W)
  - ► Establish and maintain the strategy to be used for risk management

    NSTS 07700 Program Description and Requirements Baseline (NSTS 07700 Vol I (sec. 5)) defines a risk management strategy. (S) Element risk processes appear to be independent without an integrated risk perspective. (C)

- Goal 2: Identify and analyze risks to determine their relative importance
  - ► Identify and document the risks

    Integrated Hazard Reports and SEA Issue Sheets identify technical risks. (S) Programmatic and integration risks are not identified and documented. (W)
  - ► Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority

    Shuttle Environmental Assurance (SEA) Initiative Implementation Plan (NSTS 37366) and SEA Issue Sheets document and categorize risks. (B) Programmatic and integration risks are not comprehensively addressed. (W)

- Goal 3: Handle and mitigate risks to reduce adverse impacts on achieving objectives
  - ► Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy

    SEA Issue Sheets are a good example of technical risk mitigation planning. (S) However, SEIO is not addressing programmatic and integration risks. (W)

- ► Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate, until closed

  Imagery Plan and SEA Issue Sheets are good examples of risk mitigation. (S) No evidence was found that non-safety risks are being monitored. (W)
- ► Report the status of identified risks at project reviews

  PRCB does review risk status. (S) There is no consolidated risk reporting process that ensures management visibility. (C)

2.6.4 Contractor Management

The purpose of Contractor Management is to manage the SEIO's products and services sources (contractors and government agencies) used to satisfy project requirements.

Contractor Management addresses one Goal and nine Practices:

- Goal 1: Coordinate work with the Contractor
  - ► Monitor and analyze selected processes used by the Contractor for effectiveness and compliance with agreements

    SFOC Surveillance Plan and PDPs document the processes and products to be monitored. (S) Except for award fee, formal contractor audits have been suspended. (W)
  - ► Evaluate selected work products to detect issues as early as possible

    Top X, tech panels, and working groups review work products. (S) There is no consistent, documented process to review Contractor work products. (W)
  - ► Review candidate non-developmental items to ensure that they satisfy specified requirements

    There is no documented process or guidelines for review of Contractor-proposed non-developmental items. (W)
  - ► Conduct periodic and event-driven reviews and interchanges with the Contractor

    There is no consistent, documented process to review Contractor progress. (W) For RTF SEIO has suspended its Contractor management duties to attend to fire drills. (C)
  - ► Compare the actual technical activities, cost and schedule of the Contractor's effort to planned schedules and budgets and identify issues and risks

    SFOC Surveillance Plan and PDPs document the process. (S) Found no consistent process to track Contractor issues, risks, and performance. (W)
  - ► Review and track hardware and software products (e.g., tools, test sets, simulators, spares) required for life cycle sustainment of the acquired system or products and identify issues

    This was found to be an ad hoc, undocumented process with no identified products for sustainment. (W)
  - ► Ensure the user participates in the evaluation of system performance to determine the satisfaction of operational requirements

    Top X, ICB, PRCB, Certification of Flight Readiness (CoFR), tech panels, and working groups ensure regular stakeholder interaction. (S) However, system performance evaluations done as a prime responsibility of other organizations may inhibit SEIO from ensuring user evaluation. (C)
  - ► Track issues, risks and Contractor performance and take action as appropriate

Top X, PRCB, tech panels, and working groups track issues and risks. (S) But found no consistent process to track Contractor issues, risks, and performance. (W)

► Accept delivery products in accordance with agreements

PDPs document criteria for acceptance of products. (S) However, this was not consistently followed. (W)

2.6.5 Integrated Teaming

The purpose of Integrated Teaming is to form and sustain an integrated team for the development of work products.

Integrated Teaming addresses two Goals and seven Practices:

- Goal 1: Establish and maintain a team composition that provides the knowledge and skills required to deliver the team's product
  - ► Identify and define the team's specific internal tasks to generate the team's expected output

    NSTS 07700 Program Structure and Responsibilities (NSTS 07700 Vol II) charters integrated team and working groups. (S)
  - ► Identify the knowledge, skills, and functional expertise needed to perform team tasks

    Skills requirements for teams are not documented. (W)
  - ► Assign the appropriate personnel to be team members based on required knowledge/skills

    There is no documented guidance on technical qualifications for team assignments. (W)

- Goal 2: Govern the operation of the integrated team according to established principles
  - ► Establish and maintain a team charter based on the integrated team's shared vision and overall team objectives

    Team charters are clearly defined and centralized in NSTS 07700. (B) Unchartered teams may not follow a disciplined process. (C)
  - ► Clearly define and maintain each team member's roles and responsibilities

    Team roles and responsibilities are specified in the Program Directives. (B)
  - ► Establish and maintain integrated team operating procedures

    NSTS 07700/37366, MSFC Program/Project Planning (MPG 7120.1), NASA Policy Directive - Program/Project Management (NPD 7120.4), and work instructions document operating procedures. (S)
  - ► Establish and maintain collaboration among interfacing teams

    The SSEIG integrates the technical panels. (S) However, the SSEIG may not have visibility into and fully integrate activities of unchartered teams. (C)

2.6.6 Requirements Development

The purpose of Requirements Development is to produce and analyze customer, product, and product-component requirements.

Requirements Development addresses three Goals and ten Practices:

- Goal 1: Translate stakeholder needs (functions and requirements) into customer requirements
  - ► Elicit, identify, and collect stakeholder needs

    Imagery, flow liner, and Electromagnetic Compatibility/Interference (EMC/I) activities are examples of where stakeholder needs are elicited. (S) But it is not a documented or consistently used process throughout SEIO. (W)
  - ► Develop the customer's requirements

    Tech panels and working groups develop requirements, PRCB approves. (S)

- Goal 2: Develop customer requirements into program requirements
  - ► Establish and maintain the project requirements

    NSTS 07700, Operations and Maintenance Requirements and Specifications Documents (NSTS 08171), and Space Shuttle Operations and Maintenance Requirements and Specifications Document – Introduction (NSTS 16007) capture program requirements. (S)
  - ► Allocate the requirements for each project component

    Tech panels and working groups allocate requirements, PRCB approves. (S)
  - ► Identify interface requirements

    Interface working groups develop and capture requirements in ICDs. (S)
  - ► Develop project verification requirements

    NSTS 07700 Vol X (Master Verification Plan) and SIPs are evidence of developed verification requirements. (S)

- Goal 3: Analyze and validate program requirements
  - ► Establish and maintain operational concepts and associated scenarios

    Models and environmental databases are maintained. (S) But operational concepts for products are not being maintained and executed. (W)
  - ► Establish and maintain a definition of required functionality

    NSTS 07700 Vol X defines the required functionality. (S)
  - ► Analyze requirements to ensure that they are necessary and sufficient and that they balance stakeholder needs and constraints

    Requirements are not consistently analyzed to achieve balance (e.g., for risks, cost, schedule) or according to a documented process. (W)
  - ► Validate requirements to ensure the resulting system will perform as intended in the user's environment

    Requirements are not validated with any comprehensive techniques following a documented process. (W)

2.6.7 Requirements Management

The purpose of Requirements Management is to manage the requirements of the project's products and to identify inconsistencies between those requirements and the project's plans and work products.

Requirements Management addresses one Goal and six Practices:

- Goal 1: The management of requirements, including the identification of inconsistencies with program plans and work products

- ► Develop an understanding with the requirements providers on the meaning of the requirements

  Requirements understanding is achieved using the well-documented change process with tech panel review and PRCB approval. (S)
- ► Obtain commitment to the requirements and requirements changes from project stakeholders

  Working groups, tech panels, SSEIG, ICB, and PRCB are forums to obtain stakeholder commitment to requirements changes. (S)
- ► Baseline and maintain requirements and place them under change control

  PRCB approves and NSTS 07700 documents requirements, following a strictly controlled configuration process. (S)
- ► Analyze requirements changes for their impact and associated risk

  Requirements and changes are not consistently analyzed for risk, supportability, and resources impacts following a documented process. (W)
- ► Maintain bidirectional traceability of requirements

  Requirements traceability is performed downward, but not upward. (W)
- ► Identify inconsistencies between project work and requirements and take appropriate action

  The PRCB and PRACA processes do identify inconsistencies. (S) However, the SEIO offices do not consistently perform this practice. (W)

2.6.8 Technical Solution

The purpose of Technical Solution is to design and control interfaces to requirements.

Technical Solution addresses one Goal and two Practices:

- Goal 1: Develop interface designs
  - ► Establish interface descriptions

    ICDs provide design guidance in addition to requirements to ensure compatibility. (B) However, this is a JSC-led function with little or no participation from the KSC or MSFC offices. (W)
  - ► Design and analyze interfaces using established and maintained criteria

    The interface definition process is clearly defined, well-documented, and executed. (B) But, found no documented process identifying element integrators roles or responsibilities from requirements definition through verification. (W) Found no evidence that an overall disciplined interface control process is applied at the integrated system level except for element interactions involving "hard" (e.g., mechanical/electrical) interfaces. (C)

2.6.9 Product Integration

The purpose of Product Integration is to prepare for element integration, ensure interface compatibility, and ensure that the integrated elements function properly.

Product Integration addresses three Goals and six Practices:

- Goal 1: Prepare for product integration
  - ► Determine the product-component integration sequence

ICDs and SIPs guide and document the integration sequence. (S) There is no documented SEIO process flow that clearly depicts the responsibilities and interactions. (C)

► Establish and maintain the environment needed to support integration of the product components

SEIO's responsibility in establishing the integrated test environment is not clearly defined. (W)

► Establish and maintain procedures and criteria for integration of the product components

SEIO roles in procedures development and integration criteria to be applied are not clear. (W)

- Goal 2: Ensure interface compatibility
  - ► Review interface descriptions for coverage and completeness

    ICDs provide design guidance in addition to requirements to ensure compatibility, documented in NSTS 07700 Vol IV. (B) No evidence was found of any verification role for the element interfaces MSFC is responsible for developing. (W) There is no SEIO integrator for the Orbiter element. (C)
  - ► Manage internal and external interface definitions, designs, and changes for products and product components

    Interface changes (Interface Change Notices (ICNs), Preliminary Revision Notices (PRNs), LCNs) follow a documented process managed primarily by working groups. (S) "Soft" interfaces may not be addressed. (W)

- Goal 3: Assemble product components and deliver the product
  - ► Evaluate assembled product components for interface compatibility

    NSTS 08117 defines no specific role for SEIO to address adequacy of elements when integrated. (W)

2.6.10 Verification

The purpose of Verification is to ensure that selected SEIO and SEIO contractor work products meet their specified requirements.

Verification addresses three Goals and seven Practices:

- Goal 1: Prepare to demonstrate that the product meets the requirements
  - ► Select the work products to be verified and verification methods to be used for each

    No process was found for selection of SEIO internal products to be verified. (W)
  - ► Establish and maintain the environment needed to support verification

    NSTS 08117 defines verification roles and responsibilities. (S) Non-board actions for products are ad hoc. (W) Found no integrated SEIO process flow that clearly depicts responsibilities and interactions. (C)
  - ► Establish and maintain verification procedures and criteria for the selected work products

    The Verification Handbook (MSFC HDBK 2221) defines a verification process, in conjunction with NSTS 07700 Vol X and NSTS 08117 guidance. (S) Could find no process that ensures products are selected based on risk (verification

activities appear based on reported anomalies instead of performance criticality. (W)

- Goal 2: Prepare for and conduct peer reviews on selected work products
  - ► Prepare for and conduct peer reviews on selected work products and identify issues resulting from the peer reviews

    Peer reviews do occur but are inconsistent and do not follow a documented process. (W)

- Goal 3: Verify work products against their requirements
  - ► Perform verification on the selected work products

    Verification of SEIO products lacks product selection criteria and consistency, and many in SEIO are unaware of SEIO verification responsibilities. (W)
  - ► Prepare for and conduct internal reviews of selected project office work products

    Top X review provides excellent incremental verification. (S) But the process is inconsistent for SEIO products. (W)
  - ► Analyze the results of all verification activities and identify appropriate action

    SEIO has a limited role in analyzing verification results. (W)

2.6.11 Validation

The purpose of Validation is to demonstrate that the integrated elements fulfill their intended use when placed in their intended environment.

The Validation Process Area addresses the following two Goals and five Practices:

- Goal 1: Prepare for validation by selecting work products, determine the environment, and establish criteria
  - ► Select products to be validated and the validation methods that will be used for each

    Imagery is provided for flight validation. (B) However, there is no documented guidance for what products will be validated. (W) Found no integrated launch-to-landing validation plan or process. (C)
  - ► Establish and maintain the environment needed to support validation

    Model validation is not current with design. (W)
  - ► Establish and maintain procedures and criteria for validation

    No evidence that there is a plan or process to validate the MSFC elements. (W)

- Goal 2: Ensure that the product is suitable for use in its intended operating environment
  - ► Validate products to ensure that they are suitable for use in their intended operating environment

    Other than for photo analysis there was no definition of the SEIO role in validation of the SSP elements, and use of expanded flight instrumentation beyond the next flight appears uncertain. (W)
  - ► Analyze the results of the validation activities and identify issues

    A multi-laboratory approach is used for image analysis and SEIO is re-introducing up-to-date empirical validation. (S)

2.6.12 Configuration Management

The purpose of Configuration Management is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

Configuration Management addresses three Goals and six Practices:

- Goal 1: Establish and release baselines of work products
  - ► Identify the configuration items, components, and related work products that will be placed under configuration management
    NSTS 07700 Vol IV guides formal configuration management. (S) However, there is no guidance for internal SEIO products to be placed under configuration control. (W)
  - ► Establish and maintain a configuration management and change management system for controlling work products
    NSTS 07700 Vol IV is the established, consistently used process for configuration management and the Shuttle Propulsion Configuration Management Manual (MSFC CM-017-022-2H) augments this process. (B) There is no configuration management for SEIO internal products. (W)
  - ► Create or release baselines for internal use and for delivery to the customer
    Baselines, including changes and dispositions, are created and released per NSTS 07700 Vol IV and are available to all electronically. (S)

- Goal 2: Track and control changes to the work products under configuration management
  - ► Track change requests for the configuration items
    Boards (Configuration Control Board (CCB), Change Review Board (CRB), Program Requirements Control Board (PRCB)) review and approve all changes to items under configuration control. (S)
  - ► Control changes to the configuration items
    The PRCB, which SEIO co-chairs, reviews and approves all changes to configuration items. (S) However, there is no configuration control for internal SEIO products. (W)

- Goal 3: Establish the integrity of baselines and keep them current
  - ► Establish and maintain records describing configuration items
    There is a comprehensive configuration management record system. (B) But found no configuration record keeping for internal SEIO products. (W)

2.6.13 Decision Analysis and Resolution

The purpose of Decision Analysis and Resolution is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Decision Analysis and Resolution addresses one Goal and six Practices:

- Goal 1: Describe how formal decisions are made including decisions made by evaluation of alternatives using established criteria and decision tools
  - ► Establish and maintain guidelines to determine which issues are subject to a formal

evaluation process

Examples of criteria for decision-making can be found in NSTS 07700 Vols II and IV, NSTS 16007 and NSTS 08218. (S)

► Establish and maintain criteria for evaluating alternatives, and the relative ranking of these criteria

Although some criteria for decisions are available, some criteria are ad hoc or applied inconsistently. (W)

► Identify alternative solutions to address issues

SEA Issue Sheets identify, analyze, and document risks and alternative approaches. (S) But found no documented guidelines or process for developing alternatives. (W)

► Select the evaluation methods

Found no documented guidelines or process for selecting evaluation methods. (W)

► Evaluate alternative solutions using the established criteria and methods

SEA Issue Sheets identify, analyze, and document risks and alternative approaches. (S) But found no documented guidelines or process for evaluating alternatives. (W)

► Select solutions from the alternatives based on the evaluation criteria

There are several good process examples of how to select solutions (PRCB, imagery analysis, MSFC Quality System Deficiency Notice System (MPG 1280.4 guidance)). (S) But the process is generally unstructured and inconsistent. (W)

2.6.14 Causal Analysis and Resolution

The purpose of Causal Analysis and Resolution is to identify causes of defects and other problems and take action to prevent them from occurring in the future.

Causal Analysis and Resolution addresses two Goals and five Practices:

- Goal 1: Systematically determine the root causes of defects and other problems
  - ► Select the defects and other problems for analysis

    There is guidance for defect resolution (safety, PMRB, MPG 1280.4.) (S) But the process for defect selection is undocumented and ad hoc. (W)
  - ► Perform causal analysis of selected defects and other problems and propose actions to address them

    There are several good process examples for performing causal analysis (Space Shuttle Requirements for Preparation and Approval of Failure Modes and Effects Analysis (NSTS 22206), NSTS 22254, and NSTS 37366, Material Review Board (MRB), imagery labs). (S) The causal analysis processes may not be followed by all element leads. (C)

- Goal 2: Systematically address root causes of defects and other problems to prevent their future occurrence
  - ► Implement the selected action proposals that were developed in causal analysis

    PRACAs and SEA Issue Sheets demonstrate actions to resolve problems. (S)

But there is no documented process found that guides action proposal implementation. (W)

- ► Evaluate the effect of changes on process performance
  Although there is some NSTS 07700 guidance, there were no metrics or measures to evaluate the effect of changes on performance. (W)
- ► Record causal analysis and resolution data for use across the project and organization
  There was no evidence that causal analysis data is recorded in a readily usable manner. (W) Some work products are kept on individual computers and not openly distributed. (C)

2.6.15 Organizational Training

The purpose of Organizational Training is to develop the skills and knowledge of people so they can perform their tasks effectively and efficiently.

Organizational Training addresses two Goals and seven Practices:

- Goal 1: Establish training needs, responsibilities, and capabilities and keep them current to meet organization/program needs
  - ► Establish and maintain the strategic training needs of the organization
    There is no strategic training plan for the organization. (W)
  - ► Determine which training needs are the responsibility of the organization and which will be left to the individual project or support group
    KSC Training Office conducts an annual web survey for training needs. (B) But there is no SEIO work-based needs assessment to determine training needs and responsibilities. (W)
  - ► Establish and maintain an organizational training tactical plan
    There is no tactical training plan for the organization. (W)
  - ► Establish and maintain training capability to address organizational training needs
    Although there are courses, training facilities, and mentoring, the training capability is ad hoc. (W)

- Goal 2: Provide the training necessary for individuals to perform their roles effectively
  - ► Deliver the training following the organizational training tactical plan
    Except for the KSC Training Office there is no organizational training and no plan. (W)
  - ► Establish and maintain records of the organizational training
    ISO 9000 training records (personal development plans) do exist and are kept current. (B)
  - ► Assess the effectiveness of the organization's training program
    There was no indication that training is assessed or feedback given to determine training effectiveness. (W)

2.6.16 Organizational Process Definition

The purpose of Organizational Process Definition is to establish and maintain a usable set of organizational process assets.

Organizational Process Definition addresses one Goal and two Practices:

- Goal 1: Establish and maintain a set of organizational process assets
  - ► Establish and maintain the organization's set of standard processes

    There is a well-documented set of organizational standard processes for all NASA centers. (B)
  - ► Establish and maintain the organization's process asset library

    MSFC has an online process asset library of policies, standards, processes, work instructions, plans templates, and process aids. (B) But the other centers have no equivalent library. (W)

3. Results

At each SEIO organization, the Appraisal Team used the 103 practices of the CMMI®-NS model as a tool to appraise the level of implementation of their processes. In performing the appraisal, the Appraisal Team used five levels of Practice Implementation. The five levels are:

- Best Practice
- Fully Implemented
- Partially Implemented
- Not Implemented
- Not Applicable

Figure 3 below describes the levels.

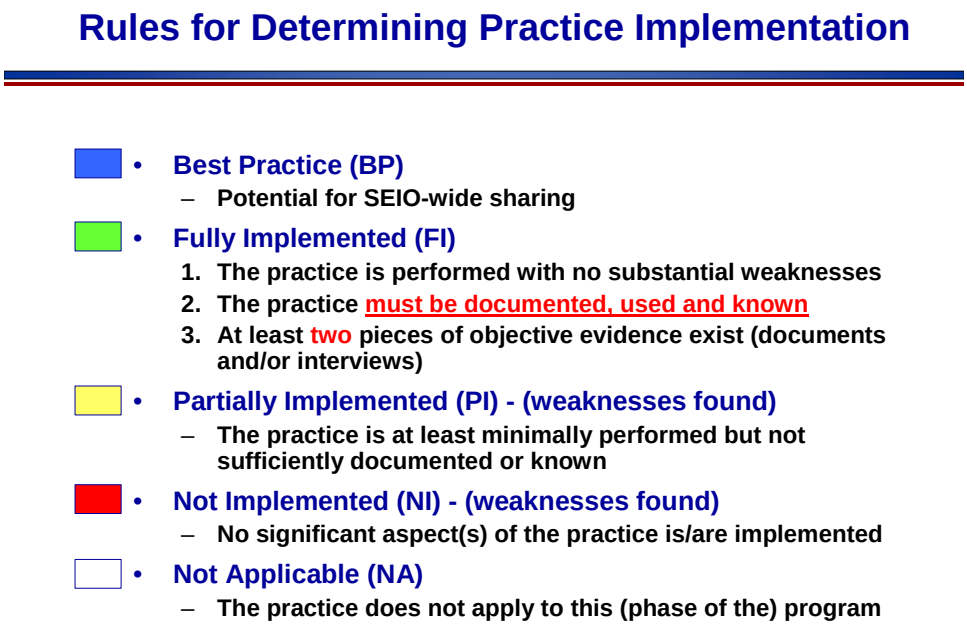

Figure 3 Rules for Determining Practice Implementation

3.1 SEIO Results

Figure 3.1 summarizes the results of the SEIO Appraisal. This summary was achieved by combining the results of individual results from JSC, KSC, and MSFC. Because three organizations were involved, the results summarize a total of 309 practices. For the SEIO organization, 14 (4.5%) of the practices were identified as a Best Practice (BP), 107 (34.6%) of the practices were identified as Fully Implemented (FI), 169 (54.7%) of the practices were identified as Partially Implemented (PI), 17 (5.5%) of the practices were identified as Not Implemented (NI), and two (0.6%) of the practices were identified as Not Applicable (NA).

BP and FI practices are evidenced by efficient operations. Typically, these practices are documented and managed, and are used by all on a regular basis. PI practices typically are getting the job done, but sometimes rely on an undocumented process (i.e. using "tribal knowledge" of experienced individuals). Conversely, a PI practice could be one which is well documented, but which people just do not follow. Those practices deemed to be NI just are not getting the job done.

The recommendations contained in Section 4 address those Practices that were found to be either Partially Implemented or Not Implemented. In several cases, applying a Best Practice is part of the recommended approach.

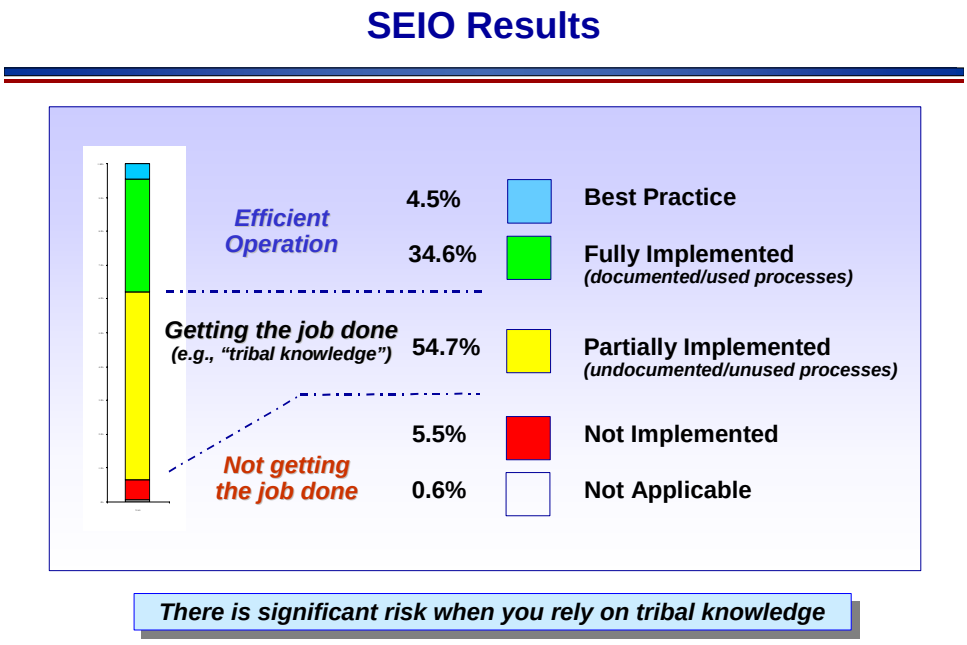

Figure 3.1 SEIO Results

3.2 SEIO Appraisal Summary

The bar chart shown in Figure 3.2 summarizes the results of the SEIO Appraisal. For each Process Area (such as "PP" – Program Planning), the number of Best Practices, "Fully Implemented", "Partially Implemented", "Not Implemented", and "Not Applicable" are represented. The heights of the bars are different, as each Process Area has a different number of Practices. The abbreviations for each of the Process Areas shown in Figure 3.2 are as follows:

PP = Program Planning
PM = Project Management
RiM = Risk Management
KM = Contractor Management

IT = Integrated Teaming
RD = Requirements Development
ReM = Requirements Management
TS = Technical Solution
PI = Product Integration
VER = Verification
VAL = Validation
CM = Configuration Management
DAR = Decision Analysis & Resolution
CAR = Causal Analysis and Resolution
OT = Organizational Training
OPD = Organizational Process Definition

The definitions of each Process Area are contained in the Process Findings Section of this report, Section 2.6.

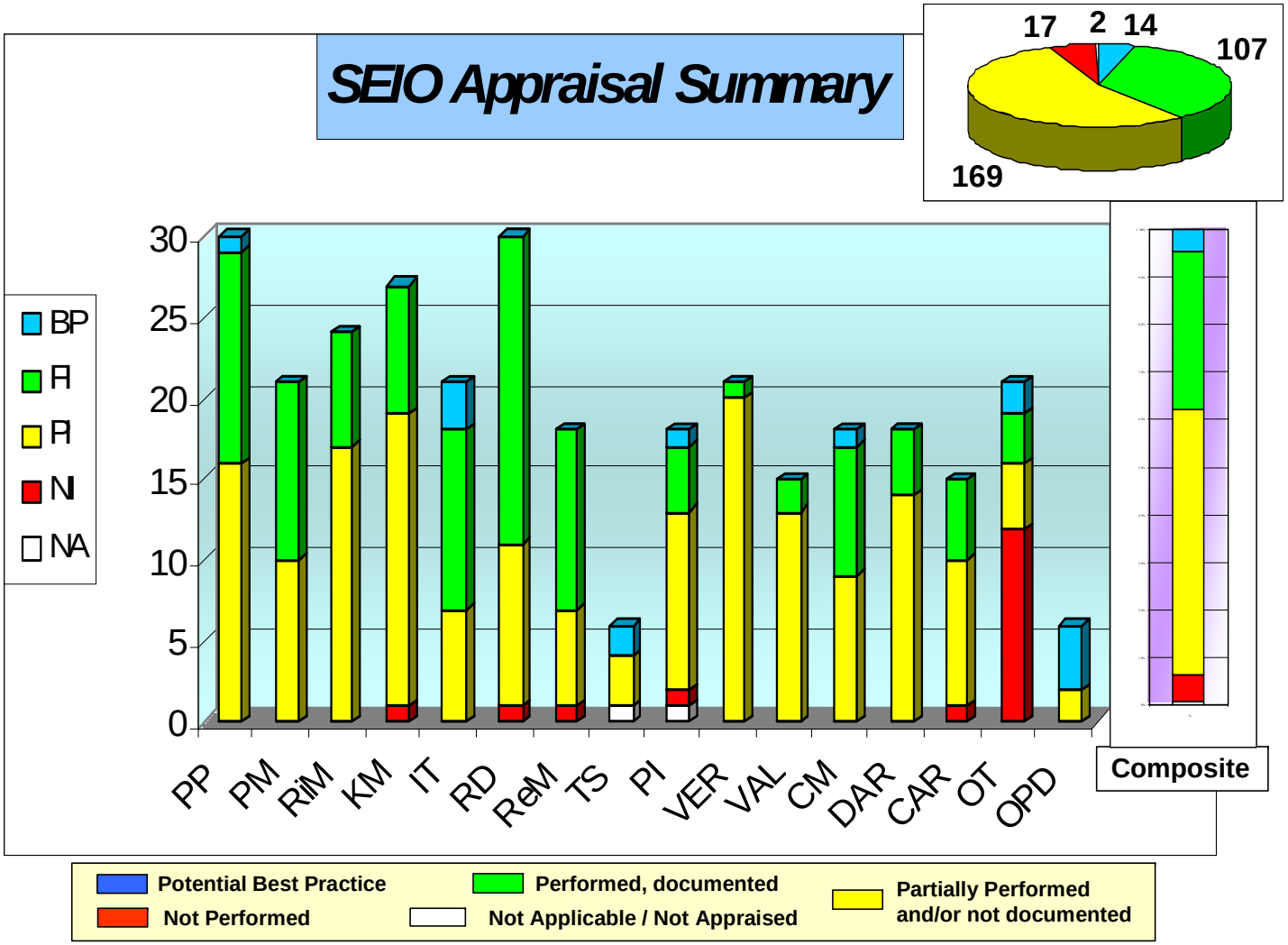

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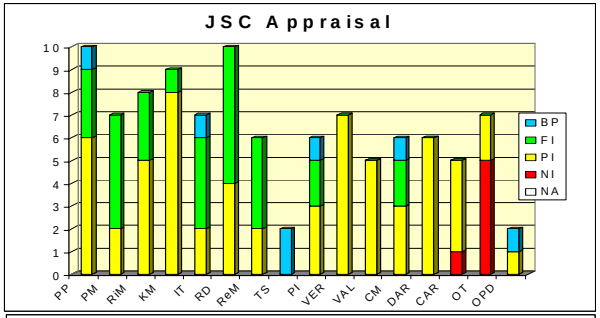
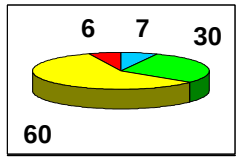
Figure 3.2 SEIO Appraisal Summary

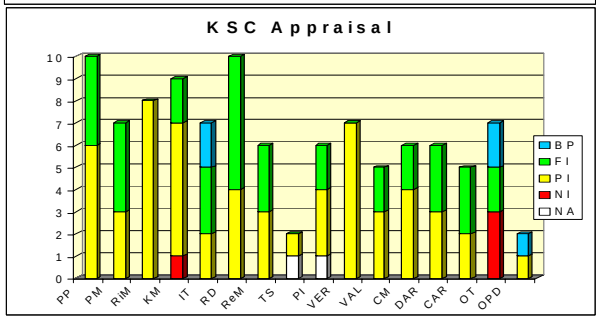
3.3 Results Summary

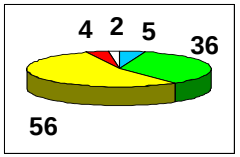
Figure 3.3 summarizes the results from each SEIO organization. While each SEIO organization was unique, Figure 3.3 shows that the same nine (out of a total of 16) Process Areas could use improvement. Therefore, many of the recommendations in Section 4 are focused on improvements in these nine areas.

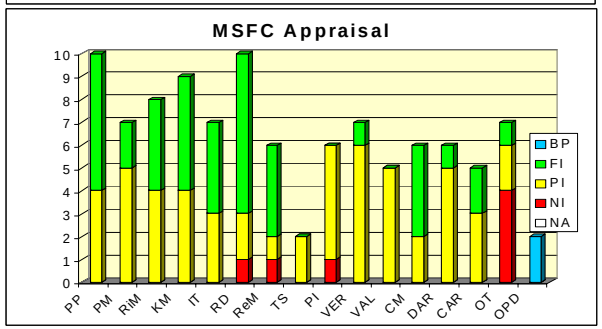
Results Summary

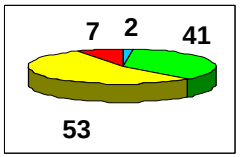












Areas identified for improvement

- Risk Management
- Contractor Management
- Verification
- Validation
- Product Integration
- Decision Analysis
- Causal Analysis
- Configuration Mgmt (internal products)
- Training

Figure 3.3 Results Summary

3.4 SEIO 2004 Benchmark

Figure 3.4 contains the SEIO 2004 Benchmark chart. This chart summarizes the results of the appraisal of each Process Area relative to the following seven Process Implementation Characteristics:

- Do processes exist?
- Are they used?
- Are they documented?
- Do others know about them?
- Are they reviewed by management?
- Are there adequate resources to perform the processes?
- Is there process training?

As can be seen in Figure 3.4, many of the Not Performed (red) Process Areas are related to training. This includes the Organizational Training Process Area as well as process training related to the other 15 Process Areas.

The next time an appraisal is performed, another Benchmark can be created and compared with Figure 3.4.

SEIO 2004 Benchmark

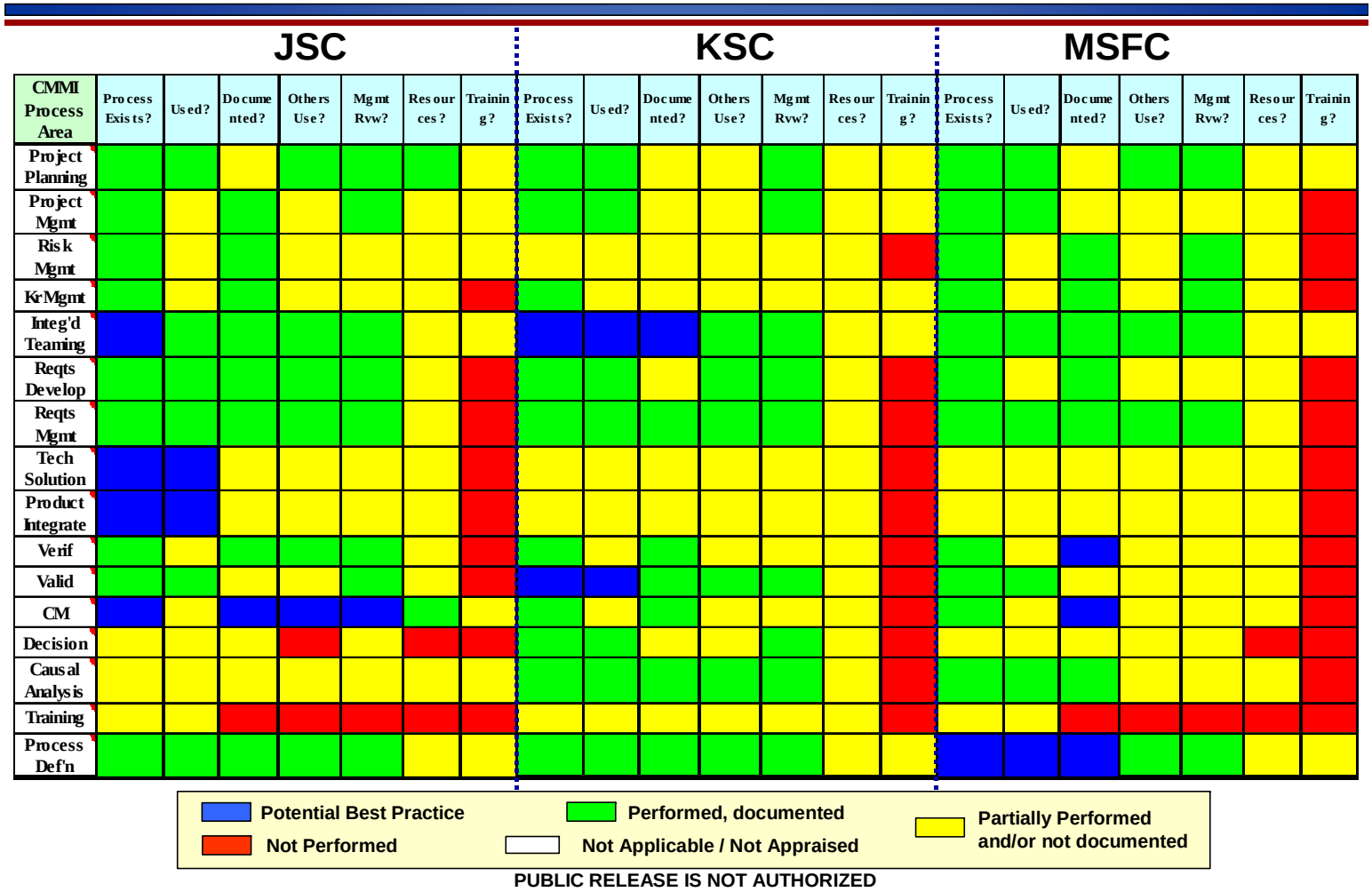


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Figure 3.4 SEIO 2004 Benchmark

4. Recommendations

The Appraisal Team has taken the findings described in Section 2.6 and generated 18 recommendations that we believe represent implementable process improvement actions that should improve SEIO operations. These recommendations can be characterized as recommendations which will:

- Improve SEIO's valued-added to the Space Shuttle Program (SSP),
- Enable SEIO to produce tangible products which will reduce the risks to the SSP and/or Return To Flight (RTF),
- Correct shortcomings in selected SEIO process areas, and
- Improve communication and reduce barriers between/among the three SEIO organizations.

Although each category implies a certain level of benefit to the SSP and/or RTF, the recommendations have been listed in our perceived order of value-added to the principal SEIO role of system integrator (SI). As part of this SI role, SEIO needs to monitor and facilitate a closed-loop two-phase process (Figure 4) that ensures each mission is performed with minimum risk, and any latent risks revealed during the mission are identified and mitigated to minimize the risk to future missions. The initial phase is the preparation for launch and the verification that the system is flight ready – the basic Master Verification Plan / Certification of Flight Readiness (MVP/CoFR) process that is currently in existence. The second phase is the validation of the system's operation/performance in the operational environment. This basic closed-loop process is in fact the engineering process area of the basic CMMI® model's framework; all processes in the CMMI®-NS model are involved in the success of this feedback loop in some manner. As a result, the following recommendations represent an integration of the individual process observations, strengths, and weaknesses into an actionable recommendation that should improve SEIO performance and enhance the probability of each shuttle mission's success.

Integration Process Flow

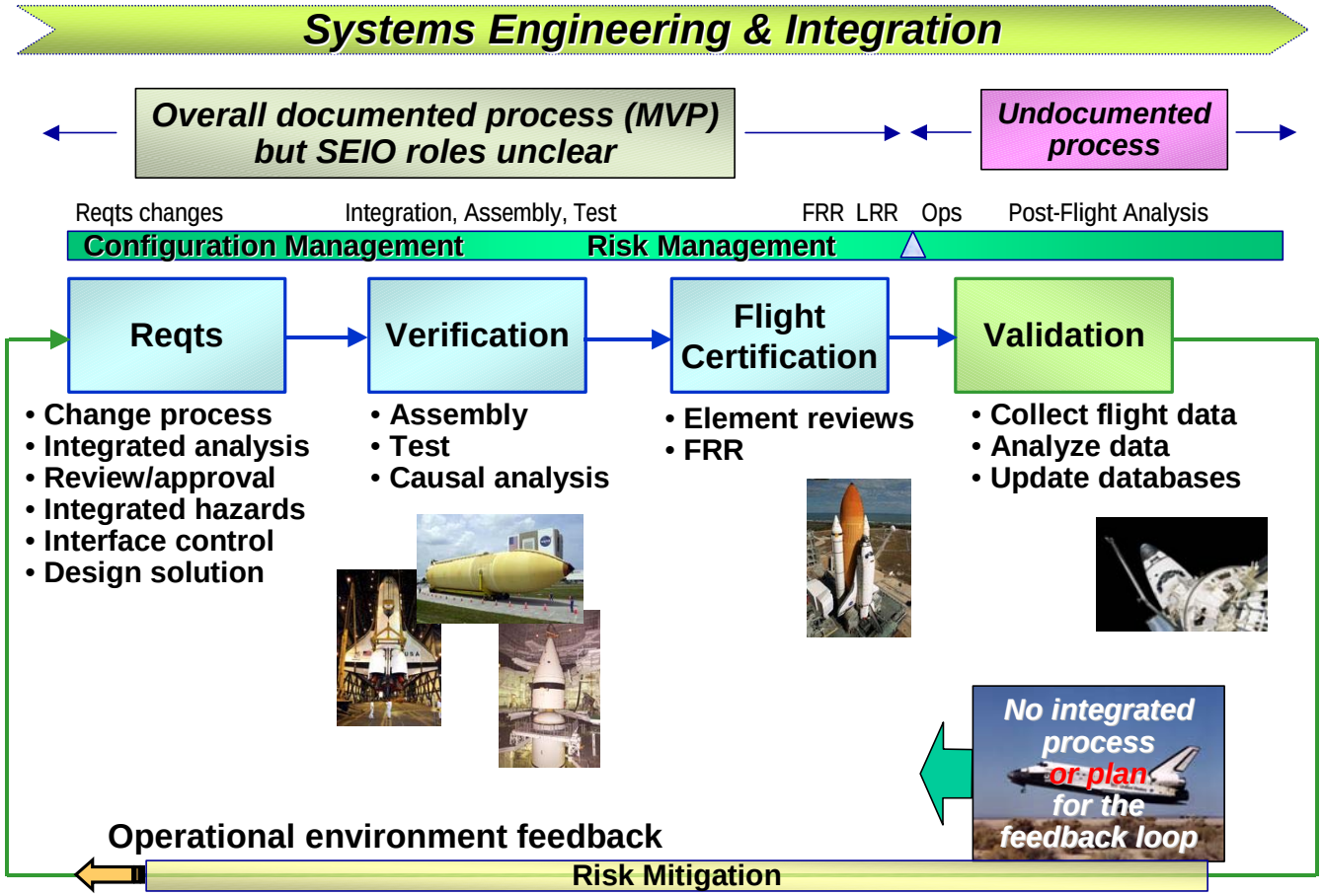

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Figure 4 SEIO Integration Process Flow

4.1 Recommendation 1 - Clarify & Document SEIO Integration Process Flow from Requirements Development through Launch

Definition of Problem:

Although the MVP provides an overview of the SSP verification process, a clear description of an integrated process detailing roles/responsibilities/products for SEIO prior to launch does not exist. All offices expressed uncertainty about their integrated roles/responsibilities during the interview process. All elements, including the orbiter, need an integrator function within SEIO, with clear responsibilities and inter-organization contacts to minimize potential that interfaces may not be examined and key integration risks/issues not be identified or sufficiently addressed. Clear definition will improve communication and collaboration, reducing the risk that a critical integration issue might be overlooked.

Recommendation:

Clarify and document the SEIO integration process flow from requirements development to launch and define SEIO offices and element integrator roles, responsibilities, and products. This will ensure that:

- Any change affecting multiple elements is well-defined and committed to by all parties to ensure proper compliance and monitoring
- Element integrators assess integrated performance of the stacked elements

Rationale:

Although there is an MVP and other planning documentation, there is no clear description of an integrated process detailing SEIO roles, responsibilities, and products prior to launch. Clear definition will improve communication and collaboration, reducing risk that a critical integration issue might be overlooked.

Suggested Approach:

Prepare an integrated process flow (e.g., similar to the MSFC Verification Handbook (MFSC-HDBK-2221) Fig. 2.1.3-1 or Fig. 2.2.2.3-1) that documents in an integrated flow chart fashion all of the current functions from requirement identification through CoFR and launch. The SEIO roles, responsibilities and products for each function should be documented, identifying the lead and all contributing positions and associated responsibilities for all positions within the SEIO offices. This would provide a correlation of information currently distributed in various documents (e.g., MVP) in a manner that clearly identifies SEIO employee responsibilities (integration, verification and risk identification/mitigation) and their value added to the shuttle mission.

The objective of this approach is to independently ensure risk-based verification of the integrated system requirements in a manner that provides better risk visibility (e.g., identification of potentially unidentified risks via an integrated perspective) and clearly identifies each employee's contribution to mission success. The result should be more efficient mitigation (greater mitigation per unit resource) of potential risks and enhanced probability of mission success.

4.2 Recommendation 2 - Define & Document SEIO Integration Process Flow from Launch through Landing

Definition of Problem:

There is no clear feedback process to ensure potentially critical performance deficiencies, or trends revealed during system operations are fed into the requirements process. No description of an integrated process identifying roles, responsibilities, and products for SEIO in assessing performance in the operating environment exists. There is no clear integrator role, focused plan (like the MVP) or defined process to ensure potentially critical performance deficiencies/trends have clear feedback into the requirements process. Individuals involved in the element development who have the greatest knowledge and insight into potential risks are not necessarily involved in looking for deficiencies. There is potential that anomalies may not be examined and integration risks and issues not identified or sufficiently addressed. Clear definition will improve communication and collaboration, reducing the risk that a critical interface might be overlooked.

Recommendation:

- Define and document the SEIO integration process flow from launch through landing and define SEIO offices and element integrator roles, responsibilities, and products.
- Develop an integrated plan (with feedback into the requirements process) for element validation in the operational environment.

Rationale:

There is no clear feedback process to ensure potentially critical performance, deficiencies, or trends are fed into the requirements process. There is potential that anomalies may not be examined and integration risks and issues may not be identified or sufficiently addressed.

Suggested Approach:

Validation requirements should be established in parallel to the verification requirements to ensure operating performance is validated and the most knowledgeable individuals are involved in a risk based search for anomalies and unforeseen trends. Based upon these requirements, an integrated process flow (e.g., similar to MFSC-HDBK-2221 Figs. 2.1.3-1 or 2.2.2.3-1) should be prepared that documents in an integrated flow chart fashion all of the identified functions from launch through landing. SEIO roles, responsibilities and products for each function should be documented, identifying the lead and all contributing positions and associated responsibilities for all positions within the SEIO offices. This would provide information in a manner that clearly identifies SEIO employee responsibilities (integration and risk identification/mitigation) and their value added to the shuttle mission.

One objective of this approach is to establish a focused approach to validation comparable to that currently done for verification/CoFR by the MVP. This should be a continuation of the SEIO prelaunch roles and responsibilities. Another objective is to provide better risk visibility (e.g., identification of potentially unidentified risks via an integrated perspective) and ensure proper assessment and incorporation of observations into the requirements process.

4.3 Recommendation 3 - Formulate an Integrating Risk Management Process

Definition of Problem:

SEIO's Continuous Risk Management process described in Appendix B to the Shuttle Environmental Assurance Initiative Implementation Plan (NSTS 37366), considered by the Appraisal Team to be a Best Practice, and other documents such as Marshall Work Instruction QS01 - Program/Project Risk Management (MWI 7120.6), provide guidance to evaluate, categorize, and prioritize risks. However, the Appraisal Team found no evidence that programmatic, integration (technical), or non-safety related risks are addressed, identified, prioritized, mitigated, or documented). Of particular concern is the fact that the element risk processes appear to operate independently without an integrated risk perspective. There is also concern that there appears to be no consolidated risk reporting process that captures all identified risks and ensures upper management visibility.

Recommendation:

Formulate an integrating Risk Management process to be used across all three SEIO organizations. Include programmatic and integration risks as risk sources, and use risk assessment results to guide the verification process.

Rationale:

There is no integrated SEIO risk management process. Programmatic and integration risks are not identified, and there is no consolidated risk reporting. Implementing a process will provide early, aggressive, and comprehensive risk identification through the collaboration and involvement of all relevant stakeholders.

Suggested Approach:

More rigorously and consistently apply Risk Management Procedures and Guidelines (NPR 8000.4). Consider NSTS 37366 Appendix B as an approach to SEIO programmatic and integration risks and use of the Shuttle Environmental Assurance Initiative Issue Summary Information Sheet (identified as a Best Practice) as a method for concise reporting and tracking. Also consider developing a risk matrix to document and track integration risks. Use of a "likelihood vs. consequence" approach to characterize each risk would be good if a more general "likelihood" scheme (e.g., improbable/probable/frequent) that is based upon expert judgment, similar to the NASA technical maturity rating scheme, is used rather than using the precision "Likelihood A/B/C/D/E" probability categories or "Probabilistic Risk Assessment". This approach (example in Table 4.3 below) emphasizes use of expert judgment and generally requires fewer resources.

Table 4.3 Risk Matrix Approach

Risk Area	Likelihood Characteristics		
	Improbable	**Probable**	**Frequent**
Integration requirements	Completely defined and funded. No special design issues.	Partially defined or not funded. Some unique design problems, solutions identified.	Not defined, critical compatibility or design problem--no solution identified.
External interfaces	Simple & well defined. No unique development required.	Minor development needed or some interfaces need more definition.	Major development required and/or major interfaces not defined.

4.4 Recommendation 4 - Select & Analyze Relevant Defects

Definition of Problem:

The Appraisal Team observed that there is no SEIO-wide consistent process for identifying and correcting the root causes of selected defects (any anomaly that has the potential to impact or actually impacts mission performance) or any criteria for selecting the priority for analysis. Furthermore, with no SEIO-wide process, there is also no database available from which to determine similarities among previously dispositioned defects, or to determine the frequency (if any) of how often the defects may be occurring in different parts of the Shuttle Program.

Recommendation:

Establish a consistent SEIO-wide process to:

a. Determine which defects to analyze,
b. Develop solutions,
c. Define actions,
d. Evaluate the effects of changes, and
e. Document in a centralized database.

Rationale:

There is no consistent process nor centralized database that surfaces associated/recurring defects, precludes duplication of work and ensures ready access to risk concerns. Such a process would provide SEIO with the ability to recognize areas of concern, select and analyze relevant defects for analysis, review what has been done in SSP organizations, better develop solutions, and take action to prevent future occurrence.

Suggested Approach:

Establish an SEIO-wide process and associated database to identify and analyze defects and the effects the proposed changes may have on the integrated SSP elements prior to implementation of the change. The identification and prioritization of the defect to be analyzed should be based on a set of criteria that consistently ensures the analyses performed will significantly enhance the probability of mission success. The analytical process should ensure a consistent approach to the analyses that will result in actionable results with sufficient documentation to minimize future duplication of effort. This process would tie in with Recommendation 9 (Analyze Requirements) and would span SEIO's Requirements Development, Requirements Management, and PRCB areas in addition to involving the Element Leads. Related with this is the establishment of a centralized data archiving system (searchable database) that supports the process. The database would be online, with username and password access.

4.5 Recommendation 5 - Establish & Maintain an Overall SEIO Plan

Definition of Problem:

The appraisal observed lack of detailed definition of responsibilities across SEIO. Staff reported unclear roles, poor communication of expectations, a tendency to focus on the crises of the present, and an uncertainty of how the organization will operate with a geographic spread across three centers. This may create an environment that leads to duplication of effort or results in critical interface risks being overlooked.

Recommendation:

Establish and maintain an overall SEIO project plan that:

a. Captures the systems engineering roles and responsibilities defined in recommendations 1 and 2,
b. Identifies tasks, budget, risks, schedule, resources, and stakeholder involvement,
c. Lays the foundation for resource and training needs, and
d. Establishes a basis on which to make resource adjustments.

Rationale:

A documented and maintained project plan literally would "connect the dots" for the offices, tying together in a logical manner the technical and management tasks, risk identification, budgets, schedules, project data, resource and skill requirements, and stakeholder interaction. Clearly defined roles and product responsibilities allow the offices to better coordinate and collaborate, providing management with greater visibility. This helps to address the stated problems of uncertainty of roles, poor communication, lack of situational awareness, possible duplication of effort, and potential omission of or insufficient attention to key issues.

Suggested Approach:

The purpose is to capture in one place a common set of processes required for the coordinated technical management and control of the SEIO effort. One way to accomplish this would be to create an SEIO Management Plan. A sample Management Plan outline, tailored for SEIO by using the results of the Appraisal, is shown in Figure 4.5. The plan should include an associated Systems Engineering Schedule or Integrated Master Schedule (IMS) that clearly identifies the interdependencies among the various tasks.

Establish a Work Breakdown Structure or equivalent, with task descriptions and products clearly defined, to scope the SEIO effort and provide a basis for estimating resource and training needs.

Capture the appropriate Space Shuttle Program Integration Support Activities (No. 033C) of the Space Shuttle Program Interface Agreement (SSPIA) Memorandum of Understanding (MOU) roles and consider eliminating the MOU. Reason: MOU's tend to reinforce "stovepipes" because they are written as a contract between two parties. If SEIO is to function as a single integrated operation regardless of its geographical components, then it should not require a contract among its units.

Figure 4.5 Sample Outline for an SEIO Management Plan

SECTION 1: SCOPE
1.1 PURPOSE
1.2 MISSION DESCRIPTION
1.3 SYSTEMS ENGINEERING OVERVIEW
1.4 SEIO MANAGEMENT PLAN CHANGE CONTROL

SECTION 2: REFERENCE DOCUMENTS
2.1 APPLICABLE DOCUMENTS
2.2 REFERENCE DOCUMENTS

SECTION 3: SYSTEMS ENGINEERING ORGANIZATION
3.1 ORGANIZATIONAL STRUCTURE
3.1.1 SEIO
3.1.2 Integrated Teams
3.1.3 Working Groups

3.2 ROLES AND RESPONSIBILITIES ***(also see Recommendations 1 and 2)***
3.2.1 MS
3.2.2 MK-SIO
3.2.3 MP-71
3.2.4 Relationship to Elements

3.3 WORK BREAKDOWN STRUCTURE (or equivalent)

3.4 PROJECT MANAGEMENT
3.4.1 Integrated Working Environment
3.4.2 Budget Development Process
3.4.3 Resources and Training ***(also see Recommendation 6)***
3.4.4 Data Management ***(also see Recommendation 13)***
3.4.5 Internal Reviews ***(also see Recommendation 7)***
3.4.6 Action Item Management ***(also see Recommendation 14)***
3.4.7 Contractor Management ***(also see Recommendation 8)***

SECTION 4: SYSTEM ENGINEERING PROCESS
4.1 INTRODUCTION AND PLANNING
4.1.1 Systems Engineering Planning

4.2 SYSTEMS ENGINEERING PROCESSES DESCRIPTION
4.2.1 Requirements Development and Management
- 4.2.1.1 Mission Operations Analysis
- 4.2.1.2 Performance Requirements and Databases
- 4.2.1.3 Specialty Engineering (reliability, EMC/I, human factors, safety, etc.)
- 4.2.1.4 Trade Studies
- 4.2.1.5 Requirements Products (specs, ICDs)
- 4.2.1.6 Change Control

4.2.2 Synthesis
- 4.2.2.1 Technology Assessments

4.2.2.2 COTS and NDI guidelines ***(also see Recommendation 15)***
4.2.2.3 Integration Analysis
4.2.3 Design Analysis
4.2.3.1 Interface Definition
4.2.3.2 Risk Assessment
4.2.3.3 Integrated Hazard Analysis
4.2.4 Product Integration and Interface Control
4.2.4.1 Integration Sequence
4.2.4.2 Interface Review
4.2.4.3 Evaluation of Assembled Products
4.2.5 Verification
4.2.5.1 Products for Verification
4.2.5.2 Verification Methods
4.2.5.3 Reviews
4.2.6 Validation ***(also see Recommendation 2)***
4.2.6.1 Products for Validation
4.2.6.2 Validation Methods
4.2.6.3 Analysis of Validation Results

SECTION 5: SYSTEM ENGINEERING CONTROLS
5.1 SYSTEM REVIEWS
5.1.1 Formal Reviews
5.1.2 Informal and Internal Reviews
5.1.3 Technical Interchange Meetings

5.2 SYSTEM ENGINEERING SCHEDULE

5.3 CONFIGURATION MANAGEMENT AND CHANGE CONTROL
(follows NSTS 07700 Vol IV)

5.4 RISK MANAGEMENT ***(also see Recommendation 3)***
5.4.1 Roles and Responsibilities
5.4.2 Risk Management Process
5.4.2.1 Risk Strategy
5.4.2.2 Risk Identification
5.4.2.3 Risk Mitigation
5.4.2.4 Risk Reporting

5.5 METRICS AND TECHNICAL PERFORMANCE MEASURES (TPMs)
5.5.1 Metrics
5.5.2 TPMs

4.6 Recommendation 6 - Develop a Training Philosophy & Plan

Definition of Problem:

The organization is responsible for development of its personnel. However, the Appraisal Team found there is no training program that ensures personnel understand their roles and responsibilities within SEIO, nor do they have ready access to the training necessary to perform them. Both strategic organizational planning and tactical implementation planning are missing. An effective training program, based on a needs assessment, can provide SEIO personnel with the necessary SEIO-specific skills and knowledge and facilitate focused Human Resources (HR) support.

Recommendation:

Determine the training needs, and develop a training philosophy and plan, based upon an assessment of the integrated roles and responsibilities within the SEIO organization.

Rationale:

The organization is responsible for personnel development but does no strategic or tactical training planning. An effective training program provides personnel with the necessary SEIO-specific skills and knowledge, and facilitates focused HR support.

Suggested Approach:

Using the roles/responsibilities/products identified in the process description developed under Recommendation 1, have the individual employees identify the training that is needed to perform their function(s) and identify what if any of this training they need to become proficient at their job. These inputs could be collected using the web tool already in use at KSC (best practice). This data set would then be used to define the SEIO training philosophy and strategic plan. Using the database in conjunction with the philosophy and strategic (multi-year) plan, the SEIO offices in coordination with the center HR could develop yearly tactical plans as currently done by KSC. The plans do not need to be elaborate but need to be in sufficient detail to enable a flexible training process to be established and training scheduled/provided by the center HRs. Keys to success will be the active participation of the employees in the identification of training needs and the establishment of a process with sufficient flexibility to enable employees to receive training without impacting job productivity (e.g., web based training and references that can be individually accessed when time is available). The objective is to ensure personnel have the necessary SEIO-specific skills and knowledge to accomplish and have confidence in their SEIO roles.

4.7 Recommendation 7 - Conduct Periodic SEIO Internal Reviews

Definition of Problem:

The Appraisal Team found that SEIO has no process for performing reviews of resource allocation, tasks, products and schedule against an overall project (program) plan. The lack of this process hampers SEIO's ability to monitor actual performance and progress against program baselines and makes it more difficult to manage corrective actions to closure.

Recommendation:

SEIO should conduct periodic internal integrated reviews. These reviews will serve to monitor resources, tasks, products, and schedules against the project plan.

Rationale:

Periodic internal integrated reviews will offer SEIO a means to better create a seamless organization, to improve communication, and to reduce the risk of overlooking integration issues.

Suggested Approach:

Consider a monthly SEIO Integrated Review to be attended by the responsible SEIO Leads. A video teleconference would reduce the travel costs, both in dollars and lost time to travel.

A typical Integrated Review agenda might include:

- Funding & Expenditures (Earned Value top-level summary)
- Issues (new issues, status of existing issues; corrective action and plan for closure, stoplight chart summary)
- Risks (new risks, status of existing risks; corrective action and plan for closure, stoplight chart summary)
- Resources (review of allocation of manpower (resources) against the issues and risks being worked, stoplight chart summary)
- Schedule Status against the overall plan (status of progress on issues and risks related to the current launch schedule; stoplight chart summary)

4.8 Recommendation 8 - Establish More Formal Monitoring/Accountability of Contractor Performance

Definition of Problem:

Although the government conducts periodic review of its contractor (United Space Alliance (USA)), it appears to be done informally. The more formal contractor surveillance has been suspended during the Return-to-Flight activities. Some SEIO staff reported lack of insight into contractor (USA) processes and products, and most reported no direct access to Boeing engineers. Contractual constraints should not prevent the free flow of information nor restrict direct government access to the performing engineers. Informal or infrequent review of contractor work may not ensure the work is executed according to agreement, is of acceptable quality, and that action can be taken early to correct problems.

Recommendation:

Establish a more formal monitoring and accountability of contractor performance (cost, schedule, and technical):

a. Reinstate the Space Flight Operations Contract (SFOC) Surveillance Plan,
b. Follow the published Product Development Plans and use the stated criteria to evaluate contractor performance, and
c. Facilitate government access to SFOC subcontractors performing the work.

Rationale:

More formal, in addition to regular, contractor evaluation allows the government to gain a more thorough understanding of contractor performance and to detect and address process and product quality, as well as programmatic and contractual, issues early.

Suggested Approach:

Consider monthly (or convenient period) formal Project Management Reviews that follow a standard format and in an integrated fashion reviews contractor performance at all three SEIO locations. Address significant accomplishments, schedule events and milestones, technical risks including mitigation progress, budget status, resources, planned work, and issues. Identify and report metrics for the appropriate tasks as specified in the agreed upon Product Development Plans.

Despite the SFOC contractual restrictions, insist on Boeing participation in reviews and become more aggressive in gaining access to the performing subcontractor engineers. Consider holding regularly telecons with Boeing that include USA.

4.9 Recommendation 9 - Analyze Requirements

Definition of Problem:

SEIO appears to have no consistent process to analyze requirements to achieve balance of stakeholder needs and constraints. Stakeholder needs and constraints can impact cost, schedule, performance, functionality, reusable components, maintainability, or risk. By not addressing these areas, the ability of SEIO to manage the requirements of the project's products and product components, and to identify inconsistencies between those requirements and the project's plans and work products, is adversely impacted.

Recommendation:

Develop a process with criteria (e.g., supportability, risks, resource impacts, cost, schedule) to analyze, maintain, and execute operations concepts and scenarios. This process should include a way to analyze the balance of stakeholder needs and constraints.

Rationale:

A requirements development process, supported with analytical techniques, will provide SEIO with a focus to ensure that requirements are adequately balanced.

Suggested Approach:

This process would tie in with Recommendations 3, 4, and 11. SEIO should consider using proven models, simulations, and prototyping to analyze the balance of stakeholder needs and constraints. Results of the analyses can be used to reduce costs and risks. Established criteria such as supportability, risks, resource impacts, cost, and schedule should be used in analyzing, maintaining, and executing operations concepts and scenarios. In addition, the process should identify the Stakeholder(s) by name, so that the Stakeholder(s) may be appropriately included in the balancing process. The proactive inclusion of the stakeholders is critical to establishing an efficient process and establishing/maintaining the stakeholder buy-in needed to ensure rapid approval for implementation of the results.

The process should ensure that the following are addressed in balancing needs and constraints:

- Risk assessment;
- Schedule impact, including task interdependencies; and
- Cost.

4.10 Recommendation 10 - Analyze Requirements Changes

Definition of Problem:

The Appraisal Team found that SEIO appears to have no process for analyzing requirements changes. Without this process, SEIO is limited in ensuring that impacts and associated risks are sufficiently considered when analyzing requirements changes.

Recommendation:

SEIO should develop a process (with criteria) to analyze requirements changes. The analysis should include impact and associated risk on product performance, architecture, supportability, system resource utilization, verification requirements, schedule, and cost. Part of this process should include maintenance of bi-directional traceability among requirements, project plans, and work products.

Rationale:

A requirements change process with criteria and bi-directional traceability focuses the approach to ensure that impacts and associated risks are sufficiently considered when analyzing requirement changes.

Suggested Approach:

Develop a process, with criteria, to analyze requirements changes, to include impact and associated risk on product performance, architecture, supportability, system resource utilization, verification requirements, and schedule and cost. Special attention needs to be paid to interdependencies among requirements, especially as they pertain to integrated element operations.

Implement a means of providing bi-directional traceability similar to that done on the External Tank. The External Tank End Item Specification (CPTO1M09A) shows requirement traceability down and back up to NSTS 07700.

4.11 Recommendation 11 - Develop a Proactive Joint Multi-Element Process for Inter-Element Requirements

Definition of Problem:

The Appraisal Team observed that requirements are not consistently being proactively identified and elicited across SEIO from the stakeholders and customers. The Team also could not find any evidence that requirements were analyzed to ensure that they are necessary and sufficient nor that stakeholder needs and constraints are being balanced. Rather, inter-element requirements, issues, risks, etc. are handled on an ad hoc basis. A joint multi-element process would help ensure that inter-element requirements, issues, risks, etc. are worked in a formalized manner.

Recommendation:

Develop a proactive joint multi-element process (technical panels, working groups, teams) to proactively solicit, develop, analyze, and validate inter-element requirements. The process needs to include stakeholder involvement.

Rationale:

A process that will actively engage stakeholders would improve understanding of requirements, and help to ensure that a full set of inter-element requirements are thoroughly developed, analyzed, and validated.

Suggested Approach:

Develop, establish, and document a process which, for each Element, identifies both the single SEIO responsible individual and Stakeholder representative. Clearly define the SEIO individual's roles and responsibilities. On a periodic basis (perhaps monthly), each responsible SEIO individual solicits requirements and requirement changes from all elements, including stakeholders. Each SEIO Element Lead then reports regarding inter-element requirements status (new/changed requirements, and related verification/validation), issue(s) status, risk(s) status, etc. This process would tie in with Recommendation 13.

4.12 Recommendation 12 - Establish Guidelines for Decision Making

Definition of Problem:

SEIO appears to have no guidelines for making decisions using a formal process. Without a formal process, SEIO has no way to help ensure that decisions are be made in a logical, structured manner, and that the decisions are documented for future reference.

Recommendation:

Develop guidelines for selecting and making decisions requiring a formalized process.

Rationale:

A clear set of guidelines is needed to identify decisions requiring a formal process, to apply a consistent process to those formal decisions, and to ensure formal decisions including rationale are documented.

Suggested Approach:

Develop a process which includes criteria by which decisions requiring a formalized process are identified/prioritized and describes how the formal decisions are to be made. This would include decisions made by evaluation of alternatives, using established criteria and decision tools. The process should identify use of an Analysis of Alternatives approach as a proven potential approach to disciplined decision-making.

Guidelines for executing this process should be established and include:

- How to determine which issues are subject to a formal evaluation process
- Criteria for evaluating alternatives, and the relative ranking of these criteria
- Methods for identifying alternative solutions to address issues
- How to select the evaluation methods
- How to evaluate alternative solutions using the established criteria and methods
- How to select solutions from the alternatives based on the evaluation criteria

4.13 Recommendation 13 - Make SEIO Work Products Available

Definition of Problem:

There is no process for making SEIO work products available to the entire SEIO organization. As a result, there is a lack of shared information, leading to possible duplication of effort or even conflicting work effort.

Recommendation:

Make SEIO work products available to the whole team by:

- Establishing an internal review process to be followed to ensure quality of internal, "non-board" products;
- Planning data management for internal products; and
- Developing a means to identify and track internal SEIO products to provide better cross-organization access.

Rationale:

Data management of internal products affords a communication "tool" to keep staff informed, to better share important data within SEIO and among integrated teams, and to reduce duplication of effort.

Suggested Approach:

Develop, establish, and document a process to make SEIO work products available to the entire SEIO organization (JSC/MS, KSC/MK-SIO, and MSFC/MP-71). This could entail a website similar to the one used at MSFC/MP-71, and would require a user name and password for access. The Configuration Management function at JSC could be made responsible for website administration (issuing user accounts) and maintenance (posting SEIO work products and updating the home page). This approach meshes with the approaches suggested for Defect Analysis (Recommendation 4) and the SEIO Management Plan (Recommendation 5) in that the searchable defect database and the SEIO Management Plan would be two of the key products to be made available.

4.14 Recommendation 14 - Establish a Centralized Action Item Management System

Definition of Problem:

The appraisal revealed that action item management is generally very well managed within the technical panels, working groups, and boards. However, with the geographic separation of SEIO offices and diversity of tasks there was some reported duplication of effort and lack of awareness of actions in work.

Recommendation:

Establish a centralized action item management system to capture and track actions. Make the action item database available to all of SEIO.

Rationale:

Centralizing action item management potentially provides greater management situational awareness, broadens visibility across the organization, reduces possibility of duplication of effort, and increases the possibility that critical issues are surfaced and sufficiently addressed. It also provides another communication "tool" to better inform all SEIO staff of ongoing efforts.

Suggested Approach:

A simple, effective method might be to capture all action items in a single database, filed by originating source (e.g., board, tech panel, working group, technical interchange meeting). Provide a searchable feature using keywords to allow quick identification of similar or related topics. Incorporate a "sort" feature so actions can be grouped by subject, originator, due date, working group or any other selectable criterion.

4.15 Recommendation 15 - Establish Guidelines for Government Review of NDI

Definition of Problem:

The appraisal revealed almost no review and little guidance for evaluation and selection of commercial-off-the-shelf (COTS) products. Non-developmental items (NDI) or COTS products and services offer a potentially cost-effective alternative to the often difficult, complex, time-consuming, and costly development of new products or services.

Recommendation:

Establish consistent guidelines for SEIO review of non-developmental items and COTS products and services.

Rationale:

When non-developmental items are proposed SEIO can consistently evaluate potential commercial products and services to ensure requirements are met and limitations are acceptable.

Suggested Approach:

Some candidate criteria for NDI or COTS usage might be:

a. Requirements – does the product deliver the required performance (e.g., physical, functional, operational, quality, reliability);
b. Supportability – will the supplier be able to deliver, maintain, upgrade, and support the product;
c. Integration – is the product able to be easily accommodated, on what schedule, with what interface impact;
d. Cost – what will be the recurring, non-recurring, and total life cycle costs;
e. Schedule – impact to requirements and timelines;
f. Risks – what might be the risks associated with performance, cost, supportability, schedule; and
g. Agreements – what are the terms and conditions for licensing (including team members and stakeholders), data rights, and configuration control.

Several methods that could be used to characterize and evaluate NDI or COTS products and services are:

a. Direct discussions with candidate vendors and suppliers,
b. Price list evaluation,
c. Dialogue with users of the products or services,
d. Review of COTS documentation,
e. Trade studies,
f. Supplier performance reports, and
g. Prototyping.

4.16 Recommendation 16 - Provide Guidance for Resources

Definition of Problem:

The Appraisal Team observed a "firefighting" atmosphere with staff assigned to cover as many activities as possible. Some staff did express confusion about why they were selected to perform certain duties and several complained of spending too much time in meetings and not enough on performing their integration function.

Recommendation:

Provide guidance for resource priority and reconciliation. This should be coupled with Recommendation 5 (documenting an SEIO project plan) to present a complete framework for project activities, staffing and training requirements, and priorities.

Rationale:

Priority guidelines for resources would facilitate adjustments and revisions to projects, when required, and may increase productivity. As project demands shift, adjustments are often necessary to bring focus on the highest priority task or problem. Reconciling differences between estimated and available resources could avoid resource shortfalls that cause integration risks to be overlooked.

Suggested Approach:

Begin with an SEIO Management Plan (refer to Recommendation 5) that includes a Work Breakdown Structure (or equivalent) that defines the tasks. The plan should also have an associated schedule that clearly identifies all SEIO tasks and other associated SSP tasks, and the interdependencies among them. This information provides a basis for estimating SEIO resource needs and the priorities needed to support the overall SSP effort. Showing the interdependencies allows task priorities to be established commensurate with the overall SSP needs and identifies non-SEIO tasks that are critical to SEIO success and whose status should be closely tracked.

This plan /schedule should be reviewed and updated periodically as tasks progress and new tasks emerge. Adjust priorities as required and assess available resources, looking forward (e.g., 3-6 months) to forecast future changes and needs. This allows sufficient time to develop alternatives (such as outsourcing, adjusting skills mix, recruiting, getting additional support from the element or engineering offices, and training) to proactively mitigate SEIO and non-SEIO problems that have the potential to adversely impact the SEIO plan.

4.17 Recommendation 17 - Establish Skills Guidelines

Definition of Problem:

While there is considerable effort to match the best candidates for teams and working groups, some staff expressed confusion about why they were selected to perform certain duties, noting that their backgrounds did not match their assigned areas of expertise. This situation also affords a learning opportunity but there does not appear to be a training program to bridge the gap between required skills and current experience. (Also refer to Recommendation 6).

Recommendation:

Establish skills guidelines for team and working group assignments.

Rationale:

Efficient and effective team member selection and assignment improves integrated team performance and provides a basis to plan the organization's resource and training needs.

Suggested Approach:

Begin with an SEIO Work Breakdown Structure or equivalent that defines the tasks and provides a basis for skills requirements. Review the integrated teams (working groups, technical panels, boards) charters for processes, products, and tasks. List the disciplines or functions required to perform these tasks. Determine skill sets and critical expertise needed to support each identified team. Where SEIO finds it lacks skills, determine the methods to bridge those gaps.

Establish criteria for assigning appropriate team members. Some example criteria to qualify an individual are:

a. Knowledge needed based on tasks, responsibilities, and team work products;
b. People skills, ability to work in a team environment;
c. Value-added to the team;
d. Ability to learn from the team activities;
e. Candidate's workload and availability;
f. Education and experience; and
g. Motivation.

4.18 Recommendation 18 – Implement the Strengths and Best Practices Throughout SEIO

Definition of Problem:

While the Appraisal Team found 31 practices which exceed the CMMI®-NS model, other SEIO locations could benefit by implementing them.

Recommendation:

Where applicable, implement the Strengths and Best Practices throughout SEIO.

Rationale:

There are 31 Strengths and Best Practices, ranging from the Continuous Risk Management process described by NSTS 37366 Appendix B, to MSFC's online process asset library. These practices could be adapted for use at all SEIO locations, thus improving SEIO's overall process performance. The Best Practices and Strengths are summarized in Table 4.18-1 and 4.18-2 respectively.

Suggested Approach:

Begin an effort to implement Strengths and Best Practices throughout SEIO. A responsible individual, preferably someone who is currently using the Best Practice, should be identified to lead the effort to implement the Best Practice at the other SEIO locations. This approach would require the identification of a counterpart at each location who would be responsible for the local implementation of the practice.

Table 4.18-1 SEIO Best Practices

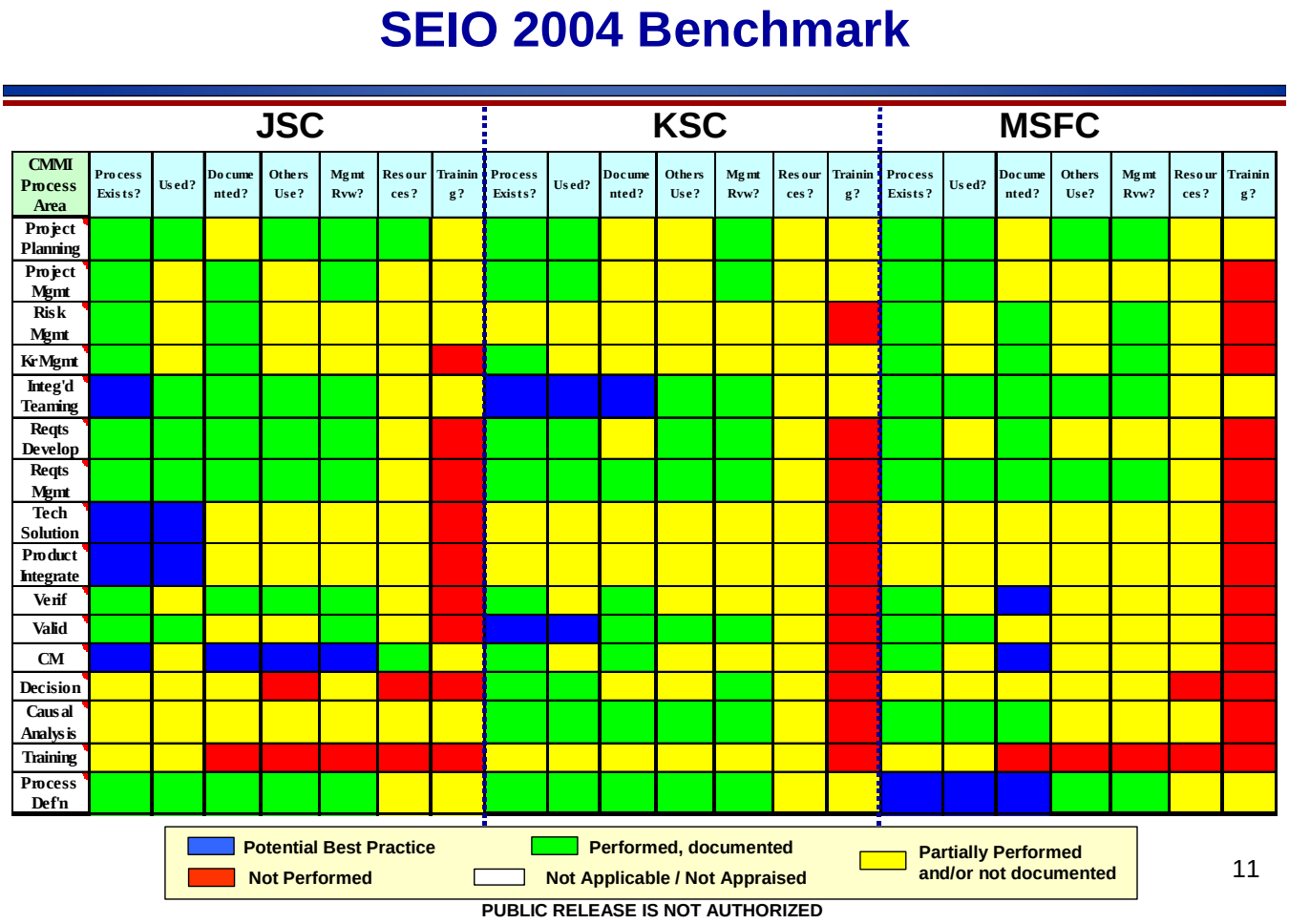
JSC	KSC	MSFC
SSP Institutional Processes		
1. Establish standard processes 2. Charter integrated teams 3. Establish CM records	• Establish standard processes • Charter integrated teams 4. Define team roles & responsibilities	• Establish standard processes
Center-Specific Processes		
5. Obtain stakeholder commitment to plans 6. Establish interface descriptions 7. Design & analyze interfaces 8. Review interface descriptions	9. Select products for validation 10. Survey training needs 11. Establish training records	12. Evaluate, categorize, prioritize risks 13. Establish configuration management system 14. Establish organization process asset library

Table 4.18-2 Process Strengths Summary

Systems Engineering Process
PRCB establishes requirements, maintained in NSTS documents
A documented interface definition process, accurately executed
MSFC HDBK 2221 defines a verification process
Systems Engineering Guidance
NSTS 08117 defines verification roles & responsibilities (CoFR)
MVP provides top-level verification guidance (but not for imagery)
NSTS 37366 Appendix B provides risk management guidance
Systems Engineering Execution
"Top X" review provides excellent incremental *verification*
SEIO is reintroducing up-to-date empirical *validation*
Multi-laboratory approach is used for *image analysis*
SEA issue sheets identify *alternative approaches* (for decisions)
Project Management
Stakeholder commitment to requirements change is part of board process
ICB/PRCB process enables significant SEIO influence in configuration management
SSEIG established to integrate the technical panels
Clear guidance for issue resolution (PRACA, RCN, LCN, IFA)
Complete configuration management data is rapidly & widely accessible for all actions
CWCs identify resources needs, commit stakeholders.

5. Summary

This appraisal benchmarked process existence and use to establish a baseline for the SSP SEIO systems engineering processes. The benchmark appears in Figure 5.



The Aerospace Corporation appraisal team gathered the appraisal data by conducting interviews with 40 members of the SEIO engineering staff at JSC, KSC, and MSFC between 23 February 2004 and 27 May 2004. These interviews were supplemented by the review of an extensive amount of process documentation and associated products. A tailored version (CMMI-NS) of the CMU SEI CMMI® model was used as a guide to gather data to estimate the level of implementation for the 103 Specific Practices contained in the tailored model. Product quality was not assessed. Preliminary findings were developed for each Center and evolved into the overall set of SEIO findings presented in this report. Data supporting these findings is contained in Appendix C1, C2, C3, D1, and D2. The briefings presented to the SEIO are included in the Appendix A1, A2, A3 and B. A top-level summary of process area performance is provided in Table 5.

Table 5 Process Area Summary

Established, Getting The Job Done	***Opportunities For Process Improvement***
Program Planning	Risk Management
Integrated Teaming	Contractor Management
Product Integration	Product Integration
Tech Solution	Verification (internal products)
Configuration Management	Configuration Management (internal products)
Training	Training
Organizational Processes	Validation
Program Management	Decision Analysis
Requirements Development	Causal Analysis
Requirements Management	

The interviewees and staff were found to be supportive and cooperative in the appraisal effort. They expressed confidence in what they viewed as strong leadership and established practices, and felt they are value added to the SSP. In fact, the appraisal found over 90% of the CMMI-NS process practices to be at least partially implemented by SEIO. Many practices, including 14 Best Practices exceptionally suitable for sharing, were found to be established and getting the job done. However, opportunities for improvement were identified by the Appraisal Team and resulted in 18 actionable recommendations being developed. These specific recommendations are detailed in the report for consideration in the SEIO process improvement efforts. Which Best Practices and recommendations to implement, what the priority should be, when and how the improvements should be implemented, is a prerogative of the SEIO. The appraisal also surfaced come "concerns" that, while not strictly covered by the model, may result in something that could "fall through the crack". These "concerns" included:

- Integration roles and responsibilities that are not sharply defined,
- No consolidated risk reporting that ensures upper management visibility, and
- Cross SEIO communication in which "stovepipes" still exist.

The systems engineering process appraisal focus was on helping to enable the improvement of selected SEIO processes. For this reason, the appraisal has been documented in a manner to enable potential future appraisals to determine what changes have occurred since this baseline was established. The Aerospace Corporation is ready to be of further help if requested.

Acronyms

AFSPC	Air Force Space Command
BP	Best Practice
CAIB	Columbia Accident Investigation Board
CAR	Causal Analysis and Resolution
CCB	Configuration Control Board
CEI	Configuration End Item
CM	Configuration Management
CMMI	Capability Maturity Model Integration
CoFR	Certification of Flight Readiness
COTS	Commercial Off The Shelf
CRB	Change Review Board
CWC	Collaborative Work Commitment
DAR	Decision Analysis & Resolution
DoD	Department of Defense
EMC	Electromagnetic Compatibility
EMC/I	Electromagnetic Compatibility/Interference
FFRDC	Federally Funded Research and Development Center
FI	Fully Implemented
HDBK	Handbook
HOSC	Huntsville Operations Support Center
HR	Human Resources
IAW	In Accordance With
ICB	Integration Control Board
ICD	Interface Control Document
ICN	Interface Change Notice
IFA	In Flight Anomaly
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
ISO	International Organization for Standards
IT	Integrated Teaming
ITA	Integrated Teaming Agreement
JSC	Johnson Space Center
KM	Contractor Management
KSC	Kennedy Space Center
LCC	Launch Commit Criteria
LCN	LCC Change Notice
MK-SIO	KSC Integration Office
MOU	Memorandum of Understanding
MP-71	Propulsion Systems Engineering and Integration Project Office
MPG	Marshall Procedures and Guidelines
MRB	Material Review Board
MS	Space Shuttle Systems Engineering and Integration Office
MSFC	Marshall Space Flight Center
MVP	Master Verification Plan

MWI	Marshall Work Instruction
NA	Not Applicable
NASA	National Aeronautics And Space Administration
NDI	Non-Developmental Item
NI	Not Implemented
NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NPR	NASA Procedural Requirements
NSTS	National Space Transportation System
OMRS	Operations and Maintenance Requirements and Specifications
OPD	Organizational Process Definition
OT	Organizational Training
OWI	Organizational Work Instruction
PDP	Product Development Plan
PI	Partially Implemented
PI	Product Integration
PM	Project Management
PM	Program Management
PMRB	Program Material Review Board
POP	Program Operating Plan
PP	Program Planning
PP	Project Planning
PRACA	Problem Reporting and Corrective Action
PRCB	Program Requirements Control Board
PRN	Preliminary Revision Notice
RCN	Requirements Change Notice
RD	Requirements Development
ReM	Requirements Management
RiM	Risk Management
RTF	Return To Flight
SCAMPI	Standard CMMI Assessment Method for Process Improvement
SEA	Shuttle Environmental Assurance
SEI	Software Engineering Institute of Carnegie Mellon University
SE&I	Systems Engineering & Integration
SEIO	Systems Engineering and Integration Office
SFOC	Space Flight Operations Contract
SI	System Integrator
SIP	Shuttle Integration Plan
SPO	System Program Office
SSEIG	Space Shuttle Engineering Integration Group
SSP	Space Shuttle Program
SSPIA	Space Shuttle Program Interface Agreement
TIM	Technical Interchange Meeting
TPM	Technical Performance Measure
TS	Technical Solution
UA	Unexplained Anomaly

USA	United Space Alliance
VAL	Validation
VER	Verification
VTC	Video Teleconference
WBS	Work Breakdown Structure

Appendix A1 - JSC Preliminary Findings Briefing

This appendix contains one the "Draft Findings" briefings presented to each of the three SEIO locations (Appendix A1: Johnson Space Center, Appendix A2: Kennedy Space Center, Appendix A3: Marshall Space Flight Center). The briefings represent preliminary findings and identify strengths, weaknesses, and concerns for each of the 16 CMMI-NS process areas, but do not include any recommendations. The level of practice implementation (described in chart 10, page A-11) is summarized by process in chart 35, page A-36. The practices contained in each process are identified in the backup slides.

The briefings were an additional fact-finding session and participation in the briefings was limited to interviewees. Data collected during these sessions was included in the final SEIO-level briefing (Appendix B) and in the recommendations included in that briefing. However, updates were not made to the "Draft Findings" briefings.

Systems Engineering Process Appraisal for Space Shuttle Systems Engineering and Integration Office

Draft Findings
JSC

5 April 2004

Releasable only by the Manager,
Space Shuttle Systems Engineering & Integration Office

THE AEROSPACE CORPORATION

PUBLIC RELEASE IS NOT AUTHORIZED

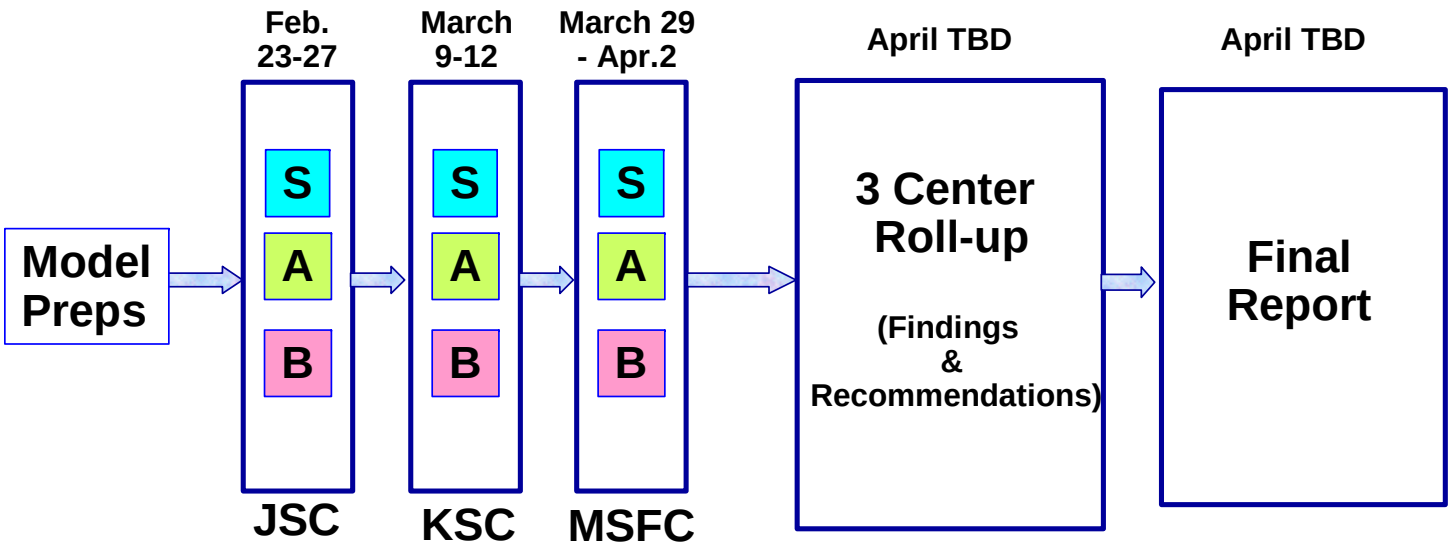
Outline

- Rules of Engagement
- Process Model (CMMI-NS) Review
- Appraisal Process Preliminary Findings
- Draft Appraisal Results

Rules of Engagement

- **Draft findings of JSC SEIO**
  - Participation limited to JSC interviewees
  - Additional fact-finding session
- **Non-attribution**
  - SEIO-Aerospace
  - SEIO-SEIO

Appraisal Process



S - Survey of Participants

A - Appraisals: Interviews / Doc. Review

B - Brief Preliminary Findings/Results

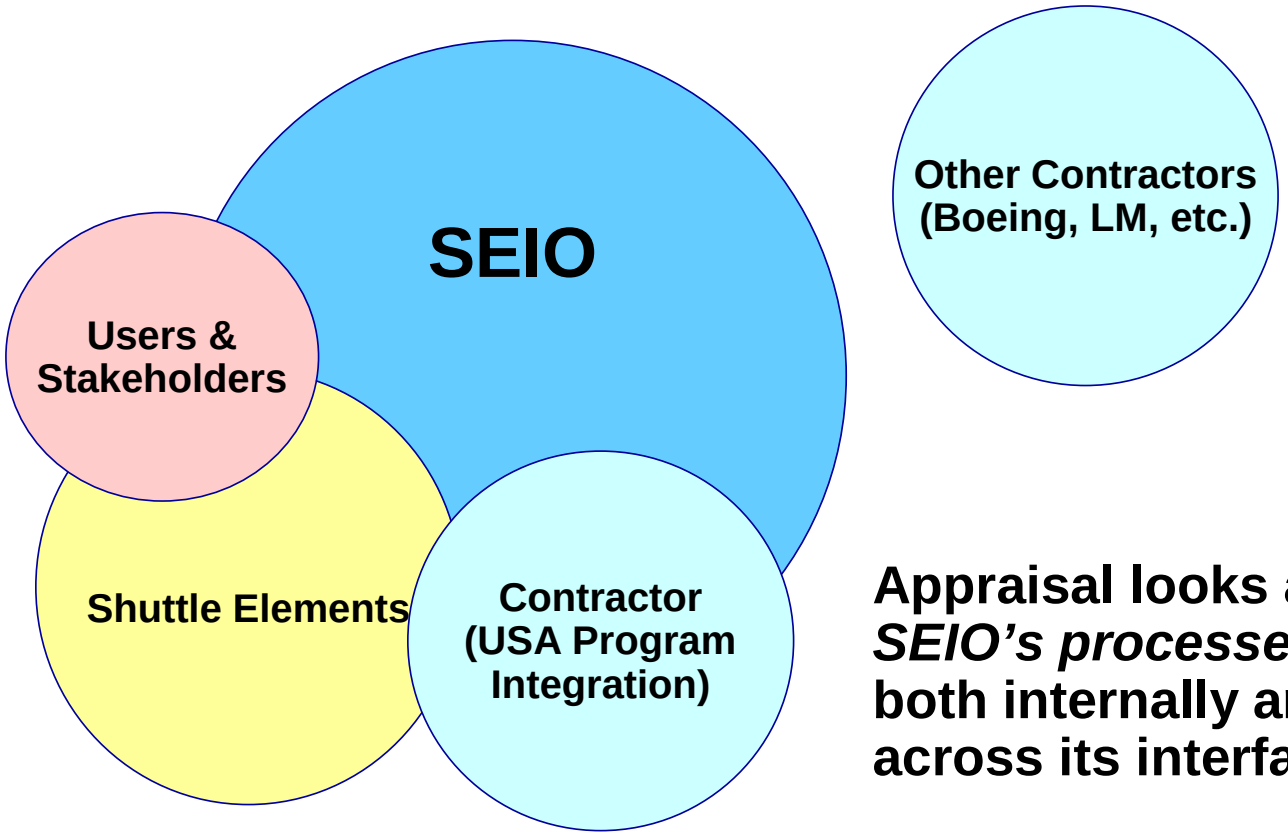
Objectives & Ground Rules

- **Our Objectives**
  - Appraise current state of process existence and usage in SEIO with respect to tailored SMC CMMI-A model
  - Does SEIO have managed processes?
    - Identify process documentation and use
    - Identify strengths and weaknesses
    - Identify Best Practices to share across SEIO
- **Ground rules**
  - There will be ***no*** numerical ratings
  - This is ***not*** a product quality assessment

Appraisal Team

MEMBER	ORGANIZATION	EXPERIENCE
Paul Humel	Aerospace	Retired SMC Colonel, Space Industry SE Manager, Deputy Program Manager
Howard Hayden	SAIC	USAF(Ret), 40 yrs exp with SMC & NASA prgms Prog Manager, Dir Systems Engineering, sat ops
Frank Knight	Aerospace	25 yrs exp at Aerospace – SE for SMC, NRO, NASA Dept Director & Manager of Concept Design Center
Joe Meltzer	Aerospace	40 yrs exp at Aerospace supporting NRO & SMC Aerospace Corporate Chief Engineer
Nick Sramek	Aerospace	32 yrs exp at Aerospace and contractors supporting SMC and NRO programs
Keith Wright	Sparta	USAF(Ret), 30 yrs with NRO, NASA, SMC Prog Mgr Former Astronaut, AF Shuttle Flight Director

Focus



Appraisal looks at *SEIO's processes* both internally and across its interfaces

Seven Characteristics of Process Implementation

- Do processes exist?
- Are they used?
- Are they documented?
- Do others know about them?
- Are they reviewed by management?
- Are there adequate resources to perform the processes?
- Is there process training?

SEIO SE Process Appraisal Model

Project Management
- Project Planning (PP)
- Project Management (PM)
- Contractor Management (KM)
- Risk Management (RiM)
- Integrated Teaming (IT)

Support
- Configuration Management (CM)
- Decision Analysis & Resolution (DAR)
- Causal Analysis and Resolution (CAR)

Engineering
- Requirements Development (RD)
- Requirements Management (RM)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (of SEIO products) (VER)
- Validation (of system) (VAL)

Organizational Process Management
- Organizational Training (OT)
- Organizational Process Definition (OPD)

103 practices across 16 process areas

Rules for Determining Practice Implementation

- **Fully Implemented (FI)**
  - **The practice is performed with no substantial weaknesses**
  - **The practice must be documented, used and known**
  - **At least two pieces of objective evidence exist (documents and/or interviews)**
- **Partially Implemented (PI) - (weaknesses found)**
  - **The practice is at least minimally performed but not sufficiently documented or known**
- **Not Implemented (NI) - (weaknesses found)**
  - **No significant aspect(s) of the practice is/are implemented**
- **Not Applicable (NA)**
  - **The practice does not apply to this (phase of the) program**

Findings Summary

- **Caveats:**
  - These are preliminary findings for JSC only
  - An integrated picture will emerge when all locations completed
- **Preliminary Findings:**
  - Most specific practices (96/103) are at least partially performed
    - 7 practices represent potential “Best Practices”
    - 7 practices found to be “Not Implemented”
  - Processes that may require attention:

    Contractor Management Verification Validation

    Decision Analysis Causal Analysis Training
  - Many processes are extremely well-documented
  - But many processes are not documented
  - Many of the documents have not been updated to reflect the current SEIO organization
  - 7 non-model concerns identified

Reporting Template

Process Purpose Statement

- **Strengths: (Above the model)**
  - Findings that exceed the process requirements.
    (“NONE” means you meet the model)
- **Weaknesses: (Below the model)**
  - Findings, deemed as significant, that do not fulfill some aspect of the process.
- **Concern:**
  - Even though some practices may be fully implemented, the CMMI model may not capture something that could be falling through the crack.

CMMI

Process Summary

Project Management Findings

Project Management

Project Planning

Project Management

Contractor Management

Risk Management

Integrated Teaming

Project Planning

Establish and maintain plans that define project activities.

- **Strength:**
  - Chartered technical panels, formal integration plans, and internal agreements ensure continual stakeholder involvement/commitment. ***Potential Best Practice***

- **Weaknesses:**
  - Could find no evidence of a comprehensive data management structure for SEIO work products.
  - Post-accident resource planning appears reactive with available staff assigned to emerging tasks.
  - Resource adjustments are made ad hoc. Could find no evidence of a documented process guiding reconciliation of resources.

Project Management

Provide understanding of project progress so that corrective actions can be taken when the project's performance deviates significantly from the plan.

- **Strengths:**
  - Chartered technical panels, formal integration plans, and internal agreements are methods to monitor stakeholder commitments.
  - Issues (e.g., changes, PRACA, integrated hazards) are analyzed and formally documented according to institutional processes.
- **Weaknesses:**
  - Although several methods are used to monitor tasks, could find no evidence of a documented process defining a coherent SEIO system-level review of activities.
  - Could find no evidence of a comprehensive process to monitor SEIO data or work products.
- ***Concerns:***
  - Although formal action item management follows a documented process, there is a concern that lower level actions may not surface or be tracked to completion.
  - Communications - not all staff aware of activities going on throughout SEIO.

Risk Management

Identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives. This includes both SEIO and Contactor risks.

- **Strength:**
  - None
- **Weaknesses:**
  - Found no evidence that programmatic risks (e.g. budget, schedule, resources) are being identified, prioritized, mitigated, and documented.
  - Found no evidence that non-safety risks are being identified and mitigated.
- **Concern:**
  - While risk is reported in tech panels and boards, there does not appear to be a consolidated risk reporting process that includes all identified risks and ensures upper management visibility.

Contractor Management

Manage the SEIO's sources of products and services (Contractor and government agencies) used to satisfy the project's requirements.

- **Strength:**
  - None
- **Weaknesses:**
  - Could find no evidence of a process for SEIO review of non-developmental items.
  - Surveillance Plan was used to monitor contractor work but has been suspended and not being maintained.
- **Concern:**
  - For the return-to-flight activities the government has suspended its contractor management duties to attend to fire drills.

Integrated Teaming

Form and sustain an integrated team for the development of work products.

- **Strengths:**
  - Team charters are clearly defined and centralized in NSTS 07700 Program Directives. ***Potential Best Practice***
  - The SSEIG was established to integrate the technical panels.
- **Weakness:**
  - Team assignments are made based on task, organizational responsibility, and workload. Could find no documented technical qualifications for team assignments.
- ***Concerns:***
  - Although chartered teams have clear operating procedures, there is a concern that unchartered teams may not adhere to the same discipline.
  - There is concern that the SSEIG does not have visibility into and fully integrate unchartered teams into the technical areas.

Engineering Findings

Engineering

Requirements Development

Requirements Management

Technical Solution

Product Integration

Verification

Validation

Requirements Development

Produce and analyze customer, product, and product-component requirements.

- **Strength:**
  - None
- **Weakness:**
  - Some requirements development processes (e.g, maintaining models and databases, validating requirements) are not documented.

Requirements Management

Manage the requirements of the project's products and to identify inconsistencies between those requirements and the project's plans and work products.

- **Strength:**
  - None
- **Weaknesses:**
  - Requirements traceability is performed downward, but not upward.
  - Could find no evidence that requirements are analyzed for risk, supportability, and resource impacts.

Technical Solution

Design and control interfaces to requirements.

- **Strengths:**
  - Interface process is clearly defined, well documented and accurately executed. ***Potential Best Practice***
  - ICDs provide design guidance in addition to requirements to ensure compatibility. ***Potential Best Practice***
- **Weakness:**
  - No evidence of detailed description of SEIO role in the interface control process.
- **Concern:**
  - Disciplined interface control is applied only to integrated system level element interactions involving “hard” (e.g., mechanical/electrical) interfaces.

Product Integration

Prepare for element integration, ensure interface compatibility, and ensure that the integrated elements function properly.

- **Strengths:**
  - There is a clearly defined interface process, accurately executed IAW detailed instructions.
  - ICDs provide design guidance in addition to requirements to ensure interface compatibility. ***Potential Best Practice***
- **Weaknesses:**
  - PDPs not updated to reflect new organization.
  - SEIO's responsibility in establishing the integrated test environment is not clearly defined.
- **Concern:**
  - There is no evidence of an integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts the respective responsibilities and interactions.

“Verification” vs. “Validation”

- **Verification:**
  - ***Ensure that selected SEIO and SEIO contractor work products meet their specified requirements***
- **Validation:**
  - ***Demonstrate that the integrated elements fulfill their intended use when placed in their intended environment***

Verification

Ensure that selected SEIO and SEIO contractor work products meet their specified requirements.

- **Strengths:**
  - MVP provides detailed top-level guidance.
  - "Top X" reviews provide excellent incremental verification process.
  - Use of non-JSC Subject Matter Experts (SMEs) in peer reviews.
- **Weaknesses:**
  - Found no evidence of process documentation, criteria and specific record retention for peer reviews.
  - Found no evidence that differences in Ver/Val processes are clearly defined, understood, and agreed.
  - Found no evidence that JSC interviewees clearly understood SEIO responsibilities identified in NSTS 08117.
  - Verification activities appear to be based upon reported anomalies instead of performance critical areas.
- **Concern:**
  - There is no evidence of an integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts the respective responsibilities/interactions.

Validation

Demonstrate that the integrated elements fulfill their intended use when placed in their intended environment.

- **Strength:**
  - SEIO is reintroducing up-to-date empirical validation -
    - Instrumentation for post flight reconstruction (next flight)
    - Ground test currency (e.g., 3% wind tunnel model)
- **Weaknesses:**
  - There is no plan to use expanded flight instrumentation beyond the next flight.
  - Model validation is not current with design.

Support Findings

Support

Configuration Management

Decision Analysis & Resolution

Causal Analysis & Resolution

Configuration Management

Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

- **Strengths:**
  - There is a strong SSP CM system in operation. ***Potential Best Practice***
    - Board process enables significant SEIO influence
  - There is a comprehensive CM record system. ***Potential Best Practice***
    - Rapid, wide accessibility
    - Complete data (including backups) available for all (approved/disapproved) actions

- **Weakness**:
  - Found no evidence of an SEIO CM system for internal SEIO products.

Decision Analysis and Resolution

Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

- **Strength:**
  - None
- **Weaknesses:**
  - Except for board actions, there is little evidence of documented processes (e.g., guidelines for formal decisions, selecting evaluation methods) for formal decision making.
  - Parts of the decision making process are ad hoc (evaluation criteria, identifying alternatives).

Causal Analysis & Resolution

Identify causes of defects and other problems and take action to prevent them from occurring in the future.

- **Strength:**
  - None
- **Weaknesses:**
  - Could find no evidence that effects of change are being evaluated after implementation for problem correction or performance improvement.
  - Could find no evidence of a documented, consistent process for causal analysis (selecting defect data, analyzing causes, and implementing action proposals).
  - Could find no evidence that causal analysis data is recorded in a readily available and easily usable manner.

Organizational Process Management

Organizational Training

Organizational Process Definition

Organizational Training

Develop the skills and knowledge of people so they can perform their tasks effectively and efficiently.

- **Strength:**
  - None
- **Weaknesses:**
  - Found no evidence of a significant management priority for training.
  - Could not find any strategic/tactical training goals/plans.
    - No SEIO work based needs assessment
    - No task/staff/training audit trail
    - HR minimally involved in specific SEIO training
  - Found no evidence of feedback that enables assessment of supervisor based training guidance.

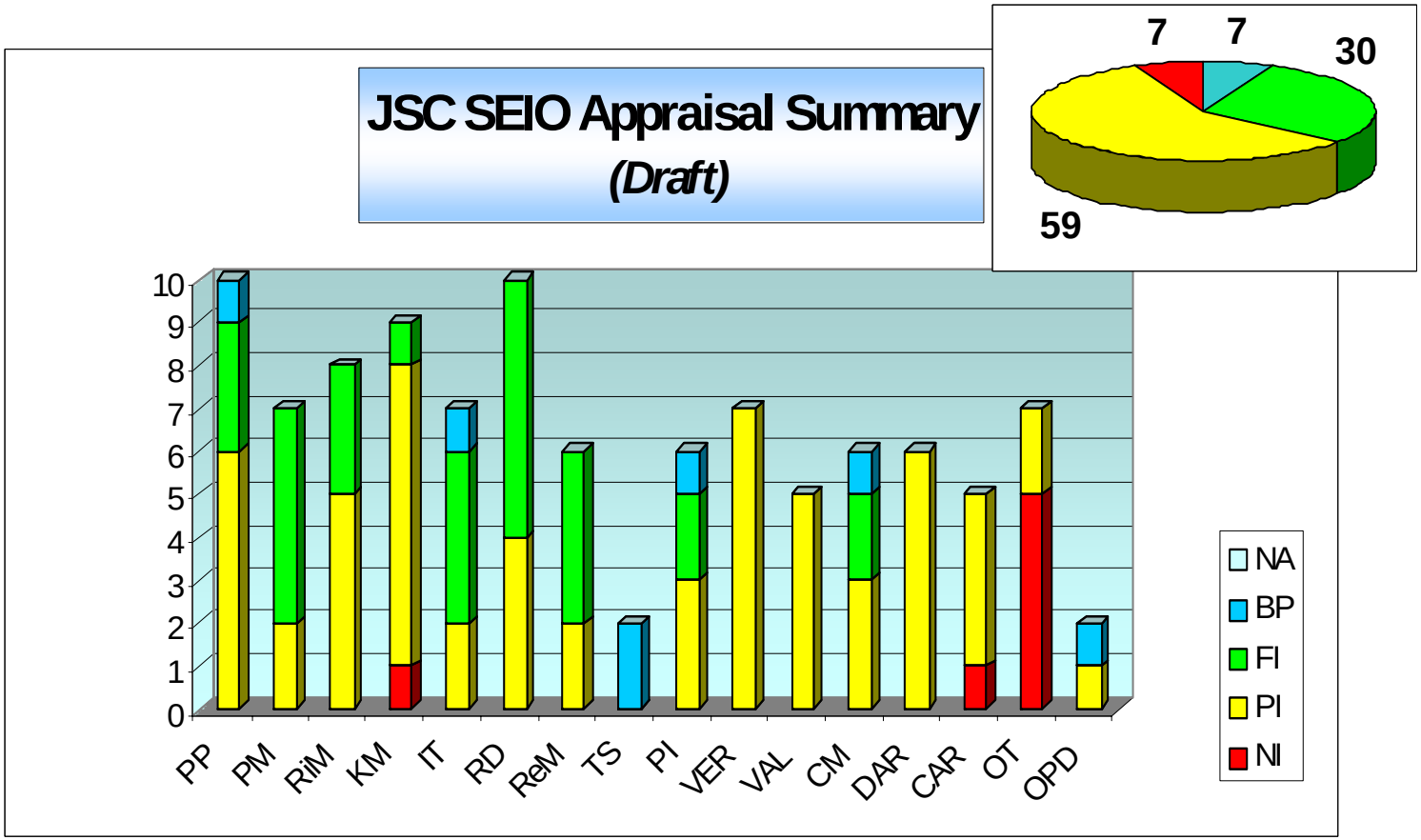
Organizational Process Definition

Establish and maintain a usable set of organizational process assets.

- **Strengths:**
  - There is a well-documented set of organizational processes for all NASA centers.
  - NSTS 07700 lays out a standard set of processes for SSP operations. ***Potential Best Practice***

- **Weakness:**
  - There are several libraries and databases for technical, programmatic, and process data. But found no “process asset library” that was accessible to all in SEIO.

Draft SEIO (JSC) Results



SEIO (JSC) Summary

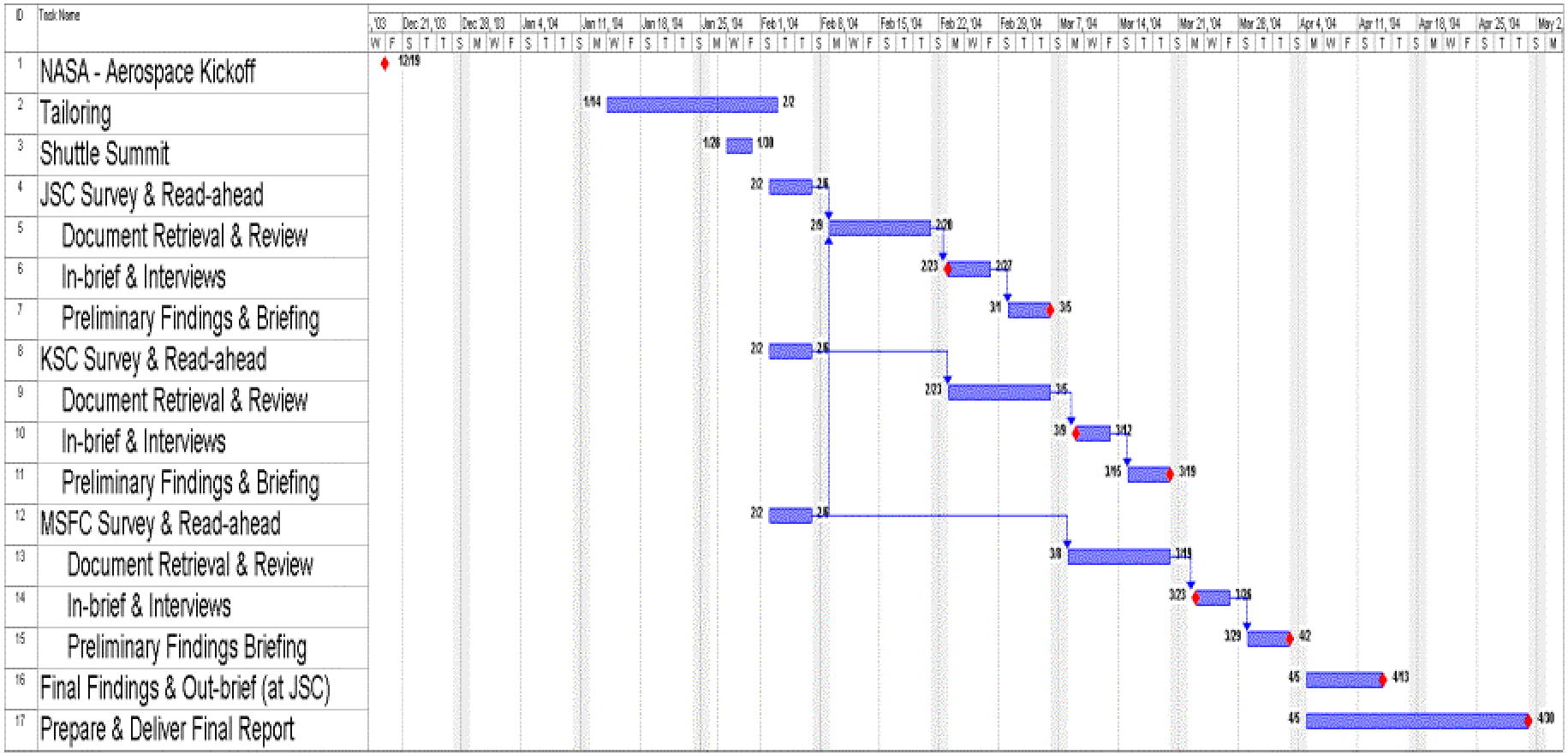
- **This appraisal was a determination of process implementation baseline for SEIO**
- **Not a report card on program or personnel**
- **Strict confidentiality observed - results not attributable**
- **Process Strengths and Weaknesses identified**
- **You will receive:**
  - Final briefing, including recommendations for improvement
  - Findings worksheets with observations for each practice
- **Remaining work:**
  - Completion of MSFC SEIO appraisal
  - MSFC SEIO preliminary findings briefing
  - Roll up of composite SEIO findings
  - Final report

Backups

What is a Process?

- General Definition of Process
  - A process is a set of practices (activities) performed to achieve a given purpose; it may include tools, methods, materials, and/or people.
- Attributes of a Managed Process
  - A managed process is one that is planned, documented, and executed in accordance with policy; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.
- What about SEIO?
  - SEIO owns processes and practices and result and decisions can have a significant impact on the development process of the contractor and on success of the integration effort.

Planned Appraisal Schedule



2/23 – 2/27 JSC Visit
3/5 Prelim Findings

3/9 – 3/12 KSC visit
3/19 Prelim Findings

3/23 – 3/26 MSFC visit
4/2 Prelim Findings

4/13 Final Out-brief at JSC

Worksheet Example

	Decision Analysis and Resolution	
	Observations	**Assessment**
	SP1.3-1 Identify Alternative Solutions ***Identify alternative solutions to address issues.***	
	CMB reviews all alternatives brought to board and decides on best alternative. CMB has become vetting ground and decision system for alternatives; CMB OI 63-1201; CMB decision brief template (A, DA)	
	"System Integration Process" (12/11/03) CMB decision brief (DA)	
	Presents options to NDS community. NDS PM then decides. (A)	
	Aerospace has attempted to document all technical decisions made and the thought processes used. (A)	
	CMB OI & ERB OI describe alternative solution identification. (A, DA)	
	Method of making decisions based on schedule. Example was polarity "reversal" between IR-M & IIF (IIR-M "won"). (A)	
	Formal AoA used for M-code, jamming resistance; M-code briefing (A, IA)	
SP1.3-1 Finding	**IIR has a documented process for looking at alternative solutions when addressing major issues. *Potential Best Practice.***	
FI	**<----Practice Finding** ***Mini-Team Recommendation --->***	**FI**

Requirements Development / Management Processes

- **Requirements Development**
  - Elicit and collect needs
  - Develop customer requirements
  - Establish program requirements
  - Allocate program requirements
  - Identify interface requirements
  - Development verification reqts
  - Establish ops concepts / scenarios
  - Define required functionality
  - Analyze reqts to achieve balance
  - Validate reqts (comprehensive methods)
- **Requirements Management**
  - Obtain understanding of reqts
  - Obtain commitment to reqts
  - Baseline requirements
  - Analyze requirements changes
  - Maintain bi-directional traceability
  - Identify inconsistencies between program work and requirements

Technical Solution/ Product Integration Processes

- **Technical Solution**
  - Establish and maintain interface solutions
  - Design and analyze interfaces
- **Product Integration**
  - Determine integration sequence
  - Establish the product integration environment
  - Establish and maintain product integration procedures and criteria
  - Review interface descriptions for coverage and completeness
  - Manage internal and external interface definitions, designs, and changes

Verification / Validation Processes

- **Verification**
  - Select work products
  - Establish verification environment
  - Establish procedures & criteria
  - Perform verification
  - Prepare / conduct internal reviews
  - Analyze results, identify actions
- **Validation**
  - Select products
  - Establish validation environment
  - Establish procedures & criteria
  - Perform validation
  - Analyze results

Configuration Management Process

- **Configuration Management**
  - Identify configuration items
  - Establish configuration management system
  - Create or release baselines
  - Track change requests
  - Control configuration items
  - Establish configuration management records
  - Perform configuration audits

Decision Analysis / Causal Analysis Processes

- **Decision Analysis & Resolution**
  - Establish guidelines
  - Establish evaluation criteria
  - Identify alternative solutions
  - Select evaluation methods
  - Evaluate alternatives
  - Select solutions
- **Causal Analysis & Resolution**
  - Select the defects and other problems for analysis
  - Perform causal analysis and propose actions to address them
  - Implement the action proposals
  - Evaluate the effect of changes
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Project Planning / Management Processes

- **Project Planning**
  - Estimate scope of project
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  - Conduct periodic and milestone reviews
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  - Manage corrective action

Contractor Management Process

- **Contract Management**
  - Monitor selected processes
  - Evaluate selected work products
  - Review non-developmental items
  - Conduct reviews and interchanges
  - Compare actual technical activities, cost, schedule to plans
  - Track sustainment products
  - Ensure user evaluation of system performance
  - Take appropriate action
  - Accept delivery of products

Risk Management / Integrated Teaming Processes

- **Risk Management**
  - Determine risk sources and categories
  - Define risk parameters
  - Establish a risk management strategy
  - Identify and document risks
  - Evaluate, categorize, and prioritize risks
  - Develop & implement risk mitigation plans
  - Periodic risk status monitoring and action
  - Risk status reporting at program reviews

- **Integrated Teaming**
  - Identify team tasks
  - Identify needed knowledge and skills
  - Assign appropriate team members
  - Establish a team charter
  - Define & maintain roles and responsibilities
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Organizational Training / Process Definition Processes

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  - Establish training needs of program and keep it current
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  - Establish training capability to address program training needs and keep it current
  - Deliver training following program training plan
  - Establish records of program training and keep it current
  - Assess the effectiveness of the program training program

- **Organizational Process Definition**
  - Establish and maintain standard processes
  - Establish and maintain the process asset library

Appendix A2 - KSC Preliminary Findings Briefing

This appendix contains one the "Draft Findings" briefings presented to each of the three SEIO locations (Appendix A1: Johnson Space Center, Appendix A2: Kennedy Space Center, Appendix A3: Marshall Space Flight Center). The briefings represent preliminary findings and identify strengths, weaknesses, and concerns for each of the 16 CMMI-NS process areas, but do not include any recommendations. The level of practice implementation (described in chart 9, page A-60) is summarized by process in chart 34, page A-85. The practices contained in each process are identified in the backup slides.

The briefings were an additional fact-finding session and participation in the briefings was limited to interviewees. Data collected during these sessions was included in the final SEIO-level briefing (Appendix B) and in the recommendations included in that briefing. However, updates were not made to the "Draft Findings" briefings.

Systems Engineering Process Appraisal for Space Shuttle Systems Engineering and Integration Office (MK-SIO)

Draft Findings
KSC

26 March 2004

Releasable only by the Manager,
Space Shuttle Systems Engineering & Integration Office

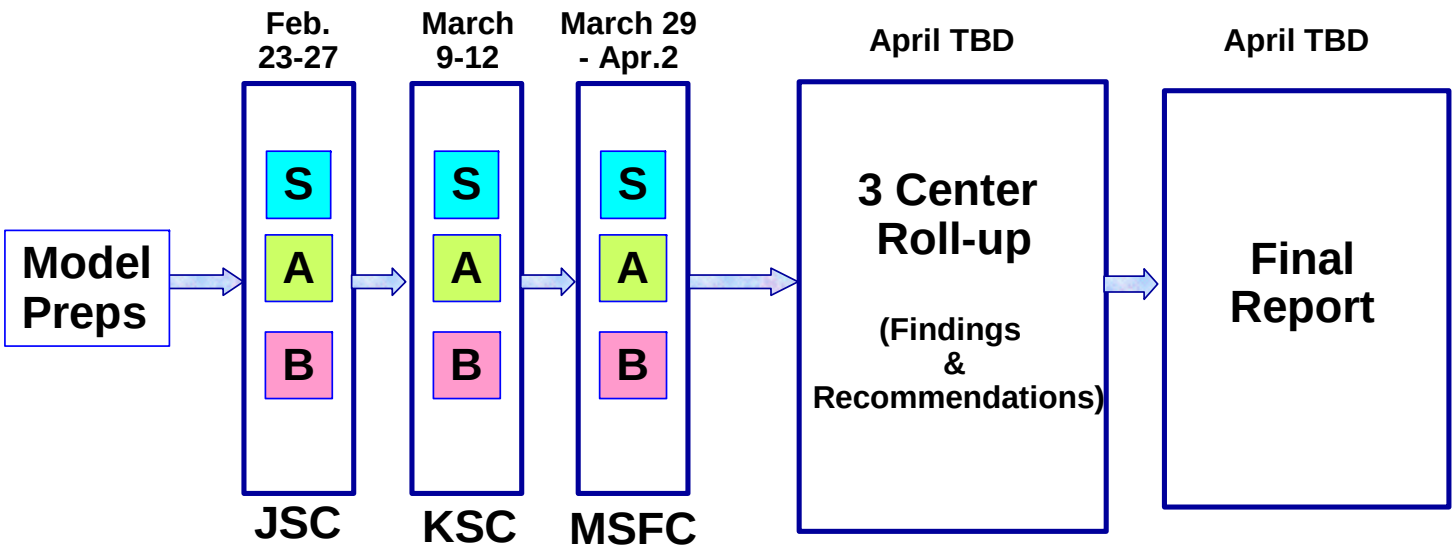
THE AEROSPACE CORPORATION

PUBLIC RELEASE IS NOT AUTHORIZED

Outline

- Introduction
- Process Model (CMMI-NS) Review
- Appraisal Process Preliminary Findings
- Draft Appraisal Results

Assessment Process



S - Survey of Participants

A - Appraisals: Interviews / Doc. Review

B - Brief Preliminary Findings/Results

Objectives & Ground Rules

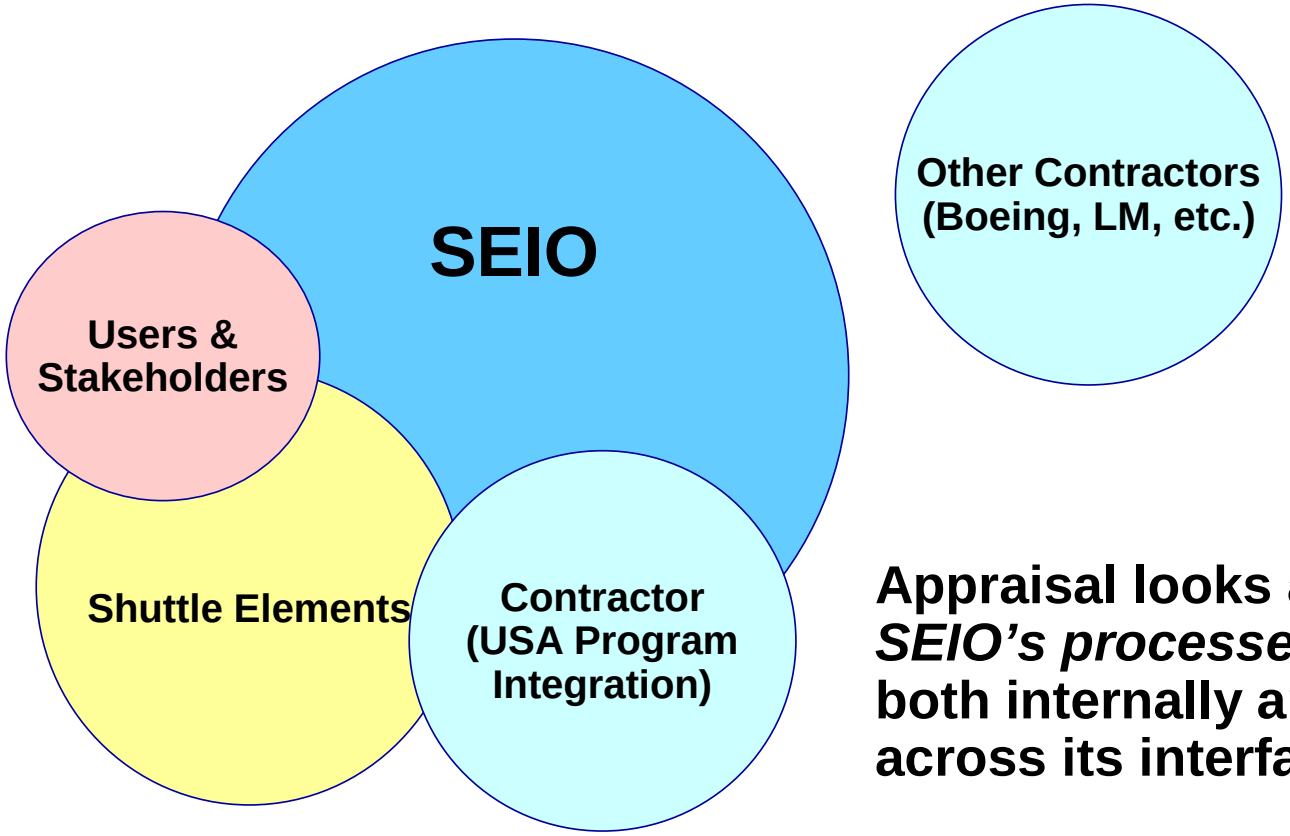
- **Our Objectives**
  - Appraise current state of process existence and usage in MK-SIO with respect to tailored SMC CMMI-A model
  - Does MK-SIO have managed processes?
    - Identify process documentation and use
    - Identify strengths and weaknesses
    - Identify Best Practices to share across MK-SIO
- **Ground rules**
  - There will be ***no*** numerical ratings
  - This is ***not*** a product quality assessment

Appraisal Team

MEMBER	ORGANIZATION	EXPERIENCE
Paul Humel	Aerospace	Retired SMC Colonel, Space Industry SE Manager, Deputy Program Manager
Howard Hayden	SAIC	USAF(Ret), 40 yrs exp with SMC & NASA prgms Prog Manager, Dir Systems Engineering, sat ops
Frank Knight	Aerospace	25 yrs exp at Aerospace – SE for SMC, NRO, NASA Dept Director & Manager of Concept Design Center
Joe Meltzer	Aerospace	40 yrs exp at Aerospace supporting NRO & SMC Aerospace Corporate Chief Engineer
Nick Sramek	Aerospace	32 yrs exp at Aerospace and contractors supporting SMC and NRO programs
Keith Wright	Sparta	USAF(Ret), 30 yrs with NRO, NASA, SMC Prog Mgr Former Astronaut, AF Shuttle Flight Director

JSC & KSC appraisals
JSC appraisal only

Focus



Appraisal looks at *SEIO's processes* both internally and across its interfaces

Seven Characteristics of Process Implementation

- Do processes exist?
- Are they used?
- Are they documented?
- Do others know about them?
- Are they reviewed by management?
- Are there adequate resources to perform the processes?
- Is there process training?

SEIO SE Process Appraisal Model

Project Management
- Project Planning (PP)
- Project Management (PM)
- Contractor Management (KM)
- Risk Management (RiM)
- Integrated Teaming (IT)

Support
- Configuration Management (CM)
- Decision Analysis & Resolution (DAR)
- Causal Analysis and Resolution (CAR)

Engineering
- Requirements Development (RD)
- Requirements Management (RM)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (of SEIO products) (VER)
- Validation (of system) (VAL)

Organizational Process Management
- Organizational Training (OT)
- Organizational Process Definition (OPD)

103 practices across 16 process areas

Rules for Determining Practice Implementation

- **Fully Implemented (FI)**
  - **The practice is performed with no substantial weaknesses**
  - **The practice must be documented, used and known**
  - **At least two pieces of objective evidence exist (documents and/or interviews)**
- **Partially Implemented (PI) - (weaknesses found)**
  - **The practice is at least minimally performed but not sufficiently documented or known**
- **Not Implemented (NI) - (weaknesses found)**
  - **No significant aspect(s) of the practice is/are implemented**
- **Not Applicable (NA)**
  - **The practice does not apply to this (phase of the) program**

Findings Summary

- **Caveats:**
  - These are preliminary findings for KSC only
  - An integrated picture will emerge when all locations completed
- **Preliminary Findings:**
  - Most specific practices (97/101) are at least partially performed
    - 5 practices represent potential “Best Practices”
    - 4 practices found to be “Not Implemented”
  - Processes that may require attention:
    - Risk Management
    - Contractor Management
    - Verification
    - Configuration Management
    - Organizational Training
  - Many processes are extremely well-documented
  - But many processes are not documented
  - 4 non-model concerns identified

Reporting Template

- **Strengths: (Above the model)**
  - Findings that exceed the process requirements.

    (“NONE” means you meet the model)
- **Weaknesses: (Below the model)**
  - Findings, deemed as significant, that do not fulfill some aspect of the process.
- **Concern:**
  - Even though some practices may be fully implemented, the CMMI model may not capture something that could be falling through the crack.

Process Purpose Statement

CMMI

Process Summary

Project Management Findings

Project Management

Project Planning

Project Management

Contractor Management

Risk Management

Integrated Teaming

Project Planning

- **Strength:**
  - Chartered working groups, formal integration plans, and signed Project Development Plans formally commit stakeholders.

- **Weaknesses:**
  - There is no WBS or equivalent on which to estimate scope of effort.
  - There is a defined structure for formal documentation, but could find no evidence of a comprehensive data management structure for MK-SIO work products.
  - There is no overall plan for the MK-SIO work effort.

Establish and maintain plans that define project activities.

Project Management

- **Strength:**
  - Issues (e.g., RCNs, LCNs, IFAs) are identified, analyzed, reported, and recommendations presented to review boards following strict, documented processes.
- **Weaknesses:**
  - Formal program documentation is closely monitored, but could find no evidence of comprehensive process to establish or monitor MK-SIO data or work products.
  - Found no evidence of a documented process defining a coherent system-level review of MK-SIO activities.
- ***Concern:***
  - Although formal changes and corrective actions follow a documented set of processes, there is a concern that lower level action items may not surface or be tracked to completion.

Provide understanding of the project's progress so that corrective actions can be taken when the project's performance deviates significantly from the plan.

Risk Management

- **Strength:**
  - None.
- **Weaknesses:**
  - MK-SIO supports, but does not appear to be proactively involved in the determination of risk sources and categories.
  - Found no evidence that programmatic & integration risks are defined, identified, or prioritized.

Identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives. This includes both SEIO and Contactor risks.

Contractor Management

- **Strength:**
  - None.
- **Weaknesses:**
  - Could find no evidence of a documented process for MK-SIO review of non-developmental items.
  - Although reviews occur sporadically, found no evidence of a documented or consistent process guiding reviews and interchanges with the contractors.
  - Could find no evidence that MK-SIO tracks sustainment products or identifies issues in accordance with a documented process.
- **Concern:**
  - Users are involved in review of technical progress. There is a concern that system performance evaluation is done by other organizations and may inhibit user evaluation.

Manage the SEIO's sources of products and services (Contractor and government agencies) used to satisfy the project's requirements.

Integrated Teaming

- **Strengths:**
  - Team charters are established and clearly defined in NSTS 07700 Program Directives. ***Potential Best Practice***
  - Team roles and responsibilities are specified in NSTS 07700 Program Directives. ***Potential Best Practice***
- **Weakness:**
  - Although qualified MK-SIO members do participate on integrated teams, there does not appear to be a documented process guiding specific skills needs.
    - Could find no documented technical qualifications or guidance for team assignments.

Form and sustain an integrated team for the development of work products.

Engineering Findings

Engineering

Requirements Development

Requirements Management

Technical Solution

Verification

Validation

Requirements Development

- **Strength:**
  - Requirements are established by the PRCB and are maintained in numerous NSTS documents.
- **Weakness:**
  - There is a process to collect and evaluate requirements changes. However, other than for imagery, could find no consistent or documented process for requirements elicitation.

Produce and analyze customer, product, and product-component requirements.

Requirements Management

- **Strength:**
  - All configuration management information is available on STS website for all users, including backup papers. ***Potential Best Practice***
- **Weakness:**
  - Bidirectional traceability is required, but found no evidence of any implementation.

Manage the requirements of the project's products and to identify inconsistencies between those requirements and the project's plans and work products.

Technical Solution

- **Strength:**
  - None.
- **Weakness:**
  - Could find no evidence of a documented process identifying roles/responsibilities within MK-SIO.

Design and control interfaces to requirements.

Product Integration

- **Strength:**
  - An as-built/flown imagery baseline is defined for validation.
- **Weaknesses:**
  - ICD/OMRS interface conflicts are reconciled with waivers.
  - Independent MK-SIO integration assessment is limited by resources.
- **Concern:**
  - MK-SIO does not appear to determine if the developed process fulfills SIP requirements.

Prepare for element integration, ensure interface compatibility, and ensure that the integrated elements function properly.

“Verification” vs. “Validation”

- **Verification:**
  - ***Ensure that selected SEIO and SEIO contractor work products meet their specified requirements***
- **Validation:**
  - ***Demonstrate that the integrated elements fulfill their intended use when placed in their intended environment***

Verification

- **Strengths:**
  - Pre/post integration imagery baselines are established.
  - Verification roles/responsibilities are defined in NSTS 08117.
- **Weaknesses:**
  - Imagery requirements are not in the MVP.
  - Could find no evidence of a documented internal product verification process.

Ensure that selected SEIO and SEIO contractor work products meet their specified requirements.

Validation

- **Strengths:**
  - Imagery is provided for flight performance validation. ***Potential Best Practice***
  - Multi-laboratory approach is used for image analysis.
- **Weakness:**
  - Non-image data is not sufficiently available for image corroboration.
- **Concern:**
  - There is no reentry image coverage.

Demonstrate that the integrated elements fulfill their intended use when placed in their intended environment.

Support Findings

Support

Configuration Management

Decision Analysis & Resolution

Causal Analysis & Resolution

Configuration Management

- **Strength:**
  - SSP CM process is consistently used.

- **Weakness**:
  - Could find no evidence of an MK-SIO internal product CM process.

Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

Decision Analysis and Resolution

- **Strength:**
  - Each Center has its own laboratory (for imagery analysis) with a unique analytical approach which provides alternatives for PRCB consideration. ***Potential Best Practice***
- **Weakness:**
  - Evaluation methods are used, but found no evidence of documented processes to select specific evaluation methods, or to evaluate alternative solutions based on established criteria.

Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Causal Analysis & Resolution

- **Strength:**
  - There are documented processes for causal analysis, which are used.
- **Weakness:**
  - None.
- **Concern:**
  - MK-SIO products (e.g., briefings, working materials) are kept on individual computers rather than being openly distributed or posted on a shared drive.

Identify causes of defects and other problems and take action to prevent them from occurring in the future.

Organizational Process Management

Organizational Training

Organizational Process Definition

Organizational Training

- **Strengths:**
  - Annual training needs survey is performed for tactical planning. ***Potential Best Practice***
  - Training monitored through use of Personal Development Plans.
- **Weaknesses:**
  - Found no evidence of strategic planning.
  - Found no evidence of internal training capability and effectiveness assessment.

Develop the skills and knowledge of people so they can perform their tasks effectively and efficiently.

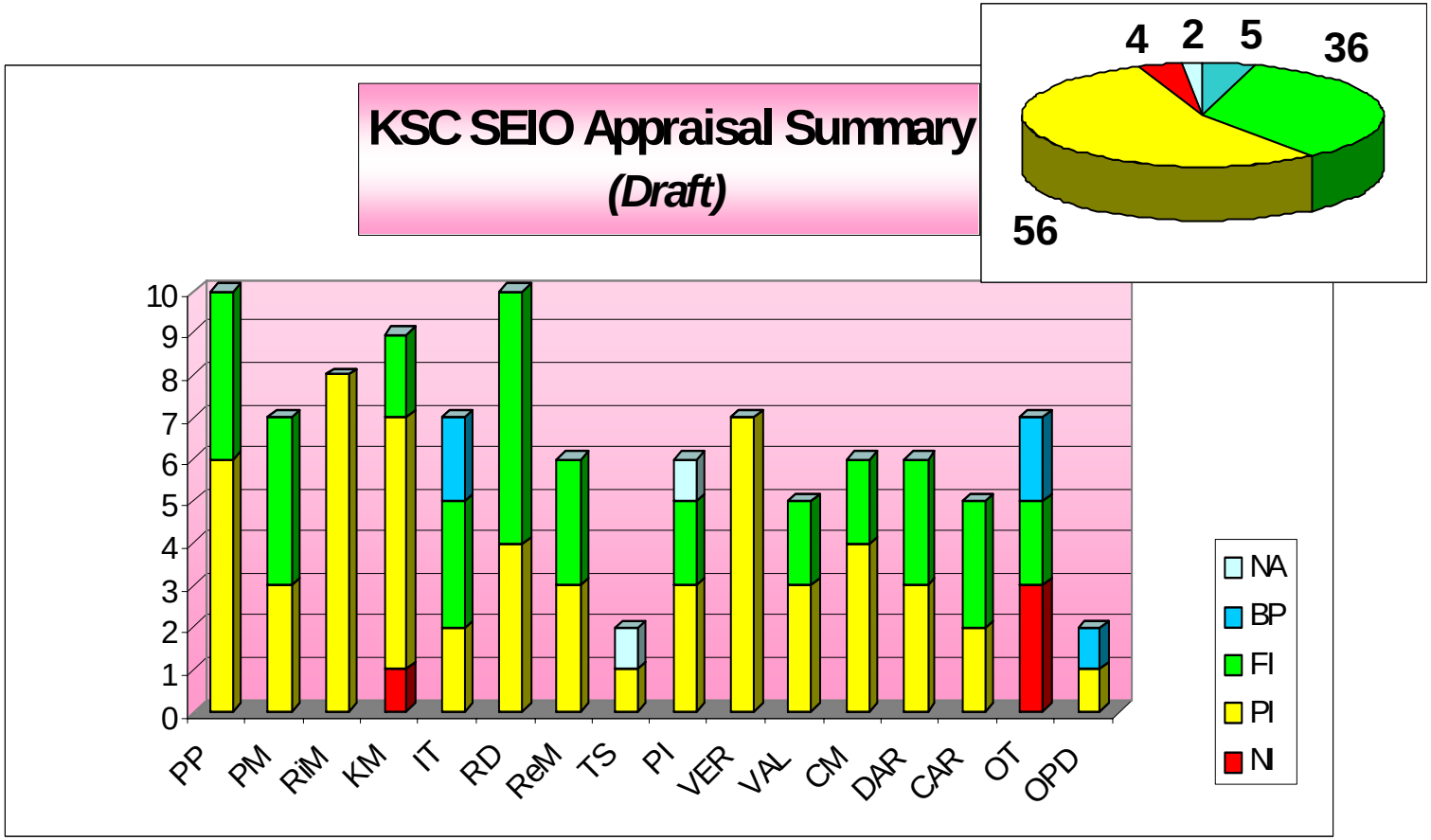
Organizational Process Definition

- **Strength:**
  - NSTS 07700 lays out a standard set of processes for SSP operations. ***Potential Best Practice***

- **Weakness:**
  - There are several libraries and databases for technical, programmatic, and process data. But found no “process asset library” that was accessible to all in MK-SIO.

Establish and maintain a usable set of organizational process assets.

Draft MK-SIO (KSC) Results



MK-SIO (KSC) Summary

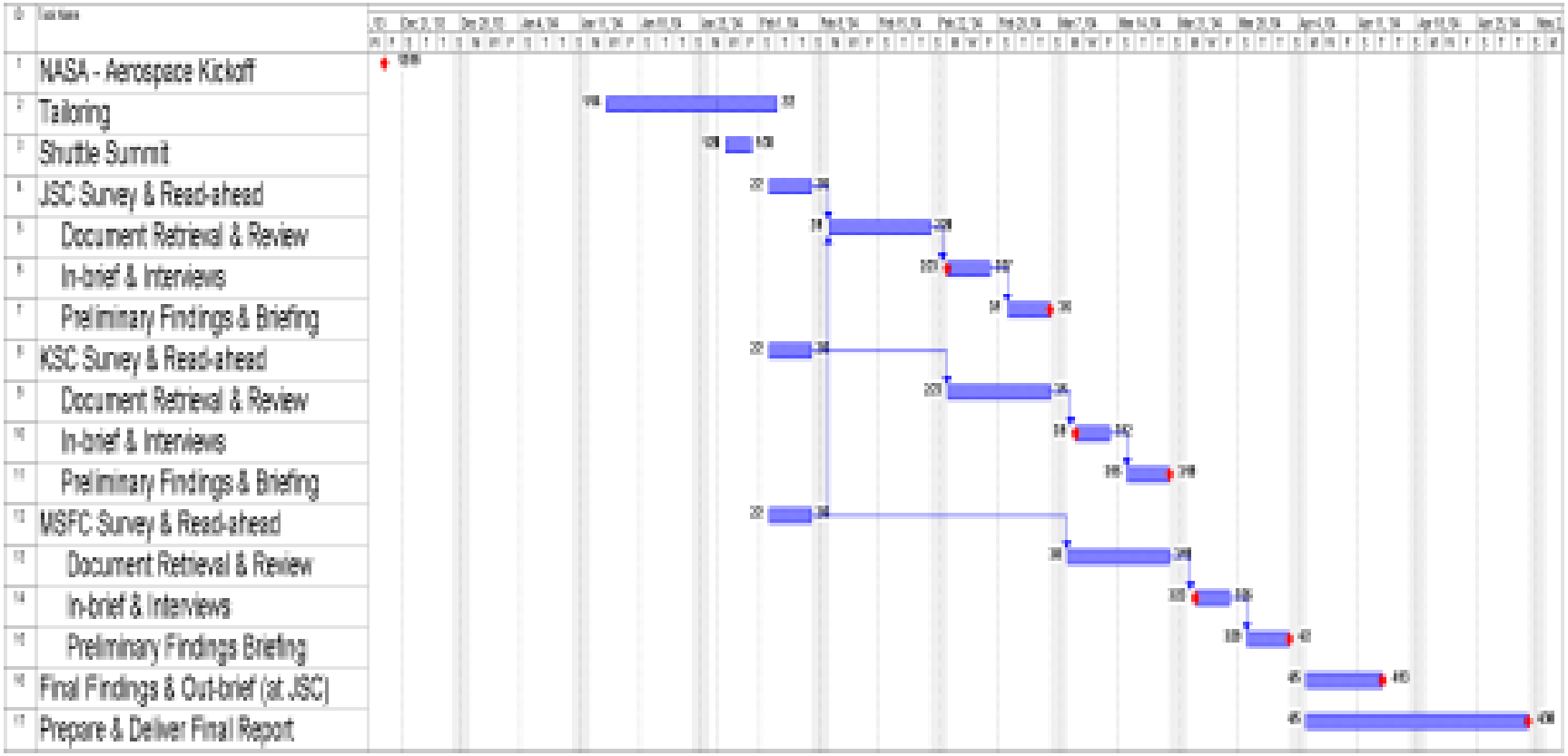
- **This appraisal was a determination of process implementation baseline for SEIO**
- **Not a report card on program or personnel**
- **Strict confidentiality observed - results not attributable**
- **Process Strengths and Weaknesses identified**
- **You will receive:**
  - Final briefing, including recommendations for improvement
  - Findings worksheets with observations for each practice
- **Remaining work:**
  - MSFC SEIO appraisal & preliminary findings briefing
  - Roll up of composite SEIO findings
  - Final report

Backups

What is a Process?

- General Definition of Process
  - A process is a set of practices (activities) performed to achieve a given purpose; it may include tools, methods, materials, and/or people.
- Attributes of a Managed Process
  - A managed process is one that is planned, documented, and executed in accordance with policy; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.
- What about SEIO?
  - SEIO owns processes and practices and result and decisions can have a significant impact on the development process of the contractor and on success of the integration effort.

Planned Appraisal Schedule



2/23 – 2/27 JSC Visit
3/5 Prelim Findings

3/9 – 3/12 KSC visit
3/19 Prelim Findings

3/23 – 3/26 MSFC visit
4/2 Prelim Findings

4/13 Final Out-brief at JSC

Worksheet Example

	Decision Analysis and Resolution	
	Observations	**Assessment**
	SP1.3-1 Identify Alternative Solutions ***Identify alternative solutions to address issues.***	
	CMB reviews all alternatives brought to board and decides on best alternative. CMB has become vetting ground and decision system for alternatives; CMB OI 63-1201; CMB decision brief template (A, DA)	
	"System Integration Process" (12/11/03) CMB decision brief (DA)	
	Presents options to NDS community. NDS PM then decides. (A)	
	Aerospace has attempted to document all technical decisions made and the thought processes used. (A)	
	CMB OI & ERB OI describe alternative solution identification. (A, DA)	
	Method of making decisions based on schedule. Example was polarity "reversal" between IR-M & IIF (IIR-M "won"). (A)	
	Formal AoA used for M-code, jamming resistance; M-code briefing (A, IA)	
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- **Organizational Process Definition**
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  - Establish and maintain the process asset library

Appendix A3 - MSFC Preliminary Findings Briefing

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Systems Engineering Process Appraisal for Space Shuttle Systems Engineering and Integration Office
(MSFC/MP71)

Draft Findings
MSFC

22 April 2004

Releasable only by the Manager,
Space Shuttle Systems Engineering & Integration Office

THE AEROSPACE CORPORATION

PUBLIC RELEASE IS NOT AUTHORIZED

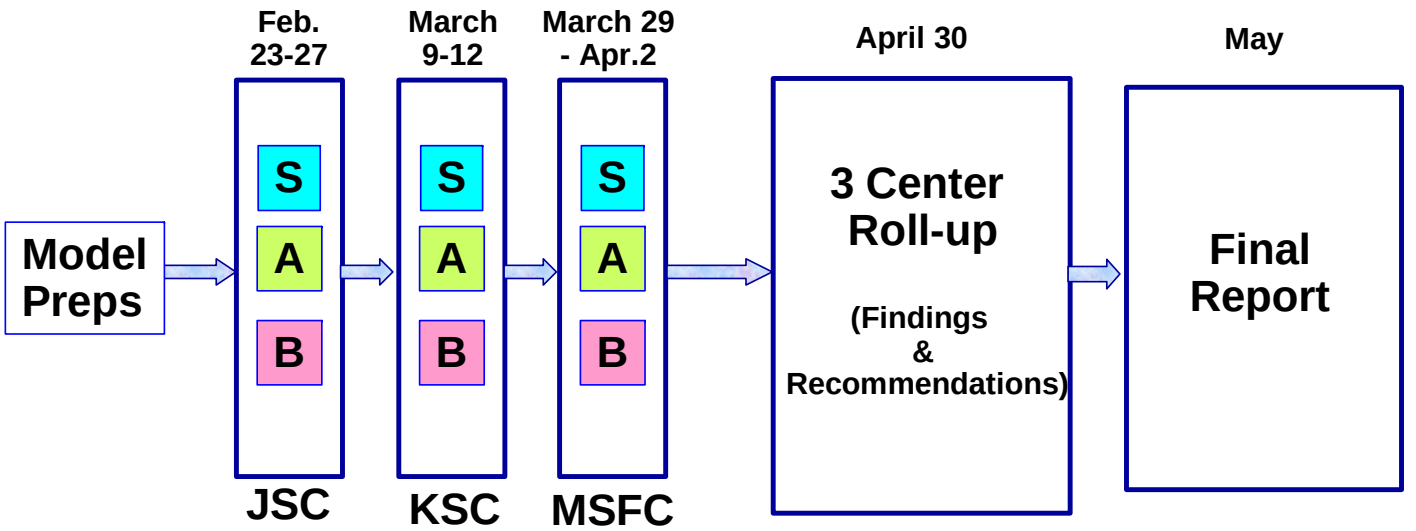
Outline

- Rules of Engagement
- Process Model (CMMI-NS) Review
- Appraisal Process Preliminary Findings
- Draft Appraisal Results

Rules of Engagement

- **Draft findings of MSFC MP71**
  - Participation limited to MP71 interviewees
  - Additional fact-finding session
- **Non-attribution**
  - Strict confidentially is observed
  - Appraisal team will not attribute results to individuals or interview groups

Appraisal Process



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  - Does MP71 have managed processes?
    - Identify process documentation and use
    - Identify strengths and weaknesses
    - Identify Best Practices to share across SEIO
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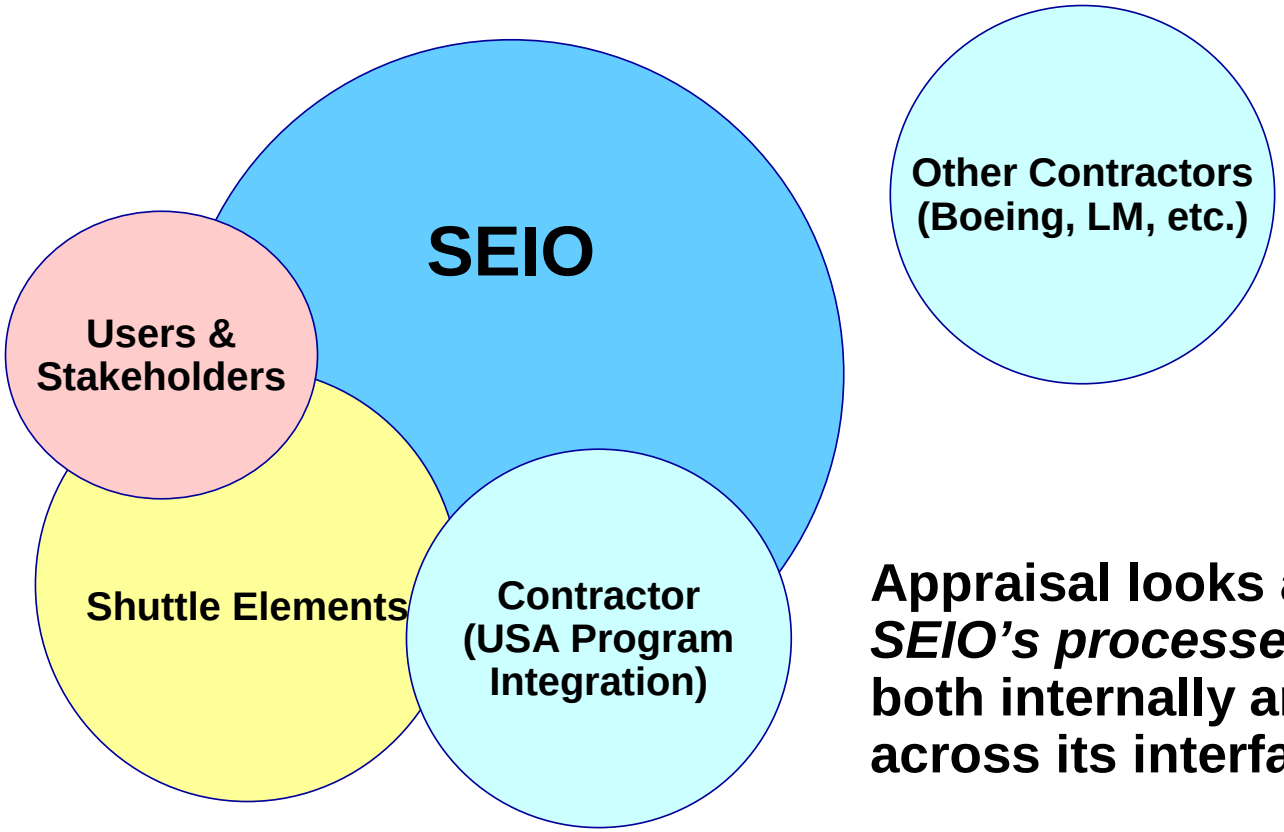
Howard Hayden	SAIC	USAF(Ret), 40 yrs exp with SMC & NASA prgms Prog Manager, Dir Systems Engineering, sat ops
Frank Knight	Aerospace	25 yrs exp at Aerospace – SE for SMC, NRO, NASA Dept Director & Manager of Concept Design Center
Joe Meltzer	Aerospace	40 yrs exp at Aerospace supporting NRO & SMC Aerospace Corporate Chief Engineer
Nick Sramek	Aerospace	32 yrs exp at Aerospace and contractors supporting SMC and NRO programs
Keith Wright	Sparta	USAF(Ret), 30 yrs with NRO, NASA, SMC Prog Mgr Former Astronaut, AF Shuttle Flight Director

JSC, KSC, & MSFC appraisals
JSC & MSFC appraisals
JSC appraisal only

Focus



Appraisal looks at *SEIO's processes* both internally and across its interfaces

Seven Characteristics of Process Implementation

- Do processes exist?
- Are they used?
- Are they documented?
- Do others know about them?
- Are they reviewed by management?
- Are there adequate resources to perform the processes?
- Is there process training?

SEIO SE Process Appraisal Model

Project Management
- Project Planning (PP)
- Project Management (PM)
- Contractor Management (KM)
- Risk Management (RiM)
- Integrated Teaming (IT)

Support
- Configuration Management (CM)
- Decision Analysis & Resolution (DAR)
- Causal Analysis and Resolution (CAR)

Engineering
- Requirements Development (RD)
- Requirements Management (RM)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (of SEIO products) (VER)
- Validation (of system) (VAL)

Organizational Process Management
- Organizational Training (OT)
- Organizational Process Definition (OPD)

103 practices across 16 process areas

Rules for Determining Practice Implementation

- **Best Practice (BP)**
  - Potential for SMC-wide sharing
- **Fully Implemented (FI)**
  1. The practice is performed with no substantial weaknesses
  2. The practice must be documented, used and known
  3. At least two pieces of objective evidence exist (documents and/or interviews)
- **Partially Implemented (PI) - (weaknesses found)**
  - The practice is at least minimally performed but not sufficiently documented or known
- **Not Implemented (NI) - (weaknesses found)**
  - No significant aspect(s) of the practice is/are implemented
- **Not Applicable (NA)**
  - The practice does not apply to this (phase of the) program

Findings Summary

- **Caveats:**
  - These are preliminary findings for MSFC only
  - An integrated picture will emerge when all locations completed
- **Preliminary Findings:**
  - Most specific practices (95/103) are at least partially performed
    - 4 practices represent potential “Best Practices”
    - 8 practices found to be “Not Implemented”
  - Processes that may require attention:
    - Contractor Management
    - Product Integration
    - Verification
    - Validation
    - Decision Analysis
    - Organizational Training
  - Many processes are extremely well-documented
  - But many processes are not documented
  - 6 non-model concerns identified

Reporting Template

Process Purpose Statement

- **Strengths: (Above the model)**
  - Findings that exceed the process requirements.
    (“NONE” means you meet the model)
- **Weaknesses: (Below the model)**
  - Findings, deemed as significant, that do not fulfill some aspect of the process.
- **Concern:**
  - Even though some practices may be fully implemented, the CMMI model may not capture something that could be falling through the crack.

CMMI

Process Summary

Project Management Findings

Project Management

Project Planning

Project Management

Contractor Management

Risk Management

Integrated Teaming

Project Planning

Establish and maintain plans that define project activities.

- **Strength:**
  - CWCs identify resource needs and formally commit stakeholders.

- **Weaknesses:**
  - Although there is center guidance (MWI 7120.5), could find no evidence of a data management structure for MP71 work products.
  - Could find no overall MP71 plan detailing the products and activities of the new, integrated technical effort.
  - Could find no evidence of a documented process guiding reconciliation of MP71 and government resources.

Project Management

Provide understanding of project progress so that corrective actions can be taken when the project's performance deviates significantly from the plan.

- **Strengths:**
  - NSTS 37366 provides clear guidance on issue analysis and resolution.
  - MPG 1280.4 provides procedures for managing corrective actions.
- **Weaknesses:**
  - Although several methods are used to monitor tasks, could find no evidence of a formal process for a coherent MP71 integrated review of its activities.
  - Could find no evidence of a comprehensive process to monitor MP71 data or work products.
  - Could find no evidence of a documented process to monitor stakeholder involvement or commitments.
- ***Concern:***
  - Although formal action item management follows a documented process, there is a concern that some actions may not surface or be examined from an integration perspective.

Risk Management

Identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives. This includes both SEIO and Contactor risks.

- **Strength:**
  - NSTS 37366 Appendix B, Continuous Risk Management, provides guidance to evaluate, categorize, and prioritize risks. ***Potential Best Practice***
- **Weakness:**
  - Could find no evidence that programmatic risks (e.g., budget, schedule, resources) or integration risks are being defined identified, documented or mitigated.
- ***Concerns:***
  - Element risk processes appear to operate independently without an integrated perspective.
  - There does not appear to be a comprehensive risk reporting process.

Contractor Management

Manage the SEIO's sources of products and services (Contractor and government agencies) used to satisfy the project's requirements.

- **Strength:**
  - None.
- **Weaknesses:**
  - Could not find evidence that contractor work products are being regularly reviewed, following a documented process, to detect issues early.
  - Although formal guidance exists, could find no evidence of a process for MP71 review of non-developmental items.
  - Although reviews occur sporadically, found no evidence of a formal, consistent process for MP71 review of the contractor.
  - Although contractor issues and risks are reported monthly, could find no evidence of a consistent, documented process to track issues, risks, and contractor performance.

Integrated Teaming

Form and sustain an integrated team for the development of work products.

- **Strength:**
  - None.
- **Weaknesses:**
  - Team assignments are made based on task, organizational responsibility, and workload. Could find no documented technical qualifications or guidance for team assignments.
  - Found no evidence or a process that integrates teams or guides how teams are to interface.
- ***Concern:***
  - Some informal groups and unchartered teams may function ad hoc and not be fully integrated into MP71 operations.

Engineering Findings

Engineering

Requirements Development

Requirements Management

Technical Solution

Product Integration

Verification

Validation

Requirements Development

Produce and analyze customer, product, and product-component requirements.

- **Strength:**
  - None.
- **Weaknesses:**
  - Found no evidence that requirements are proactively identified and elicited.
  - Could find no evidence that requirements are being analyzed to achieve balance (e.g., for risks, cost , schedule) or validated with any comprehensive techniques.
  - Found no evidence that MP71 is maintaining and executing operational concepts for products.

Requirements Management

Manage the requirements of the project's products and to identify inconsistencies between those requirements and the project's plans and work products.

- **Strength:**
  - None.
- **Weaknesses:**
  - Tech Panels direct the review and analysis of requirements changes, but could find no evidence that MP71 analyzes requirements for risk, supportability, and resource impacts.
  - Could find no evidence that MP71 identifies disconnects and associated work inconsistencies (e.g., sources, rationale, corrective actions) between the project plans and work products and the evolving requirements.

Technical Solution

Design and control interfaces to requirements.

- **Strength:**
  - None.
- **Weakness:**
  - MP71 has major interface responsibilities, but could find no evidence of a documented process identifying associated roles/responsibilities.

Product Integration

Prepare for element integration, ensure interface compatibility, and ensure that the integrated elements function properly.

- **Strength:**
  - None.
- **Weaknesses:**
  - No evidence found of any MP71 verification role for the element interfaces they are responsible for developing.
  - NSTS 08117 identifies MSFC organizations as potential flight certification participants, however no specific MP71 role is defined.
  - No evidence was found of an MP71 role in ensuring the adequacy of MSFC elements when integrated.
  - MP71 does not appear to determine if the integration process fulfills their multi-element design requirements.

“Verification” vs. “Validation”

- **Verification:**
  - ***Ensure that selected SEIO and SEIO contractor work products meet their specified requirements***
- **Validation:**
  - ***Demonstrate that the integrated elements fulfill their intended use when placed in their intended environment***

Verification

Ensure that selected SEIO and SEIO contractor work products meet their specified requirements.

- **Strengths:**
  - MSFC HDBK 2221 defines verification process.
  - Verification roles/responsibilities are defined in NSTS 08117.
- **Weaknesses:**
  - Could find no evidence that MP71 ensures that critical products are selected for verification based on project risk.
  - No evidence found of a documented internal product verification process.

Validation

Demonstrate that the integrated elements fulfill their intended use when placed in their intended environment.

- **Strength:**
  - Image analysis capability supports SSP validation.
- **Weaknesses:**
  - No evidence found that MP71 has any plan or process for validating the MSFC elements.
  - Other than for photo analysis, no evidence was found of a definition of the MP71 role in validation of MSFC SSP elements.

Support Findings

Support

Configuration Management

Decision Analysis & Resolution

Causal Analysis & Resolution

Configuration Management

Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

- **Strength:**
  - SSP CM process, augmented by specific MFSC guidance (MFSC Shuttle Propulsion Configuration Management Manual) is consistently used. ***Potential Best Practice***
- **Weakness**:
  - Could find no evidence of an MP71 internal product CM process.

Decision Analysis and Resolution

Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

- **Strength:**
  - Issue Sheets used for SEA issues to identify & analyze risks/alternative approaches.
- **Weaknesses:**
  - Although alternatives are identified, could find no evidence of a documented process guiding identification or evaluation of alternative solutions.
  - Decisions happen, but no evidence was found that a consistent process is applied.

Causal Analysis & Resolution

Identify causes of defects and other problems and take action to prevent them from occurring in the future.

- **Strength:**
  - None.
- **Weakness:**
  - There is no evidence that causal analysis data is recorded in a readily available and easily usable manner.
- ***Concerns:***
  - All element leads may not perform causal analysis and propose actions to address defects.
  - Some element leads may not follow a rigorous implementation of action proposals resulting from causal analysis.

Organizational Process Management

Organizational Training

Organizational Process Definition

Organizational Training

Develop the skills and knowledge of people so they can perform their tasks effectively and efficiently.

- **Strength:**
  - None.
- **Weaknesses**:
  - Found no evidence of any strategic or tactical training goals/plans.
    - No MP71 work-based needs assessment is performed
    - No evidence of need-to-training traceability
  - Found no evidence of internal training capability (other than Center level facilities) or effectiveness assessment.

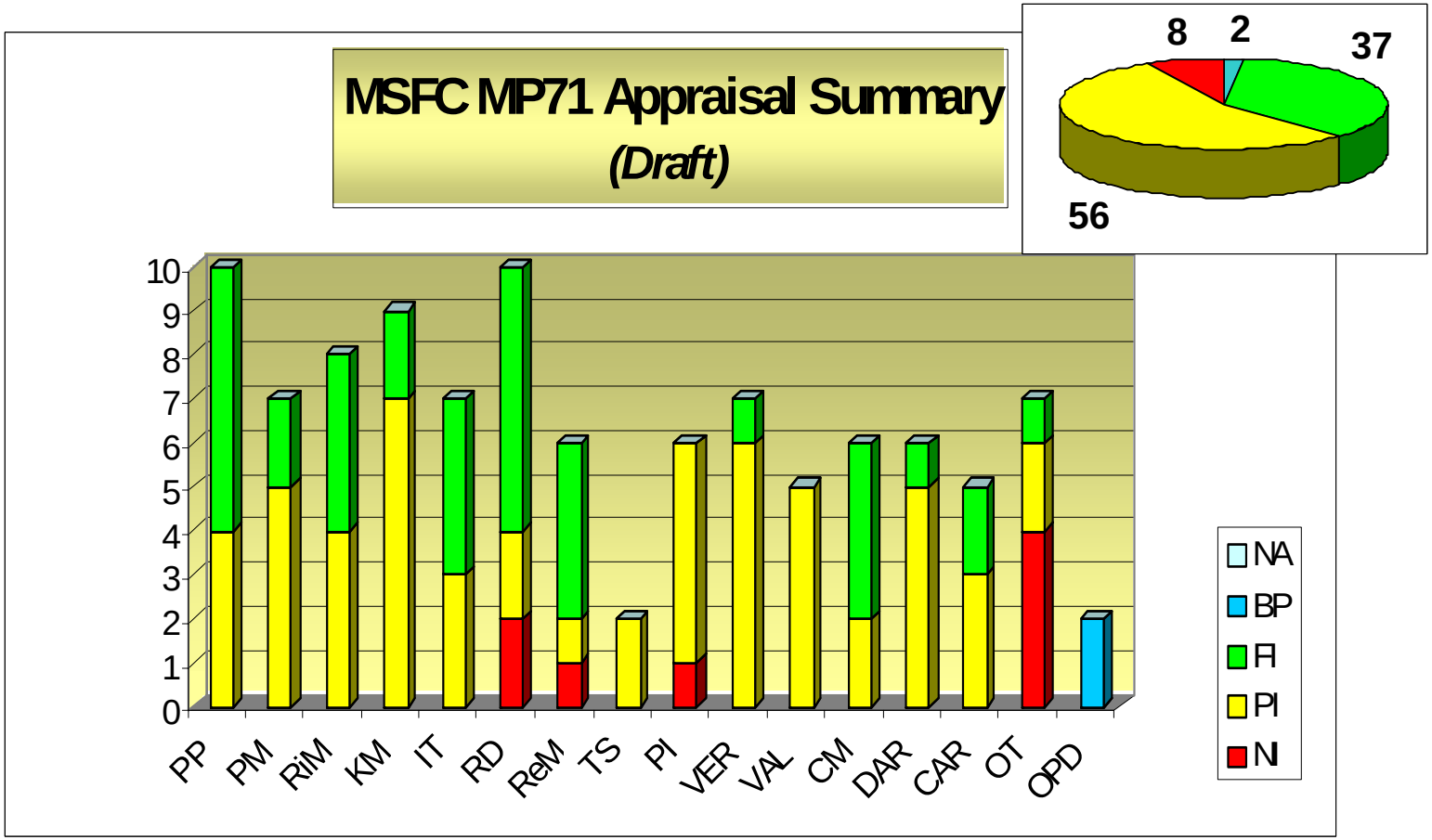
Organizational Process Definition

Establish and maintain a usable set of organizational process assets.

- **Strengths:**
  - There is a well-documented set of organizational processes for all NASA centers. ***Potential Best Practice***
  - There is an online process asset library of MSFC policies, standards, processes, work instructions, plans templates, and process aids. ***Potential Best Practice***

- **Weakness:**
  - None.

Draft MP71 (MSFC) Results



MP71 (MSFC) Summary

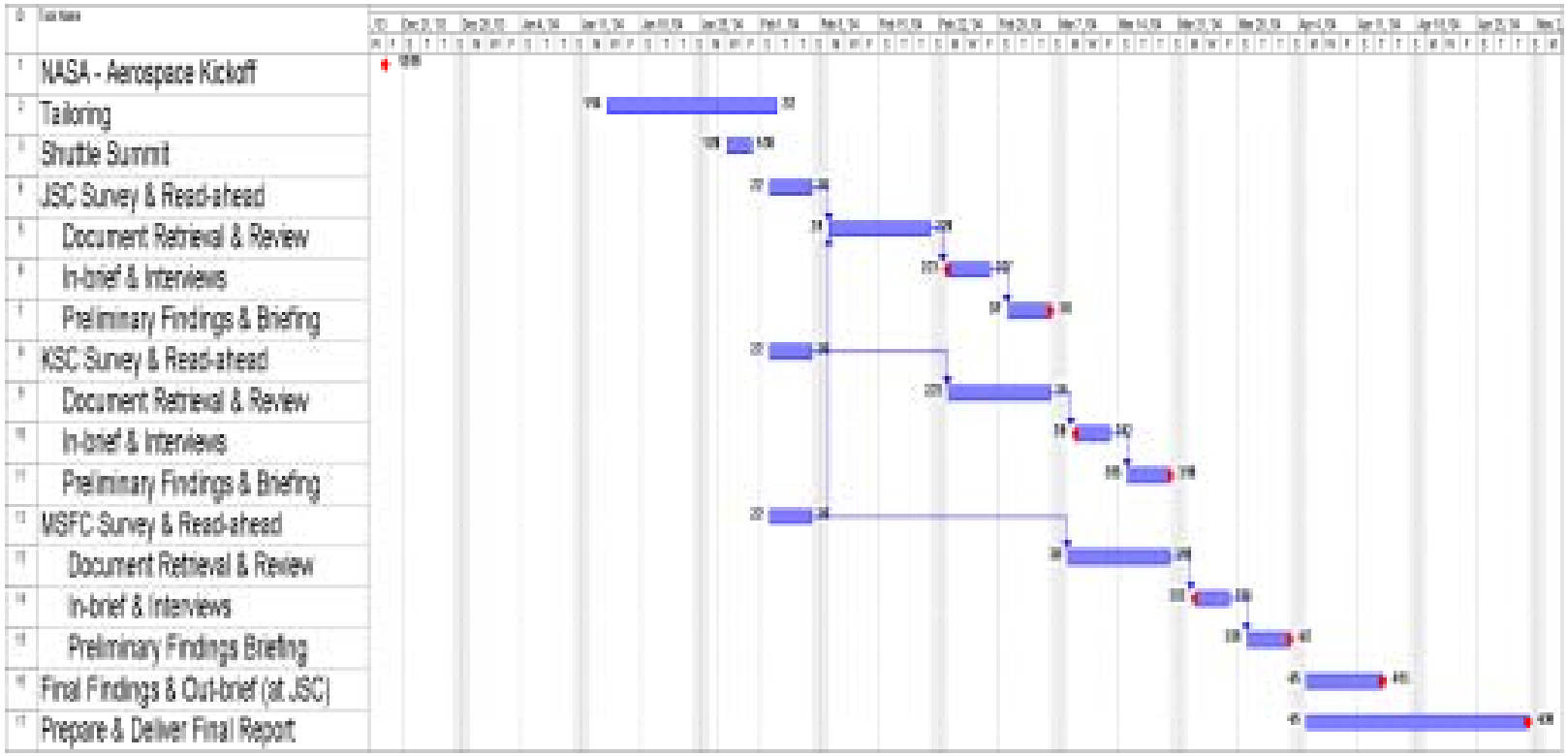
- **This appraisal was a determination of process implementation baseline for MP71**
- **Not a report card on program or personnel**
- **Strict confidentiality observed - results not attributable**
- **Process Strengths and Weaknesses identified**
- **You will receive:**
  - Final briefing, including recommendations for improvement
  - Findings worksheets with observations for each practice
- **Remaining work:**
  - Roll up of composite SEIO findings
  - Final report

Backups

What is a Process?

- General Definition of Process
  - A process is a set of practices (activities) performed to achieve a given purpose; it may include tools, methods, materials, and/or people.
- Attributes of a Managed Process
  - A managed process is one that is planned, documented, and executed in accordance with policy; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.
- What about SEIO?
  - SEIO owns processes and practices and result and decisions can have a significant impact on the development process of the contractor and on success of the integration effort.

Planned Appraisal Schedule



2/23 – 2/27 JSC Visit
3/5 Prelim Findings

3/9 – 3/12 KSC visit
3/19 Prelim Findings

3/23 – 3/26 MSFC visit
4/2 Prelim Findings

4/13 Final Out-brief at JSC

Worksheet Example

	Risk Management	
	Observations	**Assessment**
	SP1.1-1 Determine Risk Sources and Categories ***Determine risk sources and categories.***	
	Not done "up front" - limited to assessing what's on paper at PMRB on risk. Agrees or disagrees (A)	
	Determination of board can be appealed to the next higher level (A)	
	Hardware criticality defined in QA database (Crit 1/2/3) (A); NSTS 08117 defines criticality (DA)	
	Risk Mgmt process defined in NPG 7120.5B, NSTS 37400 Vol 1 contains Risk Mgmt process flow (DA)	
	Found no evidence that programmatic & integration risks are being addressed (DA)	
	NSTS 07700 Vol. 1 (paras. 5.4.2, 5.4.3, 5.4.4) defines technical/safety, cost, schedule risk categories (DA)	
SP1.1-1 Finding	**Organization supports, but does not appear to be proactively involved in, determination of risk sources and categories.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Requirements Development / Management Processes

- **Requirements Development**
  - Elicit and collect needs
  - Develop customer requirements
  - Establish program requirements
  - Allocate program requirements
  - Identify interface requirements
  - Development verification reqts
  - Establish ops concepts / scenarios
  - Define required functionality
  - Analyze reqts to achieve balance
  - Validate reqts (comprehensive methods)
- **Requirements Management**
  - Obtain understanding of reqts
  - Obtain commitment to reqts
  - Baseline requirements
  - Analyze requirements changes
  - Maintain bi-directional traceability
  - Identify inconsistencies between program work and requirements

Technical Solution/ Product Integration Processes

- **Technical Solution**
  - Establish and maintain interface solutions
  - Design and analyze interfaces
- **Product Integration**
  - Determine integration sequence
  - Establish the product integration environment
  - Establish and maintain product integration procedures and criteria
  - Review interface descriptions for coverage and completeness
  - Manage internal and external interface definitions, designs, and changes

Verification / Validation Processes

- **Verification**
  - Select work products
  - Establish verification environment
  - Establish procedures & criteria
  - Perform verification
  - Prepare / conduct internal reviews
  - Analyze results, identify actions
- **Validation**
  - Select products
  - Establish validation environment
  - Establish procedures & criteria
  - Perform validation
  - Analyze results

Configuration Management Process

- **Configuration Management**
  - Identify configuration items
  - Establish configuration management system
  - Create or release baselines
  - Track change requests
  - Control configuration items
  - Establish configuration management records
  - Perform configuration audits

Decision Analysis / Causal Analysis Processes

- **Decision Analysis & Resolution**
  - Establish guidelines
  - Establish evaluation criteria
  - Identify alternative solutions
  - Select evaluation methods
  - Evaluate alternatives
  - Select solutions
- **Causal Analysis & Resolution**
  - Select the defects and other problems for analysis
  - Perform causal analysis and propose actions to address them
  - Implement the action proposals
  - Evaluate the effect of changes
  - Record causal analysis and resolution data

Project Planning / Management Processes

- **Project Planning**
  - Estimate scope of project
  - Determine estimates of effort & cost
  - Establish budget & schedule
  - Plan for data management
  - Plan for project resources and needed knowledge & skills
  - Plan stakeholder involvement
  - Establish project plan
  - Review plans that affect project
  - Reconcile work/resource levels
  - Obtain plan commitment

- **Project Management**
  - Monitor project status
  - Monitor commitments
  - Monitor data management
  - Monitor stakeholder involvement
  - Conduct periodic and milestone reviews
  - Analyze issues
  - Manage corrective action

Contractor Management Process

- **Contract Management**
  - Monitor selected processes
  - Evaluate selected work products
  - Review non-developmental items
  - Conduct reviews and interchanges
  - Compare actual technical activities, cost, schedule to plans
  - Track sustainment products
  - Ensure user evaluation of system performance
  - Take appropriate action
  - Accept delivery of products

Risk Management / Integrated Teaming Processes

- **Risk Management**
  - Determine risk sources and categories
  - Define risk parameters
  - Establish a risk management strategy
  - Identify and document risks
  - Evaluate, categorize, and prioritize risks
  - Develop & implement risk mitigation plans
  - Periodic risk status monitoring and action
  - Risk status reporting at program reviews

- **Integrated Teaming**
  - Identify team tasks
  - Identify needed knowledge and skills
  - Assign appropriate team members
  - Establish a team charter
  - Define & maintain roles and responsibilities
  - Establish & maintain operating procedures
  - Establish & maintain collaboration among interfacing teams

Organizational Training / Process Definition Processes

- **Organizational Training**
  - Establish training needs of program and keep it current
  - Determine which training needs are the responsibilities of the program and which will be left to the individual project or support group
  - Establish a program training plan and keep it current
  - Establish training capability to address program training needs and keep it current
  - Deliver training following program training plan
  - Establish records of program training and keep it current
  - Assess the effectiveness of the program training program

- **Organizational Process Definition**
  - Establish and maintain standard processes
  - Establish and maintain the process asset library

Appendix B - SEIO Results and Recommendations Briefing

This appendix contains the "Results and Recommendations" briefing presented to the SEIO and presents a summary of the results of the appraisal from an integrated SEIO operation perspective. The results, benchmarked at the CMMI®-NS process level for both the integrated SEIO operation and each location, include both example findings and a summary of "what people are saying." Specifics are provided on the 17 actionable recommendations identified and developed during the appraisal. An 18th recommendation was added during preparation of this report; namely, to Implement the Strengths and Best Practices Throughout SEIO (see page 55 of this report). The process strengths, weaknesses, and concerns are both summarized and individually presented for each of the 16 CMMI®-NS process areas in the backup slides.

Systems Engineering Process Appraisal

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Photo Courtesy of NASA

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Agenda

- **Executive Summary**
- **Results**
  - Appraisal Summary
  - Benchmark
  - Example Findings
  - What People Are Saying
- **Recommendations**
  - Integration Process Flow
  - Systems Engineering
  - Project Management
- **Looking Forward**
- **Summary**

SEIO Process Appraisal Team

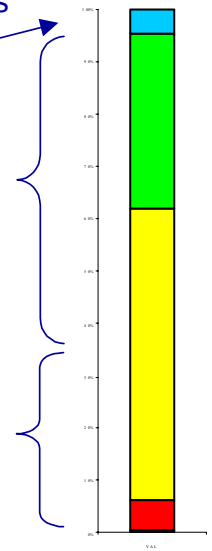
- **Team members have**
  - CMMI® training
  - Participated in appraisals at SMC
  - Significant experience in the space business
  - Strong engineering and technical backgrounds

NAME	ORGANIZATION	EXPERIENCE
Paul Humel	Aerospace	Retired SMC Colonel, Space Industry SE Manager, Deputy Program Manager
Howard Hayden	SAIC	USAF(Ret), 40 yrs exp with SMC & NASA prgms Prog Manager, Dir Systems Engineering, sat ops
Frank Knight	Aerospace	25 yrs exp at Aerospace – SE for SMC, NRO, NASA Dept Director & Manager of Concept Design Center
Joe Meltzer	Aerospace	40 yrs exp at Aerospace supporting NRO & SMC Aerospace Corporate Chief Engineer
Nick Sramek	Aerospace	32 yrs exp at Aerospace and contractors supporting SMC and NRO programs
Keith Wright	Sparta	30 yrs USAF, NRO, NASA, SMC Prog Mgr Former Astronaut, AF Shuttle Flight Director

Executive Summary

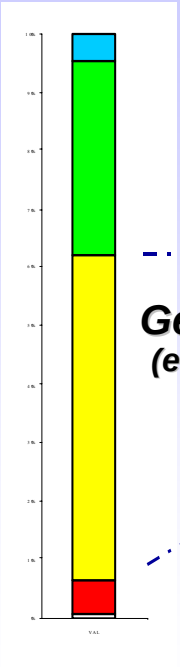
Executive Summary

- **Baselined process existence and use in SSP SEIO**
  - A tailored CMMI® model used as a benchmark, did not assess product quality
  - Assessed 103 separate practices, interviewed 36 government/4 contractors
- **Captured 14 *Best Practices*, some products suitable to share**
  - Program Planning, Integrated Teaming, Product Integration, Tech Solution, Configuration Management, Training, Orgnl Processes
- **Found many processes established, getting the job done**
  - Program Planning, Program Mgmt, Requirements Development, Requirements Management, Configuration Management
- **Identified areas for process improvement**
  - Risk Management, Contractor Management, Verification, Product Integration, Validation, Decision Analysis, Causal Analysis, Config Mgmt (internal products), Training
- **Surfaced some "*concerns*"**
  - Integration roles and responsibilities are not sharply defined
  - No consolidated risk reporting that ensures upper management visibility
  - Communication across SEIO is malfunctioning, "stovepipes" still exist
- **What People Said**
  - We have strong leadership with established processes, we are value-added
  - We need clear definition of our integration roles & processes, improve the communication
- **17 specific recommendations intended to improve your operations**



Results

SEIO Results



Efficient Operation

Getting the job done
(e.g., "tribal knowledge")

Not getting the job done

4.5%	**Best Practice**
34.6%	**Fully Implemented** *(documented/used processes)*
54.7%	**Partially Implemented** *(undocumented/unused processes)*
5.5%	**Not Implemented**
0.6%	**Not Applicable**

There is significant risk when you rely on tribal knowledge

Processes Appraised

Process Categories and Areas:

Engineering

- Requirements Development (RD)
- Requirements Management (RM)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (of SEIO products) (VER)
- Validation (of system) (VAL)

Support

- Configuration Management (CM)
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- Causal Analysis and Resolution (CAR)

Process Categories and Areas:

Project Management

- Project Planning (PP)
- Project Management (PM)
- Contractor Management (KM)
- Risk Management (RiM)
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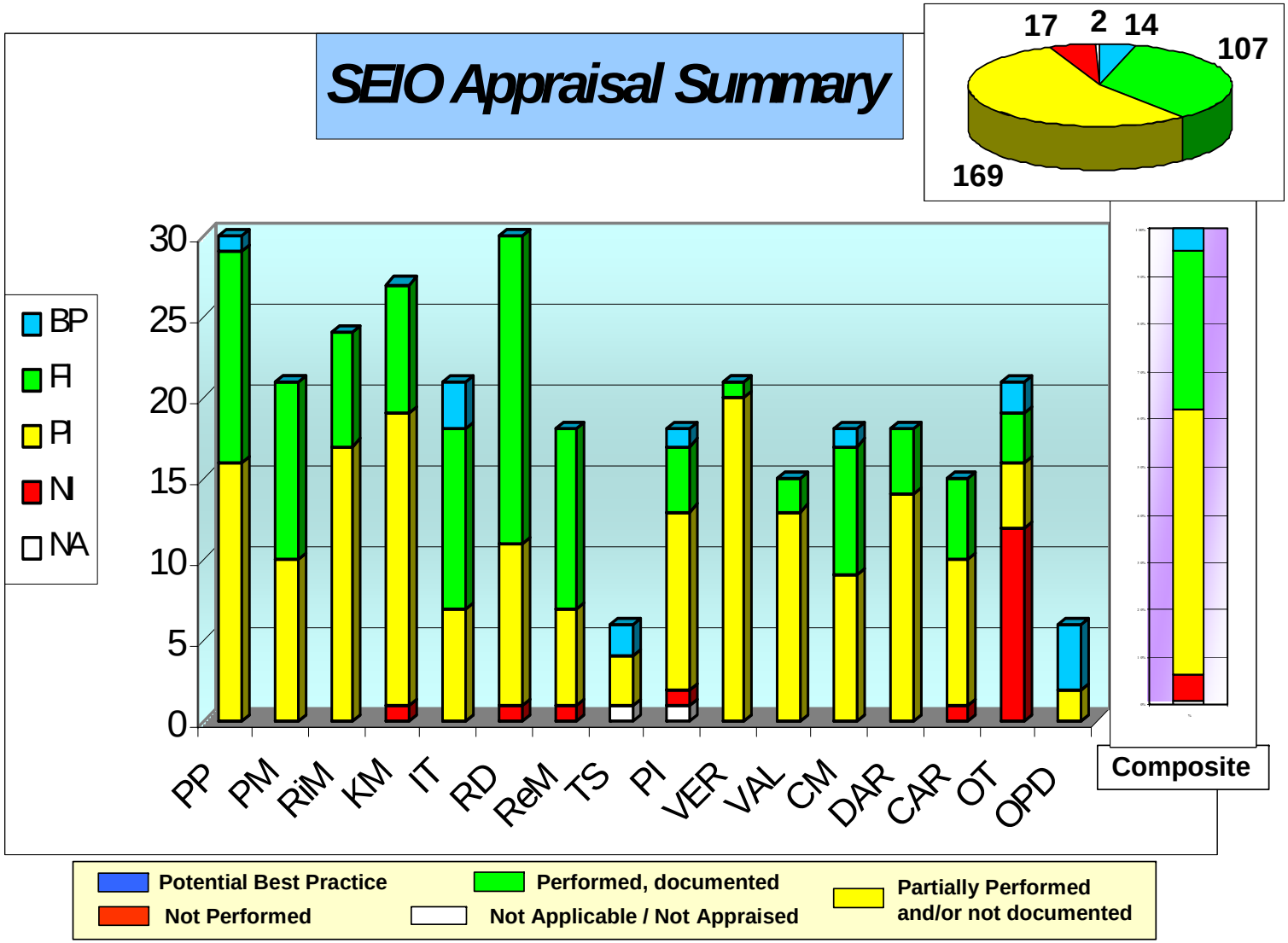
Organizational Process Management

- Organizational Training (OT)
- Organizational Process Definition (OPD)

103 practices across 16 process areas



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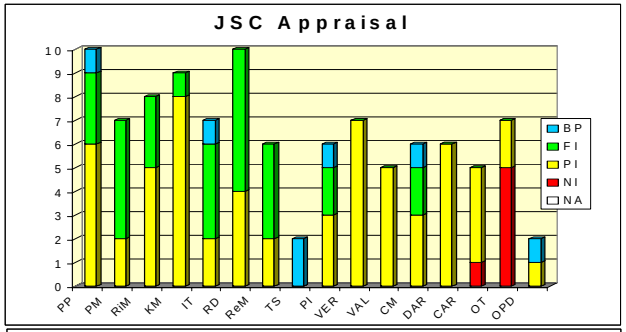
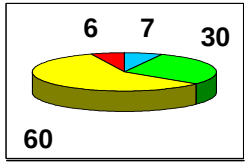
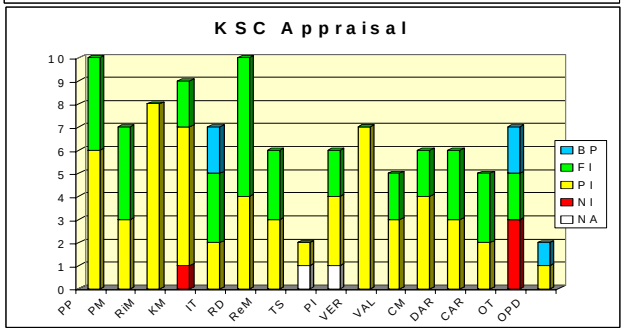
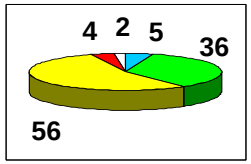
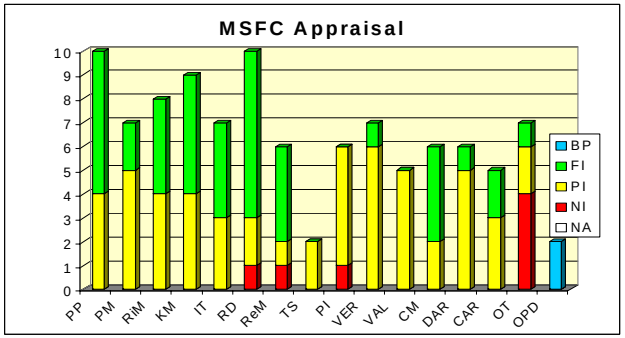
Results Summary

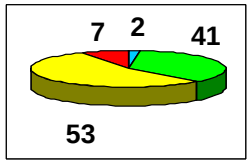








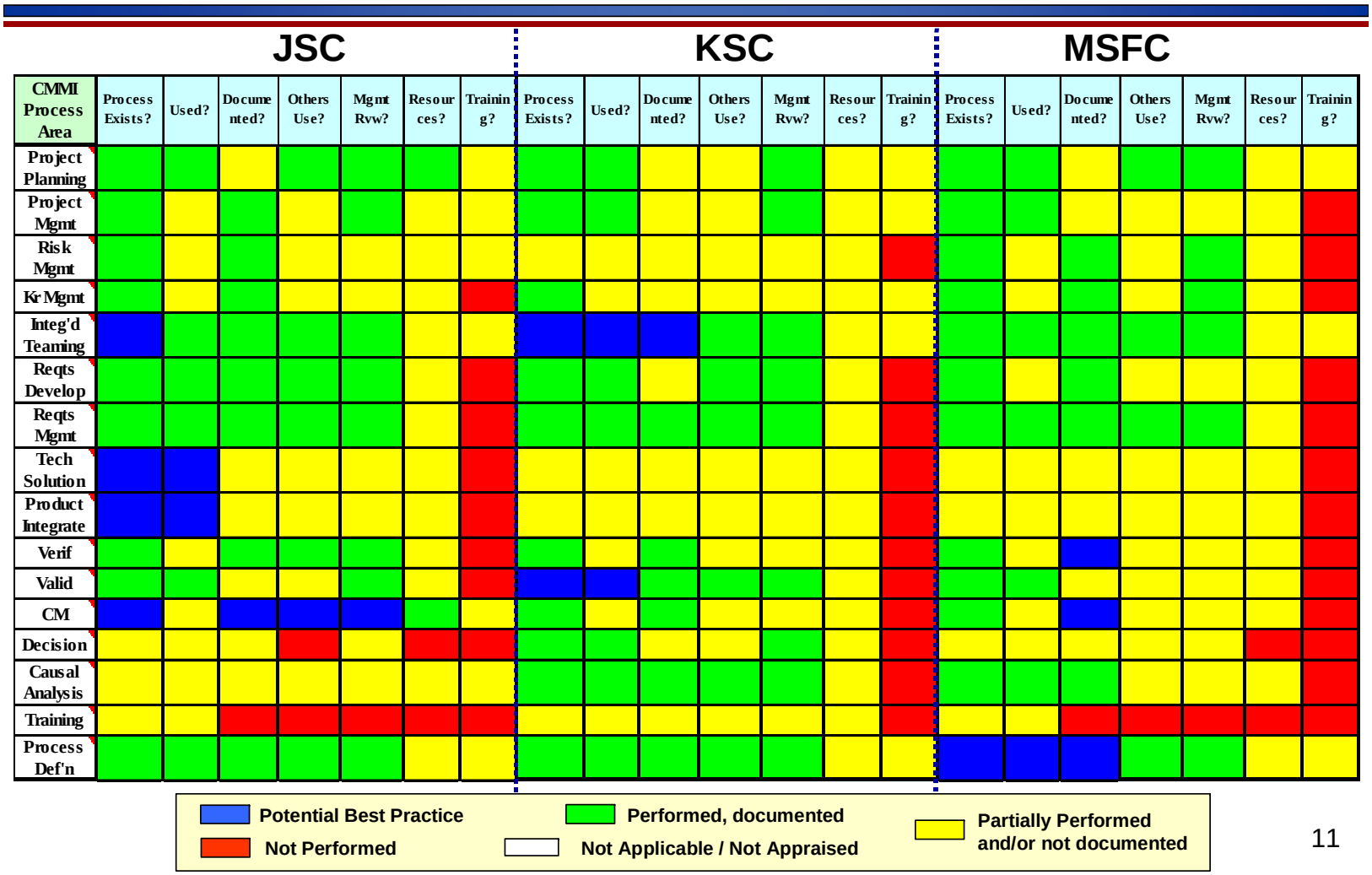




Areas identified for improvement

- Risk Management
- Contractor Management
- Verification
- Validation
- Product Integration
- Decision Analysis
- Causal Analysis
- Configuration Mgmt (internal products)
- Training

SEIO 2004 Benchmark



Example Findings
(More Detail in Backups)

- **Strengths** (fully implemented, above model)
  - There is a documented *interface definition* process, accurately executed
  - MSFC HDBK 2221 defines a *verification* process
  - NSTS 08117 defines *verification* roles & responsibilities (CoFR)
- **Weaknesses** (partially implemented)
  - Element integrators have major interface responsibility but nothing documented identifying *responsibilities* (reqts definition to verification)
  - No *SEIO role* defined to ensure adequacy of integrated elements, many do not understand SEIO responsibilities defined in NSTS 08117
  - No documented, consistent *causal analysis* process (for selecting, analyzing defects and problems)
- **Concerns** (not covered in model, but significant finding)
  - No *validation* plan or process for operational environment feedback
  - Element risk processes appear to operate independently without an *integrated* risk perspective

What People Are Saying

Greatest Organizational Strengths (except for people)?

- **Good leadership, effective, management fortitude, vision, focus**
- **Strong technical depth, tribal knowledge, diversity of experience**
  - "well motivated mob", attitude, pride, spirit, dedication
- **Renewed commitment from the top for SE&I, value-added**
  - we now have the ability to ask questions / influence the program
  - take an independent look at technical problems from a system perspective
  - we are a small, responsive organization / not a bureaucracy
- **Well-established processes - standard, documented**
  - sound requirements process & board structure, configuration management
  - tech panel structure is the backbone of the program
- **Good relationships with the elements**
  - can go anywhere and ask questions, never been denied access
  - we are present in the elements down to the working level
- **Legacy of the (shuttle) program, history of our support**

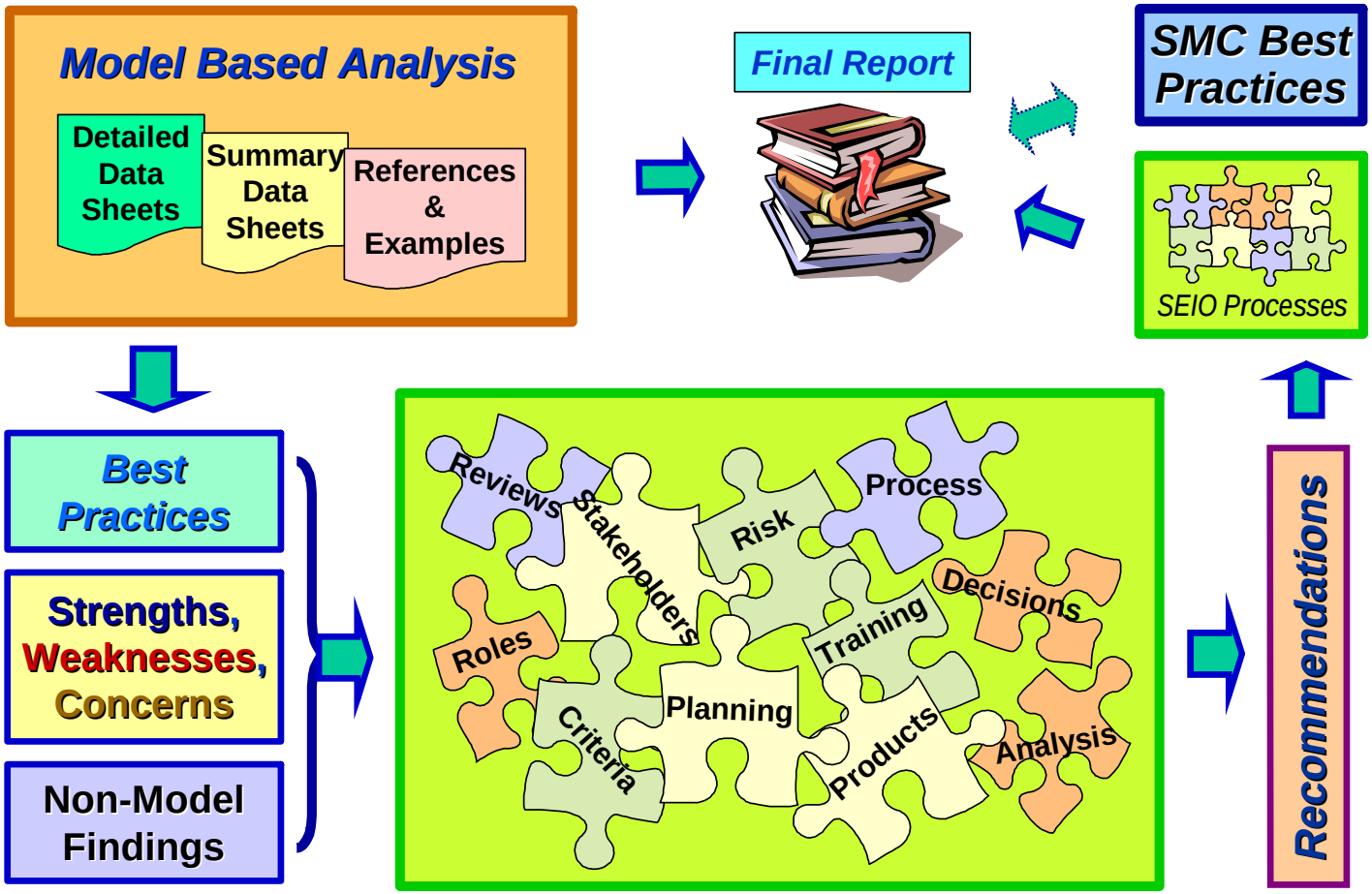
What People Are Saying

What Should Be Changed?

- **Define our roles and responsibilities**
  - need to be grounded & understand responsibilities, unsure of what JSC wants
  - would love to have a handbook describing how to do element integration
- **Improve our organizational structure and staffing**
  - organization is too ad hoc, bring SE&I where the hardware is
  - appropriately staff a couple of key positions, plus up manpower
- **Improve communications**
  - need communications both ways, infrequent occasion to meet w/ upper mgmt
  - improve communications skills, improve mgmt training, have more face-to-face
- **Provide more training**
  - get aggressive, spend the time to get our people up to speed, invest in people
  - have an official & effective mentoring program, we're missing middle managers
- **We need more documented processes**
  - get back to recognizing "processes" are not a curse, we lack processes
  - would introduce/restore more processes
- **Stop the frantic pace**
  - ridiculous pace, uncertain if we treat each issue adequately
  - need more time to work the unknowns vs. spending time in meetings
- **Turn back the clock**
  - restore what has been lost – "trust"
  - the way we functioned before – let's get to the finish line

Recommendations

Recommendations Process



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SEIO Best Practices

JSC	KSC	MSFC
SSP Institutional Processes		
1. Establish standard processes **2. Charter integrated teams** **3. Establish CM records**	• Establish standard processes • Charter integrated teams **4. Define team roles & responsibilities**	• Establish standard processes
Center-Specific Processes		
5. Obtain stakeholder commitment to plans 6. Establish interface descriptions 7. Design & analyze interfaces 8. Review interface descriptions	9. Select products for validation 10. Survey training needs 11. Establish training records	12. Evaluate, categorize, prioritize risks 13. Establish configuration management system 14. Establish organization process asset library

Recommendations
Best Practices & Strengths

- **Best Practices – 4 "institutional", 10 center-specific**
  - Final report will detail how these might be *shared*, including the examples found (e.g., NSTS 37366, ICD process, KSC Personal Development Plans)

- **Strengths**
  - Final report will identify center-specific strengths and recommend how these can be *tailored and shared* SEIO-wide, e.g.:
    - Consider Risk Management found in NPR 8000.4 (process), NSTS 37366 & SEA Issue Sheets (implementation)
  - Final report will also recommend *continuation* of practices, e.g.:
    - Continue "Top X" reviews after RTF
    - Expand SEIO-wide collaboration on work products (e.g., SIPs, Imagery Plan) as a strategy to better integrate the SEIO offices

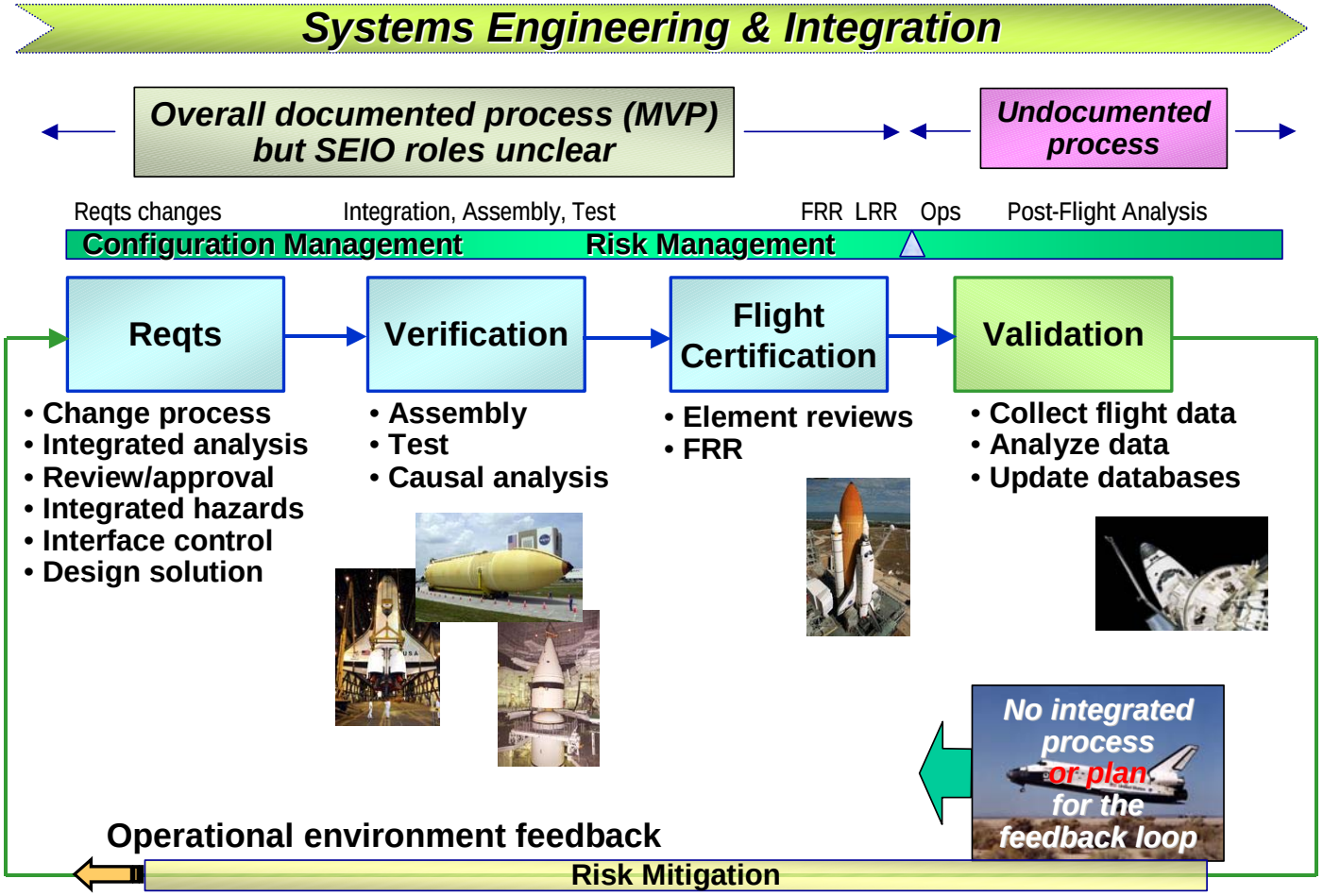
Improvement Recommendations

- **Recommendations are grouped by:**
  - Category 1: highest payoff, most immediate value-added to SEIO performance
  - Category 2: significant payoff, still important in the overall scheme

- **Within each group recommendations are listed as:**
  - Systems Engineering
  - Project Management

- **Objectives**
  - Improve SEIO value-added to SSP
    - Get into “fire prevention” vs. “fire-fighting” mode
    - Enhance SEIO ability to reduce SSP risk
  - Correct shortcomings in selected processes
  - Remove communications barriers within the organization

Integration Process Flow



Systems Engineering Recommendations
Category 1

1. **Clarify and document the SEIO integration process flow from requirements development to launch and define SEIO offices and element integrator roles, responsibilities, and products**
   - Clearly identify the process by which any change affecting multiple elements is well-defined and committed to by all parties to ensure proper compliance and monitoring
   - Element integrators need to assess integrated performance of the stacked elements

Rationale: *Although there is an MVP, there is no clear description of an* **integrated process detailing SEIO roles, responsibilities, or products** *prior to launch. Clear definition will improve communication and collaboration, reducing risk that a critical integration issue might be overlooked.*

Systems Engineering Recommendations
Category 1 (cont)

2. **Define and document the SEIO integration process flow from launch through landing and define SEIO offices and element integrator roles, responsibilities, and products**
   - Develop an integrated plan (with feedback into the requirements process) for element validation in the operational environment

Rationale: *There is* **no clear feedback** *process to ensure potentially critical performance, deficiencies, or trends are fed* **into the requirements process**. *There is potential that anomalies may not be examined and integration risks and issues not identified or sufficiently addressed.*

Systems Engineering Recommendations
Category 1 (cont)

3. **Formulate an integrating Risk Management process to be used across all three SEIO organizations**
   - Include programmatic and integration risks as risk sources
   - Use risk assessment results to guide the verification process

Rationale: *There is no integrated SEIO risk management process, programmatic and integration risks are not identified, and there is no consolidated risk reporting. This will provide* **early, aggressive, and comprehensive risk identification** *through the collaboration and involvement of all relevant stakeholders.*

Systems Engineering Recommendations
Category 1 (cont)

4. **Establish a process to determine which defects to analyze (impact, similarity, frequency, safety), to develop solutions, to define actions, and to evaluate effects of changes**
   - Establish a centralized data archiving system to support the causal analysis process

Rationale: *There is no consistent process to select defects or problems nor a centralized data base. Correcting this will provide the ability to* **select and analyze relevant defects**, *to review what has been done in SSP organizations, and to* **take action** *to prevent future occurrence.*

Project Management Recommendations
Category 1

5. **Establish and maintain overall SEIO plan (addresses tasks, budget, products, risks, schedule, resources, stakeholder involvement)**
   - Define roles and responsibilities including those defined in Systems Engineering recommendations 1 and 2
   - Establish a government WBS (task descriptions, work products) to scope the SEIO effort and provide a basis for estimating resource and training needs
   - Capture the appropriate SSPIA (033C) MOU roles and eliminate the MOU

Rationale: *A documented plan can better achieve* **collaboration** *and* **commitment** *among those required to execute the project and management* **visibility**. *It ties together in a* **logical manner** *the technical and management tasks, risk identification, budgets, schedules, data, resource and skill requirements, and stakeholder interaction.*

Project Management Recommendations

Category 1 (cont)

6. **Determine the training needs, and develop a training philosophy and plan, based upon an assessment of the integrated roles and responsibilities within the SEIO organization**

Rationale: *The organization is responsible for personnel development but does no strategic or tactical training planning. An effective training program provides personnel with the necessary* **SEIO-specific skills** *and knowledge, and* **facilitates** *focused HR support.*

Project Management Recommendations
Category 1 (cont)

7. **Conduct periodic internal SEIO integrated reviews (monitor resources, tasks, products, and schedules against the project plan)**

Rationale: *This offers a means to better create a* **seamless** *organization, to* **improve communication**, *and to* **reduce the risk** *of overlooking integration issues.*

Project Management Recommendations
Category 1 (cont)

8. Establish more formal monitoring and accountability of contractor performance (cost, schedule, technical)

- Re-instate contractor surveillance per published plans
- Apply criteria and metrics identified in the Program Development Plans
- Facilitate government access to SFOC subcontractors performing the work

Rationale: *More formal contractor evaluation allows the government to* **detect and address** *process and product quality* **issues early**.

Systems Engineering Recommendations
Category 2

9. Establish a process to analyze requirements to achieve balance of stakeholder needs and constraints

- Develop a process to analyze, maintain, and execute operations concepts and scenarios

Rationale: *A requirements development process* **with criteria** *(e.g., supportability, risks, resource impacts, cost, schedule), supported with analytical techniques, focuses the approach to ensure that requirements are adequately balanced.*

10. Develop a process with criteria to analyze requirements changes, to include impact and associated risk on product performance, architecture, supportability, system resource utilization, verification requirements, and schedule and cost

- Maintain bi-directional traceability among requirements - project plans - work products

Rationale: *A requirements change process* **with criteria** *and bi-directional traceability focuses the approach to ensure that impacts and associated risks are sufficiently considered when analyzing requirement changes.*

Systems Engineering Recommendations
Category 2

11. Develop a proactive joint multi-element process (technical panels, working groups, teams) to develop, analyze, and validate inter-element requirements

***Rationale**: A process that will actively engage stakeholders would* **improve understanding** *of requirements, and help to ensure that a* **full set** *of inter-element requirements are thoroughly developed, analyzed, and validated.*

12. Set clear guidelines for decisions requiring a formal process

- Consider use of Analysis of Alternatives approach as an additional method to support decision-making

***Rationale**: A clear* **set of guidelines** *is needed to identify decisions requiring a formal process, to apply a* **consistent process** *to those formal decisions, and to ensure formal decisions including rationale are* **documented.**

Project Management Recommendations
Category 2

13. Make SEIO work products available to the whole team

- Establish an internal review process to be followed to ensure quality of internal, "non-board" products
- Plan data management for internal products
- Develop a means to identify and track internal SEIO products to provide better cross-organization access

Rationale: *Data management of internal products affords a communication "tool" to keep staff informed, to better* **share important data** *within SEIO and among integrated teams, and to reduce duplication of effort.*

14. Establish a centralized action item management system to capture and track actions

Rationale: *Centralizing action item management provides greater management* **situational awareness**, *potentially* **broadens visibility** *across the organization, reduces possibility of duplication of effort, and increases the possibility that* **critical issues** *are surfaced and sufficiently addressed.*

Project Management Recommendations
Category 2 (cont)

15. Establish consistent guidelines for government review of non-developmental items

Rationale: *When non-developmental items are proposed, this allows a way to better evaluate potential commercial products and services to ensure requirements are met and* **limitations are acceptable***.*

16. Provide guidance for resource priority and reconciliation

Rationale: *Resource priority guidelines facilitate project adjustments and revisions and may increase* **productivity***.*

17. Establish skills guidelines for team and working group assignments

Rationale: *This improves integrated team performance and provides a* **basis to plan** *the organization's resource and training needs.*

Looking Forward

Next Steps

- **SEIO Choices**
  - What recommendations to implement
  - Priority
  - When
  - How / Who
- **Plan and Implement**
  - Define the tasks
  - Determine and assign the resources
  - Set a schedule
- **Review**
  - Measure progress
  - Follow up appraisal (2005)
  - Continue process improvement

Summary

Summary

- This appraisal benchmarked process implementation and established a baseline for SEIO
- You have exceptional people who were supportive, cooperative
- Many good practices are in place, suitable for sharing
- Opportunities for improvement have been identified, with actionable recommendations
- You will decide what you want to do next
- How may we be of further help?

Photo Courtesy of NASA

It was a privilege to participate in your revitalization effort

BACK UP SLIDES

Capability Maturity Model Integration (CMMI®)

- **Establish a baseline of Systems Engineering Processes against a widely accepted public process model**

Appraisals Emphasized Managed Processes:

- ***Do processes exist?***
- ***Are they used?***
- ***Are they documented?***
- ***Do others know about them?***
- ***Are they reviewed by mgmt?***
- ***Are there adequate resources to perform the processes?***
- ***Is there process training?***

5 Optimizing

4 Quantitatively Managed

3 Defined (Qualitative)

2 Managed

1 Performed

0 Incomplete

SEIO Appraisals Do *NOT* Produce Any Numerical Ratings

Rules for Determining Practice Implementation

- **Best Practice (BP)**
  - Potential for SEIO-wide sharing
- **Fully Implemented (FI)**
  1. The practice is performed with no substantial weaknesses
  2. The practice must be documented, used and known
  3. At least two pieces of objective evidence exist (documents and/or interviews)
- **Partially Implemented (PI) - (weaknesses found)**
  - The practice is at least minimally performed but not sufficiently documented or known
- **Not Implemented (NI) - (weaknesses found)**
  - No significant aspect(s) of the practice is/are implemented
- **Not Applicable (NA)**
  - The practice does not apply to this (phase of the) program

Additional Data Provided

	CMMI-NS Model		JSC		KSC		MSFC		Improvements Observed	Areas for Improvement
	SP	Practice		Strength/Weakness		Strength/Weakness		Strength/Weakness		
PROGRAM PLANNING	*SG1 Establish Estimates*									
	1.1-1	Estimate program scope		WBS, CARD		WBS, CARD		WBS, CCaRS used		
	1.2-1	Est. work product/task attributes		CARD		*CARD, CZ OI 63-1200*			*Documented process for establishing program office estimates*	
	1.3-1	Define program life cycle		CCaRS process defines cycle		GPS Modernization SAMP		GPS Modernization SAMP		
	1.4-1	Determine estimates of effort & cost		CARD used		CZ OI 65-201 defines how		CZ OI 65-201 defines how		
	SG2 Develop a Program Plan									
	2.0-1	Establish pgm acquisition strategy						SAMP updates acq strategy		
	2.1-1	Establish budget & schedule		CCaRS process helps define		CZ OI 65-201 defines how		CCaRS used, CZ OI 65-201	*Documented process*	
	2.2-1	Identify program risks		consequence matrix used				SAMP, IIR RMP identify	*Documented process*	
	2.3-1	Plan for data management				CZ OIs 63-1103, -1104		CZ OIs 63-1103, -1104	*Documented process*	
	2.4-1	Plan for program resources								*Use WBS to decompose program resource reqts (staff, facilities, tools, etc.)*
	2.5-1	Plan needed knowledge & skills		no evidence of any planning		no tactical training plan		no tactical training plan		
	2.6-1	Plan stakeholder involvement				key stakeholders are in orgn		key stakeholders are in orgn		
	2.6a-1	Plan for sustainment		PSMP used		on-orbit performance data used		CRLCMP, PSMP, on-orbit data		
	2.7-1	Establish the program plan		Technology PMP		GPS Modernization SAMP		GPS Modernization SAMP		
	SG3 Obtain Commitment to the Plan									
	3.1-1	Review plans that affect the program		no evidence found					*Documented IPT process*	
	3.2-1	Reconcile work & resource levels				no reconciliation process		no reconciliation process		*Define a process (e.g., like what Aerospace does) to reconcile work & resources*
	3.3-1	Obtain plan commitment		CCaRS coordination		key stakeholders are in orgn		key stakeholders are in orgn		

- **Analysis at the practice level for all processes**
  - Strengths / weaknesses identified by office
- **Identified areas for improvement**
- **Recommendations for improvement**
- **Reference material that may assist**

Worksheet Example

	Risk Management	
	Observations	**Assessment**
	SP1.1-1 Determine Risk Sources and Categories ***Determine risk sources and categories.***	
	Not done "up front" - limited to assessing what's on paper at PMRB on risk. Agrees or disagrees (A)	
	Determination of board can be appealed to the next higher level (A)	
	Hardware criticality defined in QA database (Crit 1/2/3) (A); NSTS 08117 defines criticality (DA)	
	Risk Mgmt process defined in NPG 7120.5B, NSTS 37400 Vol 1 contains Risk Mgmt process flow (DA)	
	Found no evidence that programmatic & integration risks are being addressed (DA)	
	NSTS 07700 Vol. 1 (paras. 5.4.2, 5.4.3, 5.4.4) defines technical/safety, cost, schedule risk categories (DA)	
SP1.1-1 Finding	**Organization supports, but does not appear to be proactively involved in, determination of risk sources and categories.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

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Process *Strengths* Summary

Process | Guidance | Execution

Systems Engineering

- PRCB establishes *requirements*, maintained in NSTS documents
- A documented *interface definition* process, accurately executed
- MSFC HDBK 2221 defines a *verification* process
- NSTS 08117 defines *verification* roles & responsibilities (CoFR)
- MVP provides top-level *verification* guidance (but not for imagery)
- NSTS 37366 Appx B provides *risk management* guidance
- "Top X" review provides excellent incremental *verification*
- SEIO is reintroducing up-to-date empirical *validation*
- Multi-laboratory approach is used for *image analysis*
- SEA issue sheets identify *alternative approaches* (for decisions)

Project Management

- Stakeholder commitment to reqts change is part of board process
- ICB/PRCB process enables significant SEIO influence in config mgmt
- SSEIG established to integrate the technical panels
- Clear guidance for issue resolution (PRACA, RCN, LCN, IFA)
- Complete config mgmt data is rapidly & widely accessible for all actions
- CWCs identify resources needs, commit stakeholders

Process Weaknesses Summary

Systems Engineering

Roles/Responsibilities

- No definition of ***SEIO role*** in validation of SSP elements (except for imagery)
- Element integrators have major interface responsibility but no documented process identifying ***responsibilities*** from reqts definition through verification
- No clear ***SEIO responsibility*** in establishing the integrated test environment
- No clear verification ***role*** for element interfaces MSFC responsible to develop
- No ***SEIO role*** defined to ensure adequacy of integrated elements, many do not understand SEIO responsibilities defined in NSTS 08117

Risk

- No process to ensure products are selected for verification based on ***risk***
- Programmatic, integration, & non-safety ***risks*** not identified, documented

Requirements

- Requirements not analyzed for ***risk***, supportability, & resource impacts
- Requirements not consistently being ***proactively*** identified and elicited
- Requirements not analyzed to achieve ***balance*** or validated comprehensively
- Requirements ***traceability*** performed downward, not upward

Execution

- ***Operational concepts*** for products not maintained and executed
- No plan or process to ***validate*** the MSFC elements
- ***Model validation*** not current with design
- Use of expanded ***flight instrumentation*** beyond next flight appears uncertain
- No documented, consistent ***causal analysis*** process (selecting, analyzing)
- Causal analysis ***data*** not recorded in a readily available & easily used manner

Process Weaknesses Summary
Project Management

- **No overall *project plan* defining the work effort**
- **No process for *system-level review* of integrated SEIO offices activities**
- **No comprehensive *data management* structure for internal products**
- **No documented process for *internal product verification***
- **No process to monitor *informal work products* or data**
- **No configuration management system for internal SEIO products**
- **No documented process guiding *reconciliation* of resources**
- **No documented guidance on *technical qualifications* for team assignments**
- **No significant management priority for *training* (no strategic plan, no consistent tactical plan, no work-based needs assessment)**
- **No training feedback that enables *assessment of training* adequacy**
- **No documented, consistent process guiding formal *decision-making***
- **Inconsistent process to *track contractor* issues, risks, performance**
- **Inconsistent process for review of *non-developmental items***
- ***Sustainment products* not tracked or issues identified**

Process *Concerns* Summary

Integration

Execution

Systems Engineering

- No *consolidated* risk reporting process that captures all identified risk and ensures upper management visibility
- Element risk processes appear to operate independently without an *integrated* risk perspective
- The *integrated system interface* control process primarily looks at "hard" interfaces, EMI is only "soft" interface under bi-lateral control
- No *integrated* SEIO (JSC/KSC/MSFC) process flow clearly depicts respective product integration responsibilities and interactions
- There is no SEIO *integrator* for the Orbiter element
- No *integrated* SEIO (JSC/KSC/MSFC) process flow clearly depicts respective verification responsibilities and interactions
- System performance evaluations done as a prime responsibility of other organizations may inhibit SEIO from ensuring *user evaluation*
- No *validation* plan or process for operational environment feedback
- *Causal analysis products* kept individually, may not be openly distributed

Project Management

- Lower level *action items* may not surface or follow formal procedures
- Many staff *not aware* of ongoing activities throughout SEIO
- For RTF the government has suspended its *contractor management* duties to attend to fire drills
- SSEIG may not have *visibility* into and fully integrate unchartered teams

Legend for the Following Process Charts

Purpose of process

- ***Best Practices***
  - **An exemplary practice implementation to be shared SEIO-wide**

- **Strengths (above the model)**
  - **A practice that exceeds model requirements**
  - **"None" means no practice exceeds the model**

- **Weaknesses**
  - **Findings, deemed as significant, that do not fulfill some aspect of the process**

- ***Concerns***
  - **An observation not strictly covered by the model**
  - **Deemed as something that could "fall through the crack"**

Program Planning

Establish and maintain plans that define program office activities

- ***Best Practice***
  - Chartered tech panels, formal integration plans, and signed internal agreements commit the stakeholders

- **Strength**
  - CWCs identify resource needs, formally commit stakeholders
- **Weaknesses**
  - There is no project plan or equivalent defining the overall work effort
  - Could find no comprehensive data management structure for internal products
  - There is no documented process guiding reconciliation of resources

Program Management

Understand program progress, take action when required

- ***Best Practices***
  - None

- **Strength**
  - There is clear guidance for issue resolution (PRACA, RCNs, LCNs, IFAs, integrated hazards)
- **Weaknesses**
  - Could find no process for ***system level*** review of ***integrated*** SEIO activities
  - There is no process to monitor informal work products or data
- ***Concerns***
  - Lower level action items may not surface or follow formal procedures
  - Many staff not aware of ongoing activities throughout SEIO

Risk Management

Identify problems before they occur

- ***Best Practices***
  - Continuous Risk Management process provides guidance to evaluate, categorize, and prioritize risks
- **Strength**
  - NSTS 37366 Appendix B, Continuous Risk Management, provides Risk Management guidance
- **Weakness**
  - Found no evidence that programmatic, integration (technical), or non-safety related or risks are identified, prioritized, mitigated, documented
- ***Concerns***
  - There is no consolidated risk reporting process that captures all identified risks and ensures upper management visibility
  - Element risk processes appear to operate independently without an integrated risk perspective

Contractor Management

Manage sources of products & services used to satisfy requirements

- ***Best Practices***
  - None

- **Strengths**
  - None
- **Weaknesses**
  - The government conducts periodic but inconsistent review of contractor work products to detect issues early
  - Found no consistent process to track contractor issues, risks, performance
  - The process for review of non-developmental items is inconsistent
  - No evidence that sustainment products are tracked or issues identified
- ***Concerns***
  - For RTF the government has suspended its contractor management duties to attend to fire drills
  - System performance evaluations done as a prime responsibility of other organizations may inhibit SEIO from ensuring user evaluation

Integrated Teaming

Form & sustain integrated team to develop work products

- ***Best Practices***
  - Team charters are clearly defined and centralized in NSTS 07700
  - Team roles/responsibilities are specified in Program Directives
- **Strength**
  - SSEIG was established to integrate the technical panels
- **Weakness**
  - Found no documented guidance on technical qualifications for team assignments
- ***Concerns***
  - Unchartered teams may not follow a disciplined procedure
  - The SSEIG may not have visibility into and fully integrate unchartered teams into the technical areas

Requirements Development

Produce and analyze customer and program requirements

- ***Best Practices***
  - None

- **Strength**
  - Requirements are established by the PRCB and are maintained in numerous NSTS documents
- **Weaknesses**
  - Found little evidence that requirements are proactively identified and elicited
  - Requirements are not analyzed to achieve balance (e.g., for risks, cost, schedule) or validated with any comprehensive techniques
  - Operational concepts for products are not being maintained and executed

Requirements Management

Manage program requirements, identify inconsistencies

- ***Best Practices***
  - None

- **Strength**
  - Commitment to requirement changes is part of the board process with stakeholders
- **Weaknesses**
  - Requirements traceability is performed downward, but not upward
  - Could find no evidence that requirements are analyzed for risk, supportability, and resource impacts

Technical Solution

Design & control interfaces to requirements

- ***Best Practices***
  - Interface definition process clearly defined, well-documented, executed
  - ICDs provide design guidance in addition to requirements to ensure compatibility
- **Strengths**
  - None
- **Weaknesses**
  - Element integrators have major interface responsibilities, but could find no evidence of a documented process identifying their specific roles or responsibilities from requirement definition through verification
- ***Concern***
  - No evidence that an overall disciplined interface control process is applied at the integrated system level except for element interactions involving “hard” (e.g., mechanical/electrical) interfaces

Product Integration

Prepare element integration, ensure interface compatibility & function

- ***Best Practice***
  - ICDs provide design guidance in addition to requirements to ensure compatibility
- **Strength**
  - There is a documented interface definition process, accurately executed IAW detailed instructions
- **Weaknesses**
  - SEIO's responsibility in establishing the integrated test environment is not clearly defined
  - No evidence was found of any verification role for the element interfaces MSFC is responsible for developing
  - No evidence was found of defined role in ensuring the adequacy of elements when integrated (NSTS 08117 defines no specific SEIO role)
- ***Concerns***
  - There is no evidence of an integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts the respective responsibilities and interactions
  - There is no SEIO integrator for the Orbiter element

Verification

Ensure selected SEIO products meet specified requirements

- ***Best Practices*** - None

- **Strengths**
  - MVP provides detailed top-level guidance (but no imagery)
  - MSFC HDBK 2221 defines a verification process
  - "Top X" type review provides excellent incremental verification process
  - Verification roles/responsibilities are defined in NSTS 08117
- **Weaknesses**
  - Found no evidence that JSC interviewees clearly understood SEIO responsibilities identified in NSTS 08117
  - Found no evidence of process that ensures that products are selected for verification based on risk (verification activities appear to be based upon reported anomalies instead of performance criticality)
  - Found no evidence of a documented internal product verification process
- ***Concern***
  - Found no integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts the respective responsibilities and interactions

Validation

Demonstrate system meets user's needs in intended environment

- ***Best Practice***
  - Imagery is provided for flight performance validation
- **Strengths**
  - SEIO is reintroducing up-to-date empirical validation
  - Multi-laboratory approach is used for image analysis
- **Weaknesses**
  - Model validation is not current with design
  - Use of expanded flight instrumentation beyond the next flight appears uncertain
  - No evidence found that MP71 has any plan or process for validating the MSFC elements
  - Other than for photo analysis, no evidence was found of a definition of the SEIO role in validation of SSP elements
- ***Concerns***
  - Found no integrated "launch-to-landing" validation plan or process

Configuration Management

Establish and maintain work product integrity

- ***Best Practices***
  - Formal, integrated CM processes are consistently used
  - There is a comprehensive CM record system
  - Specific guidance (MFSC Shuttle Propulsion Configuration Management Manual) used to augment SSP CM process

- **Strengths**
  - Board process enables significant SEIO influence
  - Complete data (including backups) is rapidly and widely accessible for all (approved/disapproved) actions

- **Weakness**
  - Found no evidence of a CM system for internal SEIO products

Decision Analysis & Resolution

Analyze possible decisions using a formal evaluation process

- ***Best Practices***
  - None

- **Strength**
  - Issue Sheets used for Shuttle Environmental Assurance (SEA) issues to identify and analyze risks/alternative approaches

- **Weakness**
  - Found little evidence of documented, consistent processes or guidelines in formal decision-making for:
    - Applying evaluation criteria
    - Selecting evaluation methods
    - Identifying alternative solutions

Causal Analysis & Resolution

Identify causes of defects & take action to prevent further occurrence

- ***Best Practices***
  - None

- **Strength**
  - None

- **Weaknesses**
  - No evidence of a documented, consistent process in causal analysis for:
    - Selecting defect data
    - Analyzing causes
    - Implementing action proposals
  - No evidence that causal analysis data is recorded in a readily available and easily usable manner

- ***Concerns***
  - Some work products (e.g., briefings, working materials) are kept on individual computers and not openly distributed on a shared drive
  - The causal analysis process may not be followed by all element leads

Organizational Training

Develop knowledge and skills for effective, efficient performance

- ***Best Practices***
  - KSC Training Office does an annual survey and feeds results and training schedule to MK-SIO for implementation
  - ISO 9000 training records (Personal Development Plans) exist, current
- **Strengths**
  - None
- **Weaknesses**
  - Found no evidence of a significant management priority for training
    - No evidence of strategic planning
    - No evidence of consistent tactical planning
    - No evidence of a work-based needs assessment
    - No evidence of need-to-training traceability
  - Found no evidence of feedback that enables training assessment (e.g., supervisor based training guidance)
  - Found no evidence of internal training capability (other than Center level facilities)

Organizational Process Definition

Establish & maintain a usable set of organizational process assets

- ***Best Practices***
  - There is a well-documented set of organizational standard processes for all NASA centers
  - MSFC has an online process asset library of policies, standards, processes, work instructions, plans templates, and process aids

- **Strengths**
  - None
- **Weakness**
  - None

Organizational Training / Process Definition Processes

- **Organizational Training**
  - Establish training needs of program and keep it current
  - Determine which training needs are the responsibilities of the program and which will be left to the individual project or support group
  - Establish a program training plan and keep it current
  - Establish training capability to address program training needs and keep it current
  - Deliver training following program training plan
  - Establish records of program training and keep it current
  - Assess the effectiveness of the program training program

- **Organizational Process Definition**
  - Establish and maintain standard processes
  - Establish and maintain the process asset library

Appendix C - Completed Appraisal Worksheets

The Aerospace Corporation Appraisal Team conducted interviews with a total of 36 members of the SEIO engineering staff and four United Space Alliance managers at Johnson Space Center (JSC), Kennedy Space Center (KSC), and Marshall Space Flight Center (MSFC). These interviews were supplemented by the review of an extensive amount of process documentation and associated products. This appendix contains the "Appraisal Worksheets" developed during the interviews at the three SEIO locations (C1: JSC, C2: KSC, C3: MSFC). Data was accumulated for each of the 103 specific practices contained in the Aerospace-tailored version (CMMI®-NS) of the SEI CMMI® model.

Figure C is a generic (non-SEIO) example of how the data is presented for each of the specific practices (SP). The sheet is identified by the number and title of the SP and includes a brief practice description. The entries are the observations recorded by the appraisers. The observations are identified as either an affirmation (A – statement by interviewee) and/or direct artifact (DA – document review). The colors indicate whether the observation exceeds (blue), meets (green), or partially meets (yellow) the expectations of the model. Red indicates a weakness. The finding is the mini-team assessment of the practice implementation, as concurred by the entire team. Both the mini-team recommendation and appraisal team determination of appraisal implementation are provided. Fully implemented (FI) indicates a documented, known, and used practice that has no significant weaknesses. Partially implemented (PI) means the practice is minimally performed (e.g., not sufficiently documented and/or known). Not implemented (NI) means no significant aspects are implemented. NA means not applicable to the program.

Figure C Worksheet Generic Example

SP1.1-1 Determine Risk Sources and Categories *Determine risk sources and categories.*		
	Risk sources are categorized as technical performance, cost, or schedule. (A)	g
	The contractor has a Risk Management Plan (RMP) that identifies sources and categories, that the government monitors. (A)	g
	Each IPT has its own Risk Management process, there is no Risk Management plan and SPO risks aren't formally tracked. (A)	y
	There is a Risk Management Plan in coordination that was reviewed and signed off on by IIR. (A, DA)	g
	There is a Risk Management process described in the Narrative, pages 3-33 through 3-37. (A, DA)	g
	Not aware of anything written for Program Office or risk process. (A)	r
	A Risk Management Plan was developed dated 06 January 2003, together with briefing charts for training dated January 13, 2003. (A, DA)	g
	Risk Management charts (1/13/03) show risks are being identified (DA)	g
SP1.1-1 Finding	**Determination of risk sources and categories is defined in the Risk Management Plan (RMP). However, not everyone is aware of the Plan.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Appendix C1 - Completed JSC Appraisal Worksheets

CMMI Process Area	What the Appraisal Found	Process Exists?	Is It Used?	Documented?	Others Know & Use?	Mgmt Aware & Review?	Resources?	Training?
Project Planning								
Project Management								
Risk Management								
Contractor Management								
Integrated Teaming								
Requirements Development								
Requirements Management								
Technical Solution								
Product Integration								
Verification								
Validation								
Configuration Management								
Decision Analysis & Resolution								
Causal Analysis & Resolution								
Organizational Training								
Organizational Process Definition								

- Yes, Potential Model
- Yes or Performed
- Partially Performed
- No or Not Performed
- Not Applicable or Not Appraised

Project Planning

	Observations	Assessment
SP1.1-1 Estimate the Scope of the Project ***Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.***		
	No longer a WBS, no SEIO WBS (A)	
	Note: NSTS 07700 Vol. I para.4.1 references retirement of Program WBS (DA)	
	MS org chart with enumerated functions scope work effort (DA)	
	Draft WBS in work (A, DA)	
	FY04 POP itemizes tasks & estimates (DA)	
SP1.1-1 Finding	**Although a WBS is no longer used as a basis to estimate project scope, the SEIO organizational structure and POP process accomplish this practice.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-1 Determine Estimates of Effort and Cost ***Estimate the project effort and cost for the work products and tasks based on estimation rationale.***		
	Now in a "full cost world", get inputs from other orgns (e.g., engineering, life sciences) to build a budget, feeds into Program Operating Plan (POP) (A)	
	Budgeted for independent safety function, increased Kr support, split integrated safety & cargo safety to highlight relative importance (A)	
	Resource estimates driven by flight rates (manifest), based on historical data (A)	
	Cost & schedule are estimated by responsible engineer, reported periodically to SEIO mgmt (A)	
	Used to have work partner tasks for Kr & could plan a year ahead, since accident they have thrown that out & don't do any more, directives are from PRCBs (A)	
	"SEIO Budget Status" (Feb 04), "POP Schedules & Guidelines" (DA)	
	"SFOC Workforce Augmentation for SE&IO" (PCIN 062099, 12/23/03) details a revitalization proposal for tasks (DA)	
SP1.4-1 Finding	**The project updates resource and funding requirements annually, including rationale, following the documented POP process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Establish the Budget and Schedule *Establish and maintain the project's budget and schedule.*		
	RTF schedule established & maintained by MS (A); NSTS 60503 + change 9 (Jan 04) Integrated RTF Schedule (DA)	
	Annual POP process to develop SEIO budget, allocated by SSP (A)	
	Have spreadsheet models used to estimate cost & schedule; Boeing & USA do the lion's share of costing (A)	
	Change Requests (CRs) have associated funding that comes with them (A)	
	"SEIO Budget Status" (Feb 04), "POP Schedules & Guidelines" (DA)	
	"SFOC Workforce Augmentation for SE&IO" (PCIN 062099, 12/23/03) details a revitalization proposal for tasks (DA)	
SP2.1-1 Finding	**Project budget and schedule are established and maintained according to a documented process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Plan for Data Management *Plan for the management of project data.*		
	Shuttle program CM and change control defined by NSTS 07700, Vol. IV & managed by MG (A, DA);	
	Office hasn't done good job of data mgmt or knowledge mgmt (A)	
	"When we want to keep stuff we write a formal letter" (A)	
	SEIO data mgmt in early stages, developing an MS file plan (A)	
	SFOC "PDP for Program Records" (MS7-006, 3/21/02) & "PDP for Program Documentation (MS7-005, 6/20/01) define CM/data archival/retrieval reqts (DA)	
	Could find no evidence of a plan for SEIO data management (DA)	
	On-line Program Documentation Center (PDC) (A, DA)	
	Data filed on SSPWeb (not effective), shared drive ineffective, unaware of any data file plan (A)	
	Some tech data (data pkgs) kept by individuals, some posted on web pages (A)	
	Config Mgmt Office monitors & controls program CM items, documented in NSTS 07700 Vol. IV (A, DA)	
SP2.3-1 Finding	**There is a defined structure for formal documentation, but could find no evidence of a comprehensive data management structure for SEIO work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.4a-1 Plan for Project Resources and Needed Knowledge and Skills *Plan for the necessary resources and needed knowledge and skills needed to perform the project.*		
	JSC/MS org chart establishes functional responsibilities (A, DA)	
	Pre-accident estimates based on flt rates w/ detailed budget buildup; post-accident we're surging to complete RTF tasks/directives, attempting to recover; we allocate effort for tasks & plan for # people needed to support a specific discipline (A)	
	Internal Tasking Agreements (ITA) sets gov't manpower support from other JSC offices (A) JSC ITA between MS & EV (E3 Panel Support) MS0001862 (DA)	
	No SEIO needs analysis, hiring or training plan found (DA)	
	Annual POP process to develop SEIO budget, identifies resources required (A)	
	NSTS 07700 Vol. XV Resource Mgmt Policy & Reqts specifies business mgmt responsibilities & resource planning (DA)	
SP2.4a-1 Finding	**Post-accident resource planning appears reactive with available staff assigned to emerging tasks. Could find no evidence of a documented, repeatable process for SEIO resources.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.6-1 Plan Stakeholder Involvement *Plan the involvement of identified stakeholders.*		
	System Integration Plans (SIPs) define commitments between multiple interfacing design elements & other JSC organizations (A); NSTS 60515, ET Bi-pod Fitting Redesign, 2/10/04 (DA)	
	ITAs document stakeholder commitments & commit funding (A,DA)	
	Tech panels chartered by NSTS 07700 Vol. II (bk2) directives; membership of participating organizations + roles & responsibilities defined (A, DA)	
SP2.6-1 Finding	**Chartered tech panels, formal integration plans, and internal agreements ensure continual stakeholder involvement.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.7-1 Establish the Project Plan *Establish and maintain the overall project plan content.*		
	SIPs define mgmt roles, tech activities, products, verification reqts, schedule commitments between interfacing elements (A); NSTS 60515, ET Bi-pod Fitting Redesign, 2/10/04 (DA)	
	In chaos, used to sign yearly plan but thrown out with reorganization, now operating w/ RTF plan/schedule; have not yet reviewed where we are for FY04 (A)	
	RTF schedule, NSTS 60503 (DA)	
	POP captures institutional support, budget, justification, resources required (A)	
	Unaware of any documented process for a program plan (A)	
	Establishing an SEIO SIP template using the ET Bi-pod version (A, DA)	
	SFOC "PDP for Program Integration Management Operations" (4/12/02) (DA)	
	NSTS 47008 "Mgmt Plan for Space Shuttle Upgrades Program Integration" (Mar '01) defines roles, responsibilities, processes, & tasks for the old orgn (DA)	
	NSTS 47008: no one seemed to be aware of it, has not been updated (DA)	
SP2.7-1 Finding	**There is an overall SEIO plan that details the work activities, processes, and products for the integrated technical effort, but it has not been updated or maintained.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Review Plans that Affect the Project *Review all plans that affect the project to understand program commitments.*		
	In chaos, used to sign yearly plan but thrown out with reorganization; Surveillance Plan (Oct 02) addresses review of Kr work but is not maintained (A, DA)	
	Budget analysts review POP monthly (A)	
	Program Development Plans (PDPs) that cover recurring tasks were put on hold after accident, focus is now on RTF tasks; PDP audits should occur annually but haven't recently (A)	
	"Program Integration Plan for SFOC", not being used or updated (A, DA)	
	NSTS 47008: no one seemed to be aware of it, has not been updated (DA)	
	Today's "plan" = PRCB directives that define RTF tasks, "Top X" issues reviewed wkly (A, IA)	
SP3.1-1 Finding	**SEIO is executing to an interim RTF plan. However, the effort is reactively rather than proactively managed.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Reconcile Work and Resource Levels *Reconcile the project plan to reflect available and estimated resources.*		
	Work priorities dictate what gets done with limited resources, trying to staff up, getting more Kr support (A)	
	"SFOC Workforce Augmentation for SE&IO" (PCIN 062099, 12/23/03) details a revitalization proposal for new tasks & staff assignments (DA)	
	Setting up teams is ad hoc, we're not matrixed, lot of people needed, would be in a world of hurt if people didn't come back as consultants (A)	
	Pre-accident estimates based on flt rates w/ detailed budget buildup; post-accident we're surging to complete RTF tasks/directives, attempting to recover; we allocate effort for tasks & plan for # people needed to support a specific discipline (A)	
	Budgeted for independent safety function, understaffed but increased Kr support (A)	
	Change Requests (CRs) have associated funding that comes with them (A)	
	ITAs document stakeholder commitments & commit funding (A, DA)	
SP3.2-1 Finding	**Work priorities are established and resource adjustments are made ad hoc, but could find no evidence of a documented process guiding reconciliation of resources.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Obtain Plan Commitment *Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.*		
	ITAs (signed) are a way of obtaining other JSC orgns commitments (funding, resources) (A, DA)	
	SIPs define technical responsibilities & bind performing orgns (A); ET-Bipod SIP commits stakeholders defined in Section 5 (DA)	
	Tech panels chartered by NSTS 07700 Vol. II (bk2) directives; membership of participating organizations + roles & responsibilities defined (A, DA)	**B**
SP3.3-1 Finding	**Chartered tech panels, formal integration plans, and signed internal agreements commit the stakeholders. (Potential Best Practice)**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**6**
NI	**0**
NA	**0**
Total Practices:	**10**

Findings Summary

Although a WBS is no longer used as a basis to estimate project scope, the SEIO organizational structure and POP process accomplish this practice.

The project updates resource and funding requirements annually, including rationale, following the documented POP process.

Project budget and schedule are established and maintained according to a documented process.

There is a defined structure for formal documentation, but could find no evidence of a comprehensive data management structure for SEIO work products.

Post-accident resource planning appears reactive with available staff assigned to emerging tasks. Could find no evidence of a documented, repeatable process for SEIO resources.

Chartered tech panels, formal integration plans, and internal agreements ensure continual stakeholder involvement.

There is an overall SEIO plan that details the work activities, processes, and products for the integrated technical effort, but it has not been updated or maintained.

SEIO is executing to an interim RTF plan. However, the effort is reactively rather than proactively managed.

Work priorities are established and resource adjustments are made ad hoc, but could find no evidence of a documented process guiding reconciliation of resources.

Chartered tech panels, formal integration plans, and signed internal agreements commit the stakeholders. (Potential Best Practice)

Project Management

	Observations	Assessment
	SP1.1-1 Monitor Project Status ***Monitor project issues, risks, status, execution, funding, and expenditures against project plans.***	
	SEIO 2-wk schedule (MS_sched_Feb16) details daily mtgs, WGs, boards (DA)	
	"Top X" SEIO issues periodically reviewed (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	Most of Kr technical work is reviewed in tech panels (A)	
	Periodic RTF schedule reviews, schedule updated (A, DA)	
	NSTS 47008 requires integrated project monitoring & reporting (DA)	
SP1.1-1 Finding	**SEIO uses several documented methods to monitor the status of projects and tasks.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Monitor Commitments ***Monitor commitments against those identified in the project plan.***	
	Stakeholders are tech panel members, SSEIG integrates panels & monitors progress, NSTS 07700 Vol. IV charters & defines membership (A, DA)	
	SIPs define technical responsibilities & bind performing orgns (A); ET-Bipod SIP commits stakeholders defined in Section 5 (DA)	
	Meeting notifications, agendas available on SSPWeb (DA)	
	SICB, PRCBs include relevant stakeholders, review progress (A)	
	SEIO is a member on every tech panel (A)	
	ITAs document stakeholder commitments & commit funding (A,DA)	
SP1.2-1 Finding	**Chartered tech panels, formal integration plans, and internal agreements are methods to monitor commitments.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.4-1 Monitor Data Management *Monitor the management of project data against the project plan.*		
	No major database that everyone ties into, "this perhaps a major breakdown", no central data repository, all spread around on individual's computers (A)	
	Data searches yielded no draft or versioned internal SEIO work products (e.g., the SFOC Surveillance Plan) (DA)	
	Could find no evidence of a plan for SEIO data management (DA)	
	Config Mgmt Office monitors & controls program CM items, documented in NSTS 07700 Vol. IV (A, DA)	
	Tech panels are keepers of data books, Kr keep data pkgs on-line, but easier to call the right engineer (A)	
	This office hasn't done a good job of data mgmt or knowledge mgmt (A)	
SP1.4-1 Finding	**Formal program documentation is closely monitored, but could find no evidence of comprehensive process to establish or monitor all of the SEIO data or work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Monitor Stakeholder Involvement *Monitor stakeholder involvement against the project plan.*		
	Stakeholders are tech panel members, SSEIG integrates panels, NSTS 07700 Vol. II charters & defines membership (A, DA)	
	SIPs define technical responsibilities & bind performing orgns (A); ET-Bipod SIP commits stakeholders defined in Section 5 (DA)	
	Meeting notifications, agendas available on SSPWeb (DA)	
	SICB & PRCB include relevant stakeholders (A)	
SP1.5-1 Finding	**SEIO has both formal and informal interactions with stakeholders, following documented processes, that ensures continual involvement.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.6a-1 Conduct Periodic and Milestone Reviews *Periodically review the project's progress, performance, and issues and review the accomplishments and results of the project at selected project milestones.*		
	SEIO project 3-month schedule identifies major meetings & design reviews (DA)	
	"Top X" SEIO issues periodically reviewed (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	NSTS 08117 Reqt & Procedures for Cerification of Flight Readiness (Dec '95) establishes the details for CoFR milestone (DA)	
	Found no evidence of an SEIO integrated system-level progress review (e.g., Project Mgmt Review) (DA)	
	NSTS 47008 requires SEIO support to SSP milestones (DA)	
	NPG 7120.5B defines programmatic Critical Milestone Reviews (CMRs) (DA)	
SP1.6a-1 Finding	**SEIO uses several methods to review projects and tasks, but found no evidence of a documented process defining a coherent system-level review of SEIO activities.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Analyze Issues *Collect and analyze the issues and determine the corrective actions necessary to address the issues.*		
	"Top X" SEIO issues periodically reviewed (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	Change board (IRCB) is clearing house for all technical issues, next step is PRCB where things become law (A); NSTS 07700 Vol. IV defines change control process (DA)	
	Tech panels are forums for raising issues, root cause analysis performed, fault trees developed for anomalies (A)	
	Integrated Hazard Reports document multi-element issues, documented on Form 0249 (A, DA)	
	NSTS 08126 Problem Reporting & Corrective Action (PRACA) defines process for problem resolution (A, DR)	
	NSTS 08117 Reqt & Procedures for Cerification of Flight Readiness (Dec '95) establishes the details for CoFR milestone (DA)	
SP2.1-1 Finding	**Issues surface in a variety of ways and are analyzed and formally documented according to institutional processes.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Manage Corrective Action *Take corrective action on identified issues and manage to closure.*		
	"Top X" SEIO issues periodically reviewed (A); list of issues by priority w/ POC & status (DA)	
	Anyone (w/ Branch Manager permission) can write a Change Request (CR), anyone can look on web & comment; NSTS Vol. IV describes change process, SICB, PRCB approvals (A)	
	Formal actions (e.g., SICB, RIDs) go into CMO database; Top X, tech panel, TIM actions are informal (A)	
	Program doesn't have a major database (for actions) that everyone ties into (A)	
	NSTS 08126 PRACA defines process for problem resolution (A, DR)	
	CoFR is where risks are rolled up & decisions made (A); NSTS 08117 Reqt & Procedures for Cerification of Flight Readiness (Dec '95) establishes the details for CoFR milestone (DA)	
	Integrated Hazard Reports address & resolve multi-element issues, documented on Form 0249 (A, DA)	
	Meeting action item assignment, tracking, & closure appears ad hoc; verbal & not always documented, maintained by SEIO sec'y, limited visibility by staff (A)	
SP2.2-1 Finding	**Formal corrective actions and changes follow a documented set of processes. There is a concern that lower level action items may not surface or be tracked to completion.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	5
PI	2
NI	0
NA	0
Total Practices:	7

Findings Summary

SEIO uses several documented methods to monitor the status of projects and tasks.

Chartered tech panels, formal integration plans, and internal agreements are methods to monitor commitments.

Formal program documentation is closely monitored, but could find no evidence of comprehensive process to establish or monitor all of the SEIO data or work products.

SEIO has both formal and informal interactions with stakeholders, following documented processes, that ensures continual involvement.

SEIO uses several methods to review projects and tasks, but found no evidence of a documented process defining a coherent system-level review of SEIO activities.

Issues surface in a variety of ways and are analyzed and formally documented according to institutional processes.

Formal corrective actions and changes follow a documented set of processes. There is a concern that lower level action items may not surface or be tracked to completion.

Risk Management

	Observations	Assessment
	SP1.1-1 Determine Risk Sources and Categories ***Determine risk sources and categories.***	
	Hasn't used Shuttle Risk Mgmt system - hasn't seen one (A)	
	Risk Mgmt process defined in NPG 7120.5B (DA)	
	NSTS 22254 describes methodology required for preparation of SSP hazard analyses, hazard reports, safety analysis reports, & Management Safety Assessments (A, DA).	
	Personnel utilize 07700 and other documents it help manage risk (A)	
	NSTS 37400 Vol 1 contains Risk Mgmt process flow (DA)	
	Tech panel charters require risk identification (A, DA)	
	NSTS 07700 Vol. 1 (paras. 5.4.2, 5.4.3, 5.4.4) defines technical/safety, cost, schedule risk categories (DA)	
SP1.1-1 Finding	**Risk categories and sources are defined and documented in NSTS 07700 Vol I.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Define Risk Parameters ***Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.***	
	See 7700 Vol XI Sys Int & Assurance Plan; also 5300.4 categorizes risk (A, DA)	
	Risk parameters are utilized to control risk in integrated hazard review & hazard reports (A); HR C-00-04 Debris Impact (DA)	
	Risk parameters are done in conjunction with the Tech Panels, engineers are required to do a risk matrix before going to board (A)	
	Baseline Integrated Hazard Report.pdf provides guidance for IRs (DA)	
	NPR 8000.4 Risk Mgmt Procedures & Guidelines specifies parameters (DA)	
SP1.2-1 Finding	**There is guidance for risk parameter determination but found no evidence that it is being used.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Establish a Risk Management Strategy *Establish and maintain the strategy to be used for risk management.*		
	A risk management strategy is defined and maintained in NSTS 07700 (Vol 1, section 5) and 5300.4 (A, DA)	
	Probabilistic Risk Approach is being developed and beginning to be used (A)	
SP1.3-1 Finding	**A risk management strategy is defined and maintained in NSTS 07700 Vol 1.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Identify Risks *Identify and document the risks.*		
	NASA Program & Project Management Processes and Requirements (NPG: 7120.5B) establishes risk identification (DA)	
	22254 will be changed to add Integrated Hazard Analysis (A)	
	Not written down, safety risks are currently being identified and focused on, using fault trees, but not identified in other areas (A)	
	Looks at risks related to issues (A)	
	Risks identified in "Integrated Hazard Review" process and report (A, DA)	
	Programmatic risks are not being identified (A)	
	Required to do a risk matrix before going to board (A)	
	Brainstormed ID of hazards, using fault trees - 11 different teams, Tiger Teams centered on Tech Panels, plus SSME to orbiter team, risk trades are worked thru Tech Panels (A)	
SP2.1-1 Finding	**Technical risks are identified. However, could find no evidence that programmatic risks (e.g., budget, schedule, resources) are being identified and documented.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Evaluate, Categorize, and Prioritize Risks *Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.*		
	Matrix "likelihood" determination can lead to faulty decisions (foam shedding was "remote" likelihood) (A)	
	Three types of risk categories - Open, Controlled, Accepted (A)	
	Doesn't see if likelihood vs consequence is being done - may be done by Safety Org, used qualitative (i.e. "improbable") because it's difficult to formalize likelihood (A)	
	Risk scorecards exist but aren't used (A)	
	Mentioned 5 x 5 matrix, risk ranking & reporting called out in Appendix D of NSTS 37400 Vol I (A, DA)	
SP2.2-1 Finding	**Integrated safety risks are being evaluated and categorized. However, could find no evidence that risks (technical, cost, schedule, resources) are prioritized.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Develop Risk Mitigation Plans *Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy.*		
	Hazard/risk mitigations developed in Tiger Teams (Tech teams + SEIO) (A)	
	Mitigation strategies are developed on Tech Panels (A)	
	Required to do a risk matrix and risk mitigation plan before going to board (A)	
	Process flow for Risk Mitigation Plans in NSTS 37400 Vol 1 (DA)	
	Risk parameters are utilized to control risk in integrated hazard review & hazard reports (A); HR C-00-04 Debris Impact specifies hazard controls (DA)	
SP3.1-1 Finding	**Integrated safety risks are mitigated and controlled. However, could find no evidence that programmatic risks (i.e., cost, schedule, resources) are mitigated.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Implement Risk Mitigation Plans *Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate, until closed.*		
	Not there yet (but look at 7700 catastrophic safety definitions), 22254 is being changed to formalize the process (A)	
	Just "laying out" hazard analysis process, risk is bottoms-up (Critical Item List, FEMA) and top-down (Integrated Hazard Report), redefining integrated Risk Assessment because "it sucks" (A)	
	Risks are monitored for implementation as part of ICB, Systems Safety Review Panel, and PRCB. (A)	
	Don't design for failures, except for things like engine-out, programmatic risks are not being worked at this time (A)	
	Risk is not a formalized "check the box" process (A)	
SP3.2-1 Finding	**Integrated hazards have mitigation plans and are monitored in tech panels and boards. Found no evidence that non-safety risks are being identified and mitigated.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Report Risk Status *Report the status of identified risks at project reviews.*		
	Risks reported at PRCB (A, IA); staffed integrated hazard report (DA)	
	Rolled up & reported at CoFR (but CoFR is late to do this!)	
	Has Integrated Hazard Reports (doing major rewrite now) (A)	
	Reporting is more issue resolution (cost, schedule) (A)	
	Used to look at schedule risk, but have stopped, can't get (or hard to get) integrated schedules from contractors (A)	
	NSTS 07700 Vol 2 Directive 143D authorize PRCB as the risk review body (DA)	
	CRs are reviewed for risk impact (A)	
SP3.3-1 Finding	**Technical risk status is reported in tech panels and boards. However, there does not appear to be a consolidated risk reporting process that includes all identified risks.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
	Not there yet - but looks at Vol X of 7700	
Generic Finding		

	Final
FI	**3**
PI	**5**
NI	**0**
NA	**0**
Total Practices:	**8**

Findings Summary

Risk categories and sources are defined and documented in NSTS 07700 Vol I.

There is guidance for risk parameter determination but found no evidence that it is being used.

A risk management strategy is defined and maintained in NSTS 07700 Vol 1.

Technical risks are identified. However, could find no evidence that programmatic risks (e.g., budget, schedule, resources) are being identified and documented.

Integrated safety risks are being evaluated and categorized. However, could find no evidence that risks (technical, cost, schedule, resources) are prioritized.

Integrated safety risks are mitigated and controlled. However, could find no evidence that programmatic risks (i.e., cost, schedule, resources) are mitigated.

Integrated hazards have mitigation plans and are monitored in tech panels and boards. Found no evidence that non-safety risks are being identified and mitigated.

Technical risk status is reported in tech panels and boards. However, there does not appear to be a consolidated risk reporting process that includes all identified risks.

Contractor Management

	Observations	Assessment
	SP2.1-1 Monitor Selected Processes ***Monitor and analyze selected processes used by the Contractor for effectiveness and compliance with agreements.***	
	Kr is re-directed to perform (within current SFOC scope) according to the 15 RTF PRCB directives (A)	
	Kr now has outdated Program Development Plans (PDPs) (DA), formerly (pre-accident) audited selected Kr processes based on PDPs (A)	
	Don't regularly audit Kr processes or tools, any audit & repair will result from RTF directives, we look at "533 financials" (A); periodic assessments but haven't caught up with re-organization, doesn't have formality it should yet (A)	
	"Program Integration Plan for SFOC" documents process for contractor monitoring, not being used or updated (A, DA)	
	PDPs used as a basis for Kr process audit (A); PDPs define processes, metrics, process for gov't review (DA)	
	Surveillance Plan addresses review of Kr processes & work but is not being used post-accident (A, DA)	
	Surveillance Plan (Oct '02) addresses review of Kr processes & work (DA)	
SP2.1-1 Finding	**There is a formal process and a plan for monitoring contractor processes, but it does not appear that either are presently in use.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP2.2-1 Evaluate Selected Work Products ***Evaluate selected work products to detect issues as early as possible.***	
	PDPs identify deliverables (recurrent work), performance metrics kept (quality, timeliness), SEIO technical mgmt reps (TMRs) evaluate Kr data reqts deliverables (DRDs) (A)	
	Have done audits in the past, Kr could propose change to a process, have not changed Product Development Plan to reflect change in SEIO organization or done corresponding audits (A)	
	"Top X" SEIO meetings include Kr attendance, presentation of work products (A)	
	PDPs that cover recurring tasks were put on hold after accident, focus is now on RTF tasks; PDP audits should occur annually but haven't recently (A)	
	Most of Kr technical work is reviewed in tech panels (A)	
SP2.2-1 Finding	**PDPs define a process to evaluate recurring contractor work products. However, could not find evidence that the review of RTF work products is a documented process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.3-1 Review Non-Developmental Items *Review candidate non-developmental items to ensure that they satisfy specified requirements.*		
	Attempting to modify/simplify 07700 process for review of COTS, work instructions in place at JSC & MSFC - want to consolidate (A)	
	Unaware of NDI or sustainment products (A)	
	NSTS 07700 Vol X (bk1) contains guidance for off-the-shelf flight & ground system equipment usage (DA)	
SP2.3-1 Finding	**Formal guidance exists for non-developmental item use but could find no evidence of its application.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.4-1 Conduct Reviews and Interchanges *Conduct periodic and event-driven reviews and interchanges with the Contractor.*		
	"Top X" weekly meeting includes Kr (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	Weekly mgmt telecons, quarterly review of Kr metrics, semi-annual Kr eval (A)	
	Most of Kr work is reviewed in tech panels (A)	
	Kr formally reviewed/evaluated every 6 months (A)	
SP2.4-1 Finding	**SEIO uses several methods to regularly review contractor work, but found no evidence of a documented or consistent process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.5-1 Compare Actual Technical Activities, Costs, and Schedule to Plans *Compare the actual technical activities, cost and schedule of the contractor's effort to planned schedules and budgets and identify issues and risks.*		
	Some Kr budget review but getting no buy-in for Kr EVMS tracking, gov't does formal Kr eval semi-annually via formal grade & fee, less formal now due to RTF tasking (no metrics) (A)	
	Doesn't have very strong contract support in his area, concerned with level of engagement & strength of the company (A)	
	Weekly mgmt telecons, quarterly review of Kr metrics, semi-annual eval of Kr including strengths & weaknesses (A)	
	Still providing inputs to Kr eval every 3 months but not a repeatable process (A)	
	In chaos, used to sign yearly plan but thrown out with reorganization; Surveillance Plan (Oct 02) addresses review of Kr work but is not maintained (A, DA)	
	Wkly Top X meeting reviews work plan, wkly schedule review (A)	
SP2.5-1 Finding	**Could find no evidence that contractor technical, cost, and schedule performance are being addressed and risks identified according to a documented, repeatable process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.6-1 Track Sustainment Products *Review and track hardware and software products (e.g., tools, test sets, simulators, spares) required for life cycle sustainment of the acquired system or products and identify issues.*		
	Unaware of any NDI or sustainment products (A)	
	Post-accident Kr model review (A): list of Kr model under review & status (DA)	
SP2.6-1 Finding	**Tracking sustainment products (e.g., models) appears ad hoc. Could find no evidence of a documented process guiding this practice.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.7-1 Ensure User Evaluation of System Performance *Ensure the user participates in the evaluation of system performance to determine the satisfaction of operational requirements.*		
	Stakeholders are tech panel members, Kr's present technical work, tech panels review Kr work products (A, DA)	
	Change process described in NSTS 07700 Vol. IV, SICB & PRCB approvals required; stakeholders are board members (A, DA)	
	"Top X" SEIO internal review of priority task progress, provides incremental verification of work products (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	SEIO & stakeholder responsibilities defined in NSTS 08117 (Requirements and Procedures for CoFR) (DA)	
SP2.7-1 Finding	**Users are embedded throughout the verification and validation process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.8-1 Take Appropriate Action *Track issues, risks and Contractor performance and take action as appropriate.*		
	"Top X" weekly meeting includes Kr, actions assigned (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	NSTS 08126 PRACA defines process for problem resolution (A, DR)	
	PDPs that cover recurring tasks were put on hold after accident, focus is now on RTF tasks; PDP audits should occur annually but haven't recently (A)	
	In chaos, used to sign yearly plan but thrown out with reorganization; Surveillance Plan (Oct 02) addresses review of Kr work but is not maintained (A, DA)	
	PRCB actions assigned, tracked, Kr could respond, PRCB action closeout request minutes (Feb '04) (DA)	
SP2.8-1 Finding	**It appears that issue tracking is ad hoc. Could find no evidence of consistent, documented process to track issues, risks, and contractor performance.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.9-1 Accept Delivery of Products *Accept delivery products in accordance with Contractor agreements.*		
	Completion Form type of contract (performance based), SEIO technical mgmt reps (TMRs) evaluate Kr Data Reqts Deliverables (DRDs) (A)	
	PDPs define product acceptance criteria (A); multiple Kr PDPs (DA)	
	Kr's present technical work, tech panels review Kr work products, recurrent work deliverables via PDP (A, DA)	
	No CDRLs, performance based, end item spec is closest thing to a CDRL (A)	
	PDPs that cover recurring tasks were put on hold after accident, focus is now on RTF tasks; PDP audits should occur annually but haven't recently (A)	
SP2.9-1 Finding	**The plans (PDPs) for acceptance of the contractor's work products have been suspended for RTF tasks.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**1**
PI	**8**
NI	**0**
NA	**0**
Total Practices:	**9**

Findings Summary

There is a formal process and a plan for monitoring contractor processes, but it does not appear that either are presently in use.

PDPs define a process to evaluate recurring contractor work products. However, could not find evidence that the review of RTF work products is a documented process.

Formal guidance exists for non-developmental item use but could find no evidence of its application.

SEIO uses several methods to regularly review contractor work, but found no evidence of a documented or consistent process.

Could find no evidence that contractor technical, cost, and schedule performance are being addressed and risks identified according to a documented, repeatable process.

Tracking sustainment products (e.g., models) appears ad hoc. Could find no evidence of a documented process guiding this practice.

Users are embedded throughout the verification and validation process.

It appears that issue tracking is ad hoc. Could find no evidence of consistent, documented process to track issues, risks, and contractor performance.

The plans (PDPs) for acceptance of the contractor's work products have been suspended for RTF tasks.

Integrated Teaming

	Observations	Assessment
	SP1.1-1 Identify Team Tasks ***Identify and define the team's specific internal tasks to generate the team's expected output.***	
	Tech panels are the integrated teams, chartered by NSTS 07700 Vol. II (bk2), with defined roles & responsibilities (A, DA)	
	Temporary working groups form for special tasks (e.g., instrumentation, integrated hazards), focused objectives & responsive to tech panels (A)	
	SIPs define specific tasks, participants, roles (A); NSTS 60515, ET Bi-pod Fitting Redesign, 2/10/04 (DA)	
	Tasks come in, new (temporary) team may form, must be approved by SEIO mgmt, "Groundrules" document the tasks (A)	
SP1.1-1 Finding	**Team charters, responsibilities, and operating procedures for permanent bodies are defined in NSTS 07700 Vol. II Program Directives.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Identify Needed Knowledge and Skills ***Identify the knowledge, skills, and functional expertise needed to perform team tasks.***	
	Setting up teams is ad hoc, we are not matrixed, whole lot of people needed here, experience/education determines assignments (A)	
	Tech panels are the integrated teams chartered by NSTS 07700 Vol. II which identifies member organizations & responsibilities (A)	
SP1.2-1 Finding	**Although qualified SEIO members do participate on teams, there does not appear to be a documented process guiding needed knowledge and skills.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Assign Appropriate Team Members *Assign the appropriate personnel to be team members based on required knowledge and skills.*		
	Tech panels are the integrated teams chartered by NSTS 07700 Vol. II which identifies membership & responsibilities (A)	
	Concerned about resource loading, not good at handling overtaxing guys with issues (A)	
	Tech panel & working group assignments based tech qualifications, availability, education (A)	
	SEIO is a member on every tech panel (A)	
SP1.3-1 Finding	**Team assignments are made based on task, organizational responsibility, and workload. Could find no documented technical qualifications for team assignments.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Establish a Team Charter *Establish and maintain a team charter based on the integrated team's shared vision and overall team objectives.*		
	Tech panels are the integrated teams, chartered by NSTS 07700 Vol. II (bk2) directives (A, DA)	B
	Teaming arrangements largely not documented - "just the way we do business" (A)	
	Temporary working groups form for special tasks (e.g., instrumentation, integrated hazards), not chartered but tied to tech panels (A)	
	IWG chartered by program directive (A); NSTS 07700 Vol II (bk2) (DA)	
SP2.2-1 Finding	**Team charters are clearly defined in NSTS 07700 Program Directives. *Potential Best Practice.***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Define Roles and Responsibilities *Clearly define and maintain each team member's roles and responsibilities.*		
	Tech panels chartered by NSTS 07700 Vol. II (bk2) directives; membership, roles & responsibilities defined (A, DA)	
SP2.3-1 Finding	**Team roles and responsibilities are clearly specified in NSTS 07700 Program Directives.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.4-1 Establish Operating Procedures *Establish and maintain integrated team operating procedures.*		
	NSTS 07700 Vol. II lays out set of responsibilities and charters of control boards and tech panels, clearly defines operating procedures (A, DA)	
SP2.4-1 Finding	**Chartered integrated teams have operating procedures clearly defined in NSTS 07700, but there is a concern that unchartered teams may not adhere to the same discipline.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.5-1 Collaborate Among Interfacing Teams *Establish and maintain collaboration among interfacing teams.*		
	Tech panels report to SSEIG, SSEIG is responsible for integrating multi-panel issues (A)	
	NSTS 07700 Vol II (bk2) directive establishes SSEIG, defines role as technical integration (DA)	
SP2.5-1 Finding	**NSTS 07700 establishes the SSEIG to specifically integrate all the technical panels. However, there is a concern that unchartered teams may not be fully integrated.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**5**
PI	**2**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

Team charters, responsibilities, and operating procedures for permanent bodies are defined in NSTS 07700 Vol. II Program Directives.

Although qualified SEIO members do participate on teams, there does not appear to be a documented process guiding needed knowledge and skills.

Team assignments are made based on task, organizational responsibility, and workload. Could find no documented technical qualifications for team assignments.

Team charters are clearly defined in NSTS 07700 Program Directives. Potential Best Practice.

Team roles and responsibilities are clearly specified in NSTS 07700 Program Directives.

Chartered integrated teams have operating procedures clearly defined in NSTS 07700, but there is a concern that unchartered teams may not adhere to the same discipline.

NSTS 07700 establishes the SSEIG to specifically integrate all the technical panels. However, there is a concern that unchartered teams may not be fully integrated.

Requirements Development

	Observations	Assessment
	SP1.1a-2 Elicit and Collect Needs ***Elicit, identify, and collect stakeholder needs, expectations, constraints, and interfaces for all phases of the product life cycle.***	
	07700 is fundamental document for requirements processes, which includes collecting stakeholder needs (A)	
	Tech panels develop requirements with organization that requirements impact in an iterative process (A)	
	Changes (needs) in requirements can be identified at any level, then definitized in a CR. Needs to be approved by Branch Manager, then goes into system (TP, ICB, PRCB) (A)	
	Could find no consistent process for data trending or reconstruction that feeds back into reqts development (DA)	
SP1.1a-2 Finding	**There is a process to collect and evaluate requirements changes. However, could find no evidence that requirements are proactively identified and elicited.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Develop the Customer Requirements ***Transform stakeholder needs, expectations, constraints and interfaces into customer requirements.***	
	Tech panels work with appropriate organizations impacted by changes in an iterative process (A)	
	Changes (needs) in requirements can be started at any level. Need to be approved by Branch Manager, then go into system (TP, ICB, PRCB) (A)	
	Customer requirements are worked at Project level, then taken to boards (A)	
	Tech panels chartered by NSTS 07700 Vol. II (bk2) directives; membership of participating organizations + roles & responsibilities defined (A, DA)	
SP1.2-1 Finding	**The tech panels and boards provide the program a documented process to transform needs into requirements, taking into account constraints and interfaces.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Establish Project Requirements *Establish and maintain project requirements, which are based on the customer requirements.*		
	Project requirements are established and maintained in NSTS 07700 (A, DA)	
	Requirement changes are worked at Project Level, then reviewed in Tech Panels, then go to ICB and PRCB (A)	
	New requirements are defined in tables in NSTS 07700 Vol X (bk1) (A, DA)	
SP2.1-1 Finding	**Project requirements are established and are maintained in NSTS 07700, Vol 10, Book 1.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Allocate Project Requirements *Allocate the requirements for each project component.*		
	Requirements are allocated in Tech Panels, then reviewed by ICB and PRCB. Process is mentioned in NSTS 07700, but not in depth (A)	
	Requirements reviewed iteratively with organizations affected (A)	
	SIPs define mgmt roles, tech activities, products, verification reqts, schedule commitments between interfacing elements (A); NSTS 60515, ET Bi-pod Fitting Redesign, 2/10/04 (DA)	
SP2.2-1 Finding	**Tech Panels allocate requirements among disciplines and elements.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Identify Interface Requirements *Identify interface requirements.*		
	Interface requirements are identified thru engineering disciplines supporting the elements. Allocated to the organization(s) responsible (A)	
	Reqt for element-to-element ICDs is documented in 07700 Vol X. ICD's dealt with by IWGs (I/F WGs) (A, DA)	
	Interface requirements are documented in Interface Revision Notices (IRN) - tightly controlled process (A)	
	ICD-2-1201 Orbiter Vehicle /ET (4/99) Rev P (DA)	
	Lost control of what goes into ICDs. Running lots of waivers. (A)	
SP2.3-1 Finding	**Interface requirements are identified through IWGs and elements, documented in ICDs, in accordance with NSTS 07700.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.4-1 Develop Verification Requirements *Develop program verification requirements in conjunction with the development of project requirements.*		
	Requirements verification for the integrated stack in Vol 10, 07700 MVP, program and project level people know it (A, DA)	
SP2.4-1 Finding	**Requirements verification is described in NSTS Vol. X MVP Combined Element Verification Plan. Details are worked and reviewed in the tech panels.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.1-1 Establish Operational Concepts and Scenarios *Establish and maintain operational concepts and associated scenarios.*		
	Mission management operating concept specified in NSTS 07700 Vo. VIII (DA)	
	Ops concept being developed for collecting, integrating, fusing imagery (A)	
	Use integrated models for performance enhancement & flight certification, do mission specific launch loads analysis, end-to-end trajectory analysis (A)	
	Models (e.g., loads) have been verified in the past by post flight analysis, but not kept up to date using new data (e.g., 15 years+) (A)	
	Models validated with operational data (e.g., in the SAIL facility) provide the ability to evaluate performance across the full mission range (A)	
	Additional instrumentation on the next flight will allow for more accurate model updates and validation (A)	
SP3.1-1 Finding	**SEIO uses and maintains its integrated models and databases. But could find no evidence of a documented process or guideline for how this is to be done.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Establish a Definition of Required Functionality *Establish and maintain a definition of required functionality.*		
	Tech panels review requirements for functionality and integration into system (A)	
	Required functionality is defined in NSTS 07700 (Vol. X, bk1) (A, DA)	
SP3.2-1 Finding	**Required functionality is defined in NSTS 07700 Vol. X (bk1) and reviewed by Tech Panels, as necessary.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.4a-3 Analyze Requirements to Achieve Balance *Analyze requirements to ensure that they are necessary and sufficient and to balance stakeholder needs and constraints.*		
	Tech panels develop requirements with impacted organization in an iterative process (A)	
	PDPs for flight - during process, develop and review metrics (A)	
	Program Req'ts Doc (PRD) hasn't been written since 1973 (A)	
	Looking to have Aerospace Corp. review this (A)	
	Some analysis done for compliance, had a concensus process for initial set of reqts, now a formal process, don't have a basis to determine quality of a reqt (A)	
SP3.4a-3 Finding	**Tech panels analyze requirements across elements but could find no evidence that requirements are analyzed to achieve balance (e.g., for risks, cost , schedule).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.5-2 Validate Requirements with Comprehensive Methods *Validate requirements to ensure the resulting system will perform as intended in the user's environment using multiple techniques as appropriate.*		
	Tech panels review integrated requirements and present to ICB and PRCB (A)	
	PDPs for flight - during process, develop and review metrics. Also, define a design env (A)	
	Done thru reviews & panels process. When done well, done on analysis, test, or compliance basis. Do well ~50% of time. Tech panels are good source of reqt's. (A)	
	Very shallow in the recent past, models (e.g., loads) have been verified in the past by post flight analysis, but not kept up to date using new data (e.g., 15 yrs+) (A)	
SP3.5-2 Finding	**Although tech panels and boards review requirements, there is no documented, consistent process for validating requirements.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**6**
PI	**4**
NI	**0**
NA	**0**
Total Practices:	**10**

Findings Summary

There is a process to collect and evaluate requirements changes. However, could find no evidence that requirements are proactively identified and elicited.

The tech panels and boards provide the program a documented process to transform needs into requirements, taking into account constraints and interfaces.

Project requirements are established and are maintained in NSTS 07700, Vol 10, Book 1.

Tech Panels allocate requirements among disciplines and elements.

Interface requirements are identified through IWGs and elements, documented in ICDs, in accordance with NSTS 07700.

Requirements verification is described in NSTS Vol. X MVP Combined Element Verification Plan. Details are worked and reviewed in the tech panels.

SEIO uses and maintains its integrated models and databases. But could find no evidence of a documented process or guideline for how this is to be done.

Required functionality is defined in NSTS 07700 Vol. X (bk1) and reviewed by Tech Panels, as necessary.

Tech panels analyze requirements across elements but could find no evidence that requirements are analyzed to achieve balance (e.g., for risks, cost , schedule).

Although tech panels and boards review requirements, there is no documented, consistent process for validating requirements.

Requirements Management

	Observations	Assessment
SP1.1-1 Obtain an Understanding of Requirements ***Develop an understanding with the requirements providers on the meaning of the requirements.***		
	Requirements reviewed by Tech Panels which include reps from elements (A); NSTS 07700 Vol. II (DA)	
	Requirements changes reviewed in ICB, daily or weekly PRCB (A, DA)	
	People don't read or follow 07700 for requirements (A)	
SP1.1-1 Finding	**Changes to requirements are reviewed, following a documented process, for program impacts in boards and technical panels.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.2-2 Obtain Commitment to Requirements ***Obtain commitment to the requirements and requirements changes from the program stakeholders.***		
	Requirements reviewed in ICB, daily or weekly PRCB. Commitment is part of board actions. People are committed to requirements as part of Program (A)	
	Stakeholders are tech panel members, SSEIG integrates panels & monitors progress, NSTS 07700 Vol. IV charters & defines membership (A, DA)	
	SIPs define technical responsibilities & bind performing orgns (A); ET-Bipod SIP commits stakeholders defined in Section 5 (DA)	
	All config mgmt information available on STS website for all users, includes backup papers (A, DA)	**B**
SP1.2-2 Finding	**Commitment to requirement changes is part of the ICB and PRCB process with stakeholders.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3-1 Baseline Requirements *Baseline and maintain requirements and place them under change control.*		
	All requirements are baselined and maintained in 07700, Vol 10 (A, DA)	
	Changes to requirements are reviewed in Tech Panels and Boards. Once approved, the new requirements are put under CM and 07700 is changed (A, DA)	
	System of CCBs and the PRCB use CRs to maintain system configuration (A)	
	The CR identifies reviewers (A, DA)	
	PRCB Directive used to implement and track changes (A)	
SP1.3-1 Finding	**Requirements are baselined and placed under CM. Changes to requirements are reviewed, approved, configuration controlled, and documented in NSTS 07700.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3a-1 Analyze Requirements Changes *Analyze all changes to the requirements for their impact and associated risk on product performance, architecture, supportability, system resource utilization, verification requirements, and schedule and cost.*		
	Changes to requirements are reviewed and analyzed in Tech Panels, then reviewed and approved in ICB, and PRCB (A)	
	Criteria for analyzing requirement changes is described in 07700 (A, DA)	
	Analysis of requirements changes is also performed by elements (A)	
SP1.3a-1 Finding	**Tech Panels direct the review and analysis of requirements changes, but could find no evidence that requirements are analyzed for risk, supportability, and resource impacts.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-2 Maintain Bidirectional Traceability of Requirements *Maintain bidirectional traceability among the requirements and the project plans and work products.*		
	Traceability of requirements is directed in 07700, Vol 4, Book 1, and maintained in the tech panels, ICB, and PRCB. It is followed exactly (DA, A)	
	Projects and Engineers are required to raise any violations to requirements at ICB and PRCB (A)	
	Traceability of requirements if done well downward, but not upward (A)	
	Do not use reqts traceability tools (e.g., DOORS) (A)	
SP1.4-2 Finding	**Requirements traceability is performed downward (e.g., by tech panels and boards), but not upward.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Identify Inconsistencies Between Project Work and Requirements *Identify inconsistencies between the project plans and work products and the evolving requirements and take appropriate action.*		
	The PRCB is directed in NSTS 07700, Vol 4, Book 1, to resolve cost and schedule for work products for requirement changes (A, DA)	
	ICB minutes document action items & issue resolution (A, IA)	
	NSTS 08126 Problem Reporting & Corrective Action (PRACA) defines process for problem resolution (A, DR)	
SP1.5-1 Finding	**Requirements are reviewed for inconsistencies between project plans and work products and resolved by the SICB and/or PRCB.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**2**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

Changes to requirements are reviewed, following a documented process, for program impacts in boards and technical panels.

Commitment to requirement changes is part of the ICB and PRCB process with stakeholders.

Requirements are baselined and placed under CM. Changes to requirements are reviewed, approved, configuration controlled, and documented in NSTS 07700.

Tech Panels direct the review and analysis of requirements changes, but could find no evidence that requirements are analyzed for risk, supportability, and resource impacts.

Requirements traceability is performed downward (e.g., by tech panels and boards), but not upward.

Requirements are reviewed for inconsistencies between project plans and work products and resolved by the SICB and/or PRCB.

Technical Solution

	Observations	Assessment
	SP2.3-1 Establish Interface Descriptions ***Establish and maintain the solution for product-component interfaces.***	
	A process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700. Chair's control of IWG is performed IAW a published Desk Instruction (DI) (A)	B
	The SEIO ensures execution of the interface process, and obtains approval of and ensuring control of all IWG recommended actions (A)	
	ICD-2-12001 Orbiter Vehicle/ET (4/99), Rev P (DA)	
	Directives are issued by the PRCB to implement IRNs maintained in a secure database (A)	
	There was no evidence of a desk instruction defining the detailed SEIO role in the interface control process (A, DA)	
SP2.3-1 Finding	**SEIO ensures that the clearly defined and well-documented process for establishing and maintaining interfaces is effectively and accurately executed. *(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP2.3a-3 Design and Analyze Interfaces Using Criteria ***Design and analyze comprehensive product-component interfaces in terms of established and maintained criteria.***	
	The SSP ICDs establish reqts and provide design guidance to ensure interfacing designs are compatible & fulfill the reqts of the defined interface (A)	B
	The SEIO is responsible for ensuring a mutually acceptable solution is achieved among interfacing parties (A)	
	ICD-2-12001 Orbiter Vehicle/ET (4/99) contains reqts & I/F design criteria (DA)	
SP2.3a-3 Finding	**SEIO is an integral part of the design process performed to ensure mutually acceptable element/environment interface solutions are achieved. *(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**0**
NI	**0**
NA	**0**
Total Practices:	**2**

Findings Summary

SEIO ensures that the clearly defined and well-documented process for establishing and maintaining interfaces is effectively and accurately executed. (Potential Best Practice)

SEIO is an integral part of the design process performed to ensure mutually acceptable element/environment interface solutions are achieved. (Potential Best Practice)

Product Integration

	Observations	Assessment
	SP1.1-1 Determine Integration Sequence ***Determine the product-component integration sequence.***	
	There is currently no overall shuttle level System Integration Plan (SIP) but we want one. BiPod SIP should be a good example for a template (A)	
	NSTS 7700 provides guidance on SIP content (DA)	
	The SIP is an agreement on the roles and responsibilities, technical activities, interfaces and schedules for a given interface activity (NSTS 60515) (DA)	
	There are no operations flow diagrams like those used in the Mission Operations Directorate (A)	
SP1.1-1 Finding	**The SIP provides a means to definitize an integration process for interface activities.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-2 Establish the Product Integration Environment ***Establish and maintain the environment needed to support the integration of the product components.***	
	SEIO is responsible for establishing and maintaining all integrated environment models (A)	
	SEIO provides the environment for the interface designs (A, DA)	
	The SEIO is responsible only for the system level interface and operating environment definition portion of the integration environment, but not the I&T procedures (A)	
SP1.2-2 Finding	**SEIO interface definition/control process establishes/maintains the basic system level integration environment. However, unable to assess the I&T portion of the environment.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Product Integration Procedures and Criteria *Establish and maintain procedures and criteria for integration of the product components.*		
	SEIO develops the plan to produce a product of integration which is then board approved (A)	
	Product Development Plans describe product integration efforts, but have not been updated for the new organization (A)	
	There are no operations flow diagrams like used in the Mission Operations Directorate (A)	
	For whom does USA do system level integration? What is SEIO role?	
SP1.3-3 Finding	**Plans and criteria are developed for system level integration, but detailed procedures are the responsibility of the contractor.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Review Interface Descriptions for Completeness *Review interface descriptions for coverage and completeness.*		
	The SSP ICDs establish reqts and provide design guidance to ensure interfacing designs are compatible & fulfill the reqts of the defined interface (A); NSTS 07700 Vol IV (Appendix D) defines process for review & coordination (DA)	**B**
	The SEIO is responsible for ensuring a mutually acceptable solution is achieved among interfacing parties (A)	
	ICD-2-12001 Orbiter Vehicle/ET (4/99) contains reqts & I/F design criteria (DA)	
SP2.1-1 Finding	**The interface design and analysis process ensures appropriate coverage and completeness of the integrated set of interface descriptions. (*Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Manage Interfaces *Manage internal and external interface definitions, designs, and changes for products and product components.*		
	NSTS 7700 and OMRS directs compliance with ICDs (A, DA)	
	The SEIO and IWG members participate in element design reviews (A)	
	Compliance with ICDs is ensured by attendance at dedsign reviews (SEIO is board member with veto) and QA stamps on Task Performance Sheets (A)	
	A process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700. Chair's control of IWG is performed IAW a published Desk Instruction (DI) (A)	B
	The SEIO ensures execution of the interface process, obtains approval of and ensures control of all IWG recommended actions (A)	
	Directives are issued by the PRCB to implement IRNs maintained in a secure database (A)	
SP2.2-1 Finding	**The NSTS 7700 interface control (IWG/ICD/IRN) and design review processes provide the means to manage the system level interfaces.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.3-1 Evaluate Assembled Product Components *Evaluate assembled product components for interface compatibility.*		
	SEIO does no hardware fabrication/evaluation (A)	
	SEIO is responsible for the Master Verification Plan which provides guidance for interface verification and the associated verification matricies (A); NSTS 07700-10-MVP (DA)	
	SAIL used for flight qualification of avionics interfaces (A)	
	Who is responsible?	
SP3.3-1 Finding	**SEIO is responsible for establishing the verification requirements that the element and QA use to ensure interface compatibility, but has no role for assembled interface products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**3**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

The SIP provides a means to definitize an integration process for interface activities.

SEIO interface definition/control process establishes/maintains the basic system level integration environment. However, unable to assess the I&T portion of the environment.

Plans and criteria are developed for system level integration, but detailed procedures are the responsibility of the contractor.

The interface design and analysis process ensures appropriate coverage and completeness of the integrated set of interface descriptions. (Potential Best Practice)

The NSTS 7700 interface control (IWG/ICD/IRN) and design review processes provide the means to manage the system level interfaces.

SEIO is responsible for establishing the verification requirements that the element and QA use to ensure interface compatibility, but has no role for assembled interface products.

Verification

	Observations	Assessment
SP1.1-1 Select Work Products for Verification ***Select the work products to be verified and the verification methods that will be used for each.***		
	No process documentation on how to select SEIO work products for peer reviews (A)	
	The MVP provides top level guidance on selecting products for verification, including a verification matrix (A, DA)	
	The tech panels provided input on the selection of products and methods (A)	
	SIP identifies products to be verified (A)	
SP1.1-1 Finding	**MVP and SIP identify products and methods for system verification. Could find no evidence for identification of SEIO products to be verified.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.2-2 Establish the Verification Environment ***Establish and maintain the environment needed to support verification.***		
	Some peer reviews are done by bringing staff in from other NASA centers (A)	
	Some SEIO written products are verified primarily by peer review (A)	
	MVP, Book 2, Section 4 defines the multiple verification environments needed for the combined system verification (DA)	
	Neither the peer process nor the means of retention of peer review results is defined. However, if the products are to undergo a board review, they follow a documented process (A)	
SP1.2-2 Finding	**Environments for system verification and SEIO products undergoing board review are established. But, environments for products not undergoing board action are ad hoc.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Verification Procedures and Criteria *Establish and maintain verification procedures and criteria for the selected work products.*		
	Peer review commonly used to review SEIO products. Kickoff meeting with coordination distribution used to execute peer review (A)	
	Ver/Val have never been clearly differentiated (A); Summit briefings (1/04) (DA)	
	No process documentation on how to execute peer reviews (A)	
	A verification plan is supposed to be in 07700 appendicies but cannot find it (A)	
	The 07700/MVP provides a documented process for verification (A, DA)	
	SIP provides top level verification procedures/criteria for selected products (A, DA)	
	There is a verification table in 07700 for requirement verification (A); MVP (DA)	
SP1.3-3 Finding	**Procedures/criteria for system verification and SEIO products undergoing board review are established, but are ad hoc for products not undergoing board action.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Prepare For and Conduct Peer Reviews *Prepare for and conduct peer reviews on selected work products and identify issues resulting from the peer review.*		
	No documented ground rules or processes were found for peer reviews (A)	
	Peer reviews used to verify SEIO work products (A)	
	Peer review products are processed with all comments attached when going forward for board review (A)	
SP2.1-1 Finding	**Peer reviews are used for SEIO products, but lack a documented process and criteria.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Perform Verification *Perform verification on the selected work products.*		
	This SEIO/JSC establishes verification requirements (MVP, SIP), and responsibility for review/approval of selected verification results, but has no responsibility for conducting combined system verification (A, DA)	
	Verification visibiity of integrated performance is limited to review of reported anomalies (A) **(Confirmed by KSC)**	
	SEIO executes the responsibilities defined in NSTS 08117 (Requirements and Procedures for CoFR). JSC SEIO responsibilities not referenced by any interviewee (DA)	
	Responsible for providing environmental models & doing environmental analyses for CoFR (A); NSTS 08117 (DA)	
	Peer reviews are conducted on selected SEIO products (see SP3.1a-2) (A)	
SP3.1-1 Finding	**SEIO performs system level verification and reviews reported anomalies. But, many did not seem to be aware of the SEIO role in the overall process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1a-2 Prepare for and Conduct Internal Reviews *Prepare for and conduct internal reviews of selected project office work products.*		
	Some peer reviews are done by bringing staff in from other NASA centers (A)	
	"Top X" SEIO internal review of priority task progress, provides incremental verification of work products (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	Peer reviews used to verify selected SEIO work products (A)	
	Peer review products are processed with all comments attached when going for board review (A)	
	No documented ground rules or processes were found for peer process reviews (A)	
SP3.1a-2 Finding	**Peer reviews appear to be the only method used for verification of SEIO products. Could find no evidence of a documented process and criteria for internal reviews.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-2 Analyze Verification Results and Identify Appropriate Action *Analyze the results of all verification activities and identify appropriate action.*		
	The BiPod SIP is the prototype SIP which will establish the template and review process (A)	
	Verification visibility of integrated performance is limited to review of reported anomalies (A) **(Confirmed by KSC)**	
	Changes to requirements are reviewed and analyzed in Tech Panels, then reviewed and approved in ICB, and PRCB (A)	
SP3.2-2 Finding	**SEIO has a limited role in analysis of verification results unless anomalies are reported and/or requirement changes are involved.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	Final
FI	**0**
PI	**7**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

MVP and SIP identify products and methods for system verification. Could find no evidence for identification of SEIO products to be verified.

Environments for system verification and SEIO products undergoing board review are established. But, environments for products not undergoing board action are ad hoc.

Procedures/criteria for system verification and SEIO products undergoing board review are established, but are ad hoc for products not undergoing board action.

Peer reviews are used for SEIO products, but lack a documented process and criteria.

SEIO performs system level verification and reviews reported anomalies. But, many did not seem to be aware of the SEIO role in the overall process.

Peer reviews appear to be the only method used for verification of SEIO products. Could find no evidence of a documented process and criteria for internal reviews.

SEIO has a limited role in analysis of verification results unless anomalies are reported and/or requirement changes are involved.

Validation

	Observations	Assessment
SP1.1-1 Select Products for Validation ***Select products to be validated and the validation methods that will be used for each.***		
	NSTS 07700 Vol IV requires validation of all general items types (requirements, models, flight data, software) and approach, but provides no specific criteria (DA)	
	SEIO aware of its validation responsibilities and the methods it has and will use for each area (A)	
	Models have been verified in the past by post flight analysis (A)	
SP1.1-1 Finding	**Some general guidance exists in NSTS 07700 Vol IV, but could find no evidence of specific selection criteria for products or methods.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.2-2 Establish the Validation Environment ***Establish and maintain the environment needed to support validation.***		
	Models (e.g., loads) have been verified in the past by post flight analysis, but not kept up to date using new data (e.g., 15 years+) (A)	
	Instrumentation is to be increased on next flight for post flight reconstruction, uncertain about instrumentation on future flights (A)	
	A new 3% wind tunnel model will be used to validate models for design changes (A)	
	Models validated with operational data (e.g., in the SAIL facility) provide the ability to evaluate performance across the full mission range (A)	
SP1.2-2 Finding	**Flight instrumentation has not been maintained to enable post flight reconstruction and continual update of environment and performance models.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Validation Procedures and Criteria *Establish and maintain procedures and criteria for validation.*		
	There are standard plans for validating off-the-shelf equipment, Ref 86D and EAWI-016 (A)	
	Subject Matter Experts (SMEs) used to review designs (A)	
	Specific validation processes used for the debris issue (A)	
	Study being done to establish Ver/Val procedures (A)	
	Critical to maintain instrumentation on all future flights to support updating models via reconstruction validation (A)	
SP1.3-3 Finding	**Could find no evidence that validation procedures are being maintained. Procedures need to be updated for changes in design to make use of post-flight reconstruction data.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Perform Validation *Perform validation on the selected products.*		
	Very shallow in the recent past, models (e.g., loads) have been verified in the past by post flight analysis, but not kept up to date using new data (e.g., 15 yrs+) (A)	
	A new 3% wind tunnel model will be used to validate models for design changes (A)	
	Additional instrumentation on the next flight will allow for more accurate model updates and validation (A)	
	Validation was included as part of verification in the past (A)	
	Confusion about terms "verification" & "validation", attempting to clarify (A)	
SP2.1-1 Finding	**Validation occurs, but found no evidence of a documented process describing how it is to be consistently performed. Sometimes validation is included in verification.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Analyze Validation Results *Analyze the results of the validation activities and identify issues.*		
	3% data to be analyzed to update current models (A)	
	Addition of new instrumentation is critical to post-flight reconstruction, all tech panel plans to do post flight reconstruction in the future (A)	
	External SMEs have been hired to develop validation processes and perform independent analyses (A)	
SP2.2-1 Finding	**Although validation results are analyzed, no evidence of a process or documented guideline to ensure consistency in analyzing validation results and identifying issues was found.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**5**
NI	**0**
NA	**0**
Total Practices:	**5**

Findings Summary

Some general guidance exists in NSTS 07700 Vol IV, but could find no evidence of specific selection criteria for products or methods.

Flight instrumentation has not been maintained to enable post flight reconstruction and continual update of environment and performance models.

Could find no evidence that validation procedures are being maintained. Procedures need to be updated for changes in design to make use of post-flight reconstruction data.

Validation occurs, but found no evidence of a documented process describing how it is to be consistently performed. Sometimes validation is included in verification.

Although validation results are analyzed, no evidence of a process or documented guideline to ensure consistency in analyzing validation results and identifying issues was found.

Configuration Management

	Observations	Assessment
SP1.1-1 Identify Configuration Items ***Identify the configuration items, components, and related work products that will be placed under configuration management.***		
	Vol IV of NSTS 07700 establishes the CM system, and items to be reviewed, used to support the SEIO (A, DA)	
	SEIO aware of all iems that must be controlled (A)	
	There is no evidence of an independent SEIO CM for internal SEIO products (DA)	
SP1.1-1 Finding	**Items to be placed under configuration management are identified in accordance with NSTS 07700 Vol. IV. But found no CM system for internal SEIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.2-1 Establish a Configuration Management System ***Establish and maintain a configuration management and change management system for controlling work products.***		
	Vol IV of NSTS 07700 establishes the CM system used to support the SEIO (A, DA) (Potential Best Practice).	**B**
	System of CCBs and PRCB used to maintain system configuration (A, DA)	
	PRCB Directive used to implement and track changes (A, DA)	
	System accomodates joint STS and space station actions (A, DA)	
	Mandatory evaluators are isentified and tracked; anyone can provide evaluation input (A, DA)	
	All SEIO/USA personnel are aware of rhe CM system and participate in CM activities (A)	
	There is no evidence of an independent SEIO CM for internal SEIO products (DA)	
SP1.2-1 Finding	**A configuration/change management system is established and in operation. But found no CM system for internal SEIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Create or Release Baselines *Create or release baselines for internal use and for delivery to the customer.*		
	07700 Vol IV Table F.1 lists all documents forming the baseline (A, DA)	
	Because of many changes it is difficult to identify baseline (A)	
	NSTS 08102 provides a continually updated list of all documents referenced in the 07700 baseline (DA)	
	Drawings pkgs don't often clearly reflect the as-built configuration because changes aren't always oncorporated into drawings (A)	
SP1.3-1 Finding	**A baseline is electronically available and continually updated as each CR/directive is approved.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Track Change Requests *Track change requests for the configuration items.*		
	System of CCBs and PRCB used to maintain system configuration (A, DA)	
	PRCB Directive used to implement and track changes (A, DA)	
	Daily change control request group ensures ensure rapid correct distribution (A, DA)	
	CM support varies among boards (A)	
	A system for tracking change exists that include required reviewers (A, DA)	
SP2.1-1 Finding	**A change management system is established and in operation.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Control Configuration Items *Control changes to the configuration items.*		
	System of CCBs and the PRCB use CRs to maintain system configuration (A)	
	The CR identifies reviewers (A, DA)	
	PRCB Directive used to implement and track changes (A)	
	System accommodates joint STS and space station actions, 07700 Vol IV (A, DA)	
	The new SEIO organization provides the system integrator with new influential access to prevent waiver approval without detailed analysis (A)	
	There is no evidence of an independent SEIO CM for internal SEIO products (DA)	
SP2.2-1 Finding	**The CR process and resulting PRCB Directives provide positive change control of configuration items. But found no CM system for internal SEIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Establish Configuration Management Records *Establish and maintain records describing configuration items.*		
	CRs used to define changes an effectivity (A)	
	All board processed data (including backups) for approved or disapproved items are retained and available for review (A, DA)	B
	All information available on STS website for all users, includes backup papers (A, DA)	B
	Many documents accessible via Google (A)	
	CM maintains an SSP open action list to facilitate process execution (A, DA)	
	Records scanned if necessary to ensure all records available both in hard copy and electronically, allowing rapid access and email distribution (A, DA)	B
	A special expedite process used to maintain control when rapid action justified (A, DA	
	Data available from beginning of the program (A, DA)	
	All minutes and proceedings, inluding secretary notes and all associated material, is kept (A, DA)	B
SP3.1-1 Finding	**A CM records system is established and in operation.** ***(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**3**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

Items to be placed under configuration management are identified in accordance with NSTS 07700 Vol. IV. But found no CM system for internal SEIO products.

A configuration/change management system is established and in operation. But found no CM system for internal SEIO products.

A baseline is electronically available and continually updated as each CR/directive is approved.

A change management system is established and in operation.

The CR process and resulting PRCB Directives provide positive change control of configuration items. But found no CM system for internal SEIO products.

A CM records system is established and in operation. (Potential Best Practice)

Decision Analysis and Resolution

	Observations	Assessment
SP1.1-1 Establish Guidelines for Decision Analysis ***Establish and maintain guidelines to determine which issues are subject to a formal evaluation process.***		
	Decisions are ad hoc (A). Process is not structured - just a matter of getting a group of people together (A)	
	Vol IV (CM) of 07700 is used to guide decisions (A, DA)	
	Board & Panel process used for determining evaluations necessary, programmatic impact (element, cost, sched, perf, risk) is brought forward in panels, rely on Tech Panels & Kr expertise to determine issues (A)	
	No central database, no rules on preparing for making decisions, no knowledge capture system (A)	
	NSTS 07700 Vol 2 (bk2) Directive 128B defines process for risk decisions (DA)	
SP1.1-1 Finding	**Except for formal board actions, could find little evidence of any documented guidance for when to apply a formal evaluation process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.2-1 Establish Evaluation Criteria ***Establish and maintain the criteria for evaluating alternatives, and the relative ranking of these criteria.***		
	Evaluation criteria may be established for each individual case or project in Tech Panels (A)	
	Ad hoc criteria, but have for hazards (in 22254), class 1 changes, formal criteria in risk (safety area - 22206) (A, DA)	
	Standard criteria = cost, schedule, 07700 performance (A)	
	Engineering judgement used, dictated by skill of people involved, rely on experience (A)	
	Models & flight data used, databases describe design envelopes (A)	
	Criteria invented for each decision (A)	
SP1.2-1 Finding	**Some decision processes use established evaluation criteria, but other decision processes are ad hoc.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Identify Alternative Solutions *Identify alternative solutions to address issues.*		
	Decision process is ad hoc, process is not structured - just a matter of getting a group of people together (A)	
	Alternate solutions may be established for each individual case or project in Tech Panels (A)	
	Propulsion System Integration Group example of using altenative solutions, but doesn't think process is documented (A)	
	Use expert opinions & judgement calls, use Kr expertise & ask lots of questions, bunch of people getting together & discussing issues (A)	
SP1.3-1 Finding	**Alternatives are identified, usually ad hoc, but there was no evidence found for a documented process guiding identification of alternative solutions.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-1 Select Evaluation Methods *Select the evaluation methods.*		
	Evaluation process is ad hoc (A). Process is not structured - just a matter of getting a group of people together (A).	
	Evaluation criteria (testing methodology) is the responsibility of the Tech Panels per NSTS 07700, Vol 2, Book 2. (A, DA)	
	Use expert opinions & judgement calls, use Kr expertise & ask lots of questions, bunch of people getting together & discussing issues (A)	
	Alternate solutions may be established for each individual case or project in Tech Panels (A)	
SP1.4-1 Finding	**Little evidence was found that a documented process exists to select evaluation methods.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Evaluate Alternatives *Evaluate alternative solutions using the established criteria and methods.*		
	Decisions are ad hoc, process is not structured - just a matter of getting a group of people together (A).	
	Alternative solutions may be established for each individual case or project in Tech Panels, but there is no evidence (A)	
	Criteria used for some decisions (e.g., class 1/2/3 changes, safety & hazards) (A)	
	Use expert opinions & judgement calls, use Kr expertise & ask lots of questions, bunch of people getting together & discussing issues (A)	
SP1.5-1 Finding	**There was little evidence found for evaluating alternative solutions based on established criteria.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.6-1 Select Solutions *Select solutions from the alternatives based on the evaluation criteria.*		
	Decisions are ad hoc, process is not structured - just a matter of getting a group of people together (A)	
	Decisions can be appealed to PRCB (A)	
	Decisions documented in formal letters (A)	
	A poll taken at the end of each board presentation but no criteria exist, strive for consensus but only the chair's decision counts (A)	
	Engineering judgement, expert opinions & judgement (A)	
	NSTS 07700 prescribes decisions are to be made based on applied criteria (DA)	
SP1.6-1 Finding	**Decisions happen, but no evidence was found of a documented process that guides decision-making.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**6**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

Except for formal board actions, could find little evidence of any documented guidance for when to apply a formal evaluation process.

Some decision processes use established evaluation criteria, but other decision processes are ad hoc.

Alternatives are identified, usually ad hoc, but there was no evidence found for a documented process guiding identification of alternative solutions.

Little evidence was found that a documented process exists to select evaluation methods.

There was little evidence found for evaluating alternative solutions based on established criteria.

Decisions happen, but no evidence was found of a documented process that guides decision-making.

Causal Analysis and Resolution

	Observations	Assessment
	SP1.1-1 Select Defect Data for Analysis ***Select the defects and other problems for analysis.***	
	Done by the elements in the case of risk (A)	
	Pretty immature in this area, ad hoc; depends upon strength of individual's skills, no formal process ("enthusiastic amateurs"), process is invented every time (A)	
	Use Problem ID & Resolution process (A); NSTS 22206 FMEA CIL (DA)	
	Anomaly resolution "process" (A); NSTS 22206 FMEA CIL (DA)	
	PRACA (NSTS 08126) describes the problem cause process (DA)	
SP1.1-1 Finding	**Except for safety-related problems, the process for selecting defects and problems for analysis is ad hoc.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Analyze Causes ***Perform causal analysis of selected defects and other problems and propose actions to address them.***	
	These are USA processes - did a post-accident evaluation (A)	
	Debris transport analysis - had independent assessment team look at this, having Aerospace Corp do this (end of April 04) (A)	
	Training, experience, commitment, is frequently used to catch problems (A)	
	NSTS 22206 provides detailed instructions in preparing FMEAs (DA)	
	Risk process not written down, safety risks are currently being identified and focused on, using fault trees, but not identified in other areas (A)	
	Root cause analysis used; Kr does root cause (A)	
	Documented process - Integrated Hazard Review Process (S050425AF), 12/16/03 (DA)	
	Fault tree used (e.g., for integrated hazards) (A)	
	No formal process ("enthusiastic amateurs"), process is invented every time (A)	
	NSTS 22254, Appx A define fault tree analysis methodology (DA)	
	Problem Identification & Resolution Process is a documented process (PIRP) (A)	
SP1.2-1 Finding	**There are documented processes for causal analysis but they appear to be used infrequently and inconsistently.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Implement the Action Proposals *Implement the selected action proposals that were developed in causal analysis.*		
	No central place where the record of the causal analysis is kept (A)	
	NSTS 08126 Problem Reporting & Corrective Action (PRACA) defines process for problem resolution (A, DR)	
	SIPs define mgmt roles, tech activities, products, verification reqts, schedule commitments between interfacing elements (A); NSTS 60515, ET Bi-pod Fitting Redesign, 2/10/04 (DA)	
SP2.1-1 Finding	**Although there is ongoing causal analysis implementation, could find no evidence of a documented, consistent process guiding this activity.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Evaluate the Effect of Changes *Evaluate the effect of changes on performance.*		
	Assessment of implementation effectiveness is ad hoc (A)	
	NSTS 07700 Vol IV (bk1) change request process prescribes evaluation of change for impact, including the predicted impact (DA)	
	Could find no evidence of any evaluation or metrics for change impact (DA)	
	RTF Instrumentation brief to PRCB (Mar 04) addresses impacts (DA)	
SP2.2-1 Finding	**There is a documented process for evaluating change impact and evidence that it is done. But could find no guidance for metrics or measures for performance impacts.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.3-1 Record Data *Record causal analysis and resolution data for use across the project and organization.*		
	Recorded at tech panel, tech panels are keepers of data books, Kr's keep data pkgs on-line but easier to call the right engineer to get data quickly (A)	
	No one place where they're kept (A)	
	Hazard reports document analysis and recommendations for hazard control (DA)	
	Control Boards and Panels (PRCB, ICB, Tech Panels, SSEIG) used to record results (DA)	
SP2.3-1 Finding	**There is no evidence that the causal analysis data is recorded in a readily available and easily usable manner.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
	Have had a root cause training course. Also fault tree (fishbone, etc) training	
	Mission Management Team plan being rewritten	
	Expecting to get some fault tree training	
Generic Finding		

	Final
FI	**0**
PI	**5**
NI	**0**
NA	**0**
Total Practices:	**5**

Findings Summary

Except for safety-related problems, the process for selecting defects and problems for analysis is ad hoc.

There are documented processes for causal analysis but they appear to be used infrequently and inconsistently.

Although there is ongoing causal analysis implementation, could find no evidence of a documented, consistent process guiding this activity.

There is a documented process for evaluating change impact and evidence that it is done. But could find no guidance for metrics or measures for performance impacts.

There is no evidence that the causal analysis data is recorded in a readily available and easily usable manner.

Organizational Training

	Observations	Assessment
SP1.1-1 Establish the Strategic Training Needs ***Establish and maintain the strategic training needs of the organization.***		
	There are no strategic training goals or plan (A)	
	07700 addresses training needs of only operations personnel (A)	
	NASA requires 80 hrs of training for new supervisors (A)	
	There is mandatory security and ground safety training of all personnel (A)	
SP1.1-1 Finding	**There is no NSTS 07700 requirement nor planning for training of non-operations personnel. An SEIO position based skill/training needs assessment should be performed.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP1.2-1 Determine Which Training Needs Are the Responsibility of the Organization ***Determine which training needs are the responsibility of the organization and which will be left to the individual project or support group.***		
	Establishing training needs are responsibility of each employee's supervisor (A)	
	Supervisors maintain individual training plans for each employee and discuss/amend it during the annual review (A)	
	Found no evidence of any orgn'l needs analysis to determine what training would be provided by SEIO (DA)	
SP1.2-1 Finding	**Could find no evidence of an organizational training needs analysis that justifies relegating training to the individual's supervisor level.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP1.3-1 Establish an Organizational Training Tactical Plan ***Establish and maintain an organizational tactical training plan.***		
	There are no organizational tactical training goals or plan (A)	
	07700 addresses training needs of only operations personnel (A)	
	NASA requires 80 hrs of training for new supervisors (A)	
	There is mandatory security and ground safety training of all personnel (A)	
SP1.3-1 Finding	**The only organizational planning is the requirement for supervisors to review each individuals traning plan on an annual basis. No organizational tactical training plan exists.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP1.4-1 Establish Training Capability *Establish and maintain training capability to address organizational training needs.*		
	Low priority, "Not even on the radar screen" (A)	
	Courses are made available for selected topics (e.g., fault tree, 07700) (A)	
	Rely heavily on OJT (A)	
	Generic, voluntary mentoring system at JSC (A)	
	Mentors assigned informally (A)	
SP1.4-1 Finding	**Although some courses are offered on an ad hoc basis, could find no evidence of specific training needs against which capabilities are established.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Deliver Training *Deliver the training following the organizational training tactical plan.*		
	No organized training provided for new SEIO personnel (A)	
	HR not significantly involved to ensure adequately trained personnel (A)	
	Hiring experience used to provide capability in lieu of organized training (A)	
	Rely heavily on OJT (A)	
	HR delivers training (A)	
SP2.1-1 Finding	**Because there is no organizational tactical training plan the selection, scheduling, delivery, and tracking of training is not performed.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP2.2-1 Establish Training Records *Establish and maintain records of the organizational training.*		
	HR maintains a record of all required and HR sponsored training (A)	
	Individual training plans and annual reviews track training received (A)	
	No individual training plans (A)	
SP2.2-1 Finding	**The SEIO HR monitor maintains records of HR-funded courses, but no evidence was found of training records at the organizational level.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.3-1 Assess Training Effectiveness *Assess the effectiveness of the organization's training program.*		
	All HR sponsored training uses course assessment forms (A)	
SP2.3-1 Finding	**Could find no evidence of any means to feed back or assess the effectiveness of supervisor monitored training.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**2**
NI	**5**
NA	**0**
Total Practices:	**7**

Findings Summary

There is no NSTS 07700 requirement nor planning for training of non-operations personnel. An SEIO position based skill/training needs assessment should be performed.

Could find no evidence of an organizational training needs analysis that justifies relegating training to the individual's supervisor level.

The only organizational planning is the requirement for supervisors to review each individuals traning plan on an annual basis. No organizational tactical training plan exists.

Although some courses are offered on an ad hoc basis, could find no evidence of specific training needs against which capabilities are established.

Because there is no organizational tactical training plan the selection, scheduling, delivery, and tracking of training is not performed.

The SEIO HR monitor maintains records of HR-funded courses, but no evidence was found of training records at the organizational level.

Could find no evidence of any means to feed back or assess the effectiveness of supervisor monitored training.

Organizational Process Definition

	Observations	Assessment
	SP1.1-1 Establish Standard Processes ***Establish and maintain the organization's set of standard processes.***	
	NSTS 07700 lays out responsibilities & charters of all the various aspects of the program; maintained by CM office (A, DA)	B
	NASA Procedures & Guidelines (NPG) 7120.5B establishes program mgmt processes & reqts for all NASA centers (DA)	
	NSTS 37358 Process Control & Mgmt Plan (Dec '00) defines methods for implementing process control reqts & best practices (DA)	
SP1.1-1 Finding	**There is a well-documented set of organizational standard processes for all NASA centers.** ***Potential Best Practice***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.5-1 Establish the Organization's Process Asset Library ***Establish and maintain the organization's process asset library.***	
	Library of documented processes maintained on SSPWeb (A, DA)	
	Config Mgmt Office monitors & controls program CM items, documented in NSTS 07700 Vol. IV (A, DA)	
	No major database that everyone ties into, "this perhaps a major breakdown", no central data repository, all spread around on individual's computers (A)	
	On-line Program Documentation Center (PDC) (A, DA)	
	Data filed on SSPWeb (not effective), shared drive ineffective, unaware of any data file plan (A)	
	Some tech data (data pkgs) kept by individuals, some posted on web pages, tech panels are keepers of data books, Kr keep data pkgs on-line, but easier to call the right engineer (A)	
SP1.5-1 Finding	**There are several libraries and databases for technical, programmatic, and process data. But found no "process asset library" that was accessible to all in SEIO.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

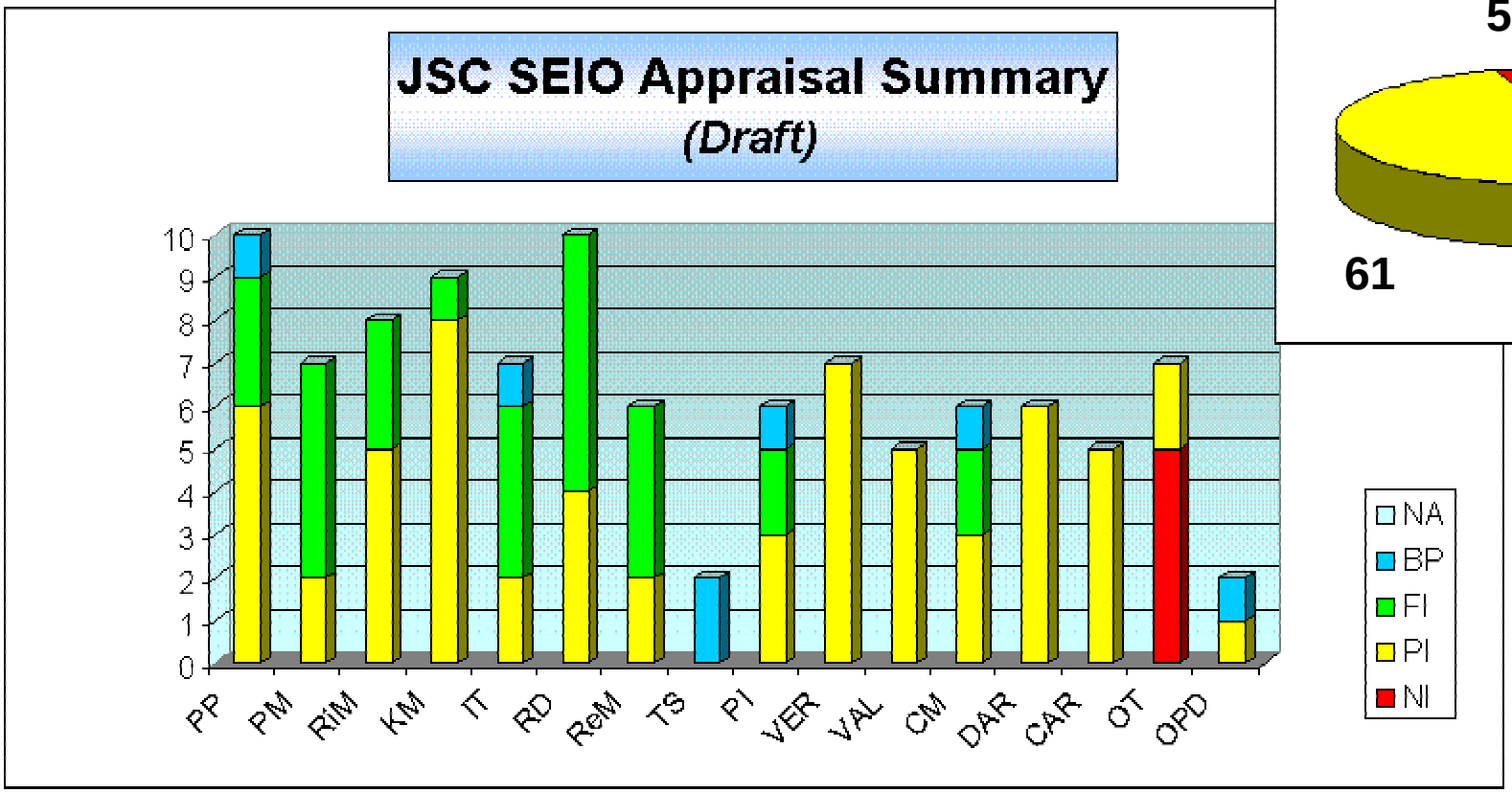
	Final
FI	**1**
PI	**1**
NI	**0**
NA	**0**
Total Practices:	**2**

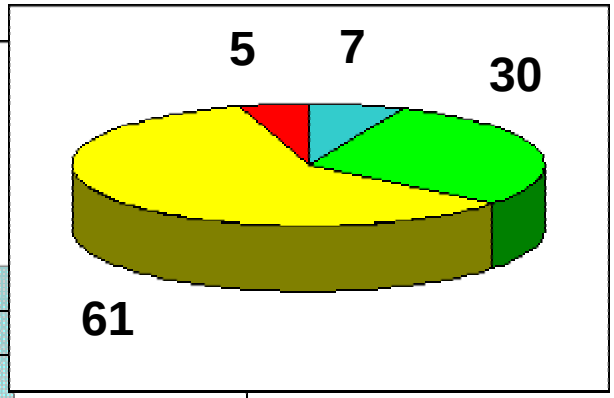
Findings Summary

There is a well-documented set of organizational standard processes for all NASA centers.
Potential Best Practice

There are several libraries and databases for technical, programmatic, and process data.
But found no "process asset library" that was accessible to all in SEIO.

	PP	PM	RiM	KM	IT	RD	ReM	TS	PI	VER	VAL	CM	DAR	CAR	OT	OPD	
BP	1				1			2	1			1				1	7
FI	3	5	3	1	4	6	4	0	2	0	0	2	0	0	0	0	30
PI	6	2	5	8	2	4	2	0	3	7	5	3	6	5	2	1	61
NI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5
NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
																	103





Appendix C2 - Completed KSC Appraisal Worksheets

CMMI Process Area	What the Appraisal Found	Process Exists?	Is It Used?	Documented?	Others Know & Use?	Mgmt Aware & Review?	Resources?	Training?
Project Planning								
Project Management								
Risk Management								
Contractor Management								
Integrated Teaming								
Requirements Development								
Requirements Management								
Technical Solution								
Product Integration								
Verification								
Validation								
Configuration Management								
Decision Analysis & Resolution								
Causal Analysis & Resolution								
Organizational Training								
Organizational Process Definition								

- Yes, Potential Model
- Yes or Performed
- Partially Performed
- No or Not Performed
- Not Applicable or Not Appraised

Project Planning

	Observations	Assessment
	SP1.1-1 Estimate the Scope of the Project ***Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.***	
	No gov't WBS (A); have functions defined & assigned (inbrief), organizational structure defines tasks (DA)	
	RTF resulted in request for add'l resources, revitalizing old responsibilities (e.g., T&E, support to WGs & tech panels) & adding new ones (integrated hazards, element integration, writing SIPs) (A); 9/20/03 Kr proposal (DA)	
	Could find no gov't WBS or equivalent (DA)	
	Note: NSTS 07700 Vol. I para.4.1 references retirement of Program WBS (DA)	
SP1.1-1 Finding	**The organizational structure provides a basis to estimate the scope of effort. But no evidence was found of a documented process guiding this.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.4-1 Determine Estimates of Effort and Cost ***Estimate the project effort and cost for the work products and tasks based on estimation rationale.***	
	RTF resulted in request for add'l resources - rationale based on revitalization of responsibilities (e.g., integrated hazards, element integration, T&E, writing SIPs, support to WGs & tech panels) (A); 9/20/03 Kr proposal (DA)	
	POP review underway, with Kr participation, looking at long-range planning (A); "POP04 Guidelines", 2/26/04 (DA)	
	Using Launch & Landing PRD as basis for add'l tasks & ROM cost, used 14 quality stds as reqts source, pulled in project mgrs w/ WBS experience & facility people to help price (A)	
	Add'l resources needed to accomplish new Intercenter Photo WG tasks (A); cost identified in "RTF Ground Camera Imagery Plan" presentation to PRCB (DA)	
SP1.4-1 Finding	**The project updates resource and funding requirements annually, including rationale, following the documented POP process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Establish the Budget and Schedule *Establish and maintain the project's budget and schedule.*		
	POP build & review w/ Kr help, long-range budget & resource plan (A); "POP04 Guidelines", 2/26/04 (DA)	
	Now following RTF schedule (A, DA)	
	MK-SIO work driven by KSC Integrated Control Schedule (KICS) which details workflow & milestones for each mission (A, DA)	
SP2.1-1 Finding	**Project budget and schedule are established and maintained according to a documented process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Plan for Data Management *Plan for the management of project data.*		
	USA LCC Management System (LMS) via SSPWeb online access of LCC WG products; OMRS Change Processing (OMRSCP) Database Mgmt System (DA)	
	On-line Program Documentation Center (PDC) (A, DA)	
	3 labs (JSC, KSC, MSFC) have separate photo databases, internal Boeing managed database for integrated reports but very limited access, important data not on web, controlled by USA (A)	
	Could find no evidence of a plan for MK-SIO data management (DA)	
	Config mgmt done by JSC, documented by NSTS 07700 Vol. IV (A, DA)	
SP2.3-1 Finding	**There is a defined structure for formal documentation, but could find no evidence of a comprehensive data management structure for MK-SIO work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.4a-1 Plan for Project Resources and Needed Knowledge and Skills *Plan for the necessary resources and needed knowledge and skills needed to perform the project.*		
	RTF effort resulted in request for add'l resources, based on revitalization of old responsibilities (e.g., integrated hazards, element integration, T&E, Gnd Systems Ops Panel, need for a deputy) (A); 9/20/03 Kr proposal (DA)	
	Need more gov't manpower to handle the increased workload (A)	
	Add'l resources needed to accomplish new Intercenter Photo WG tasks (A); "RTF Ground Camera Imagery Plan" presentation to PRCB (DA)	
	No MK-SIO needs analysis, hiring or strategic training plan found (DA)	
	Now have to go through KSC system to get add'l resources (A)	
SP2.4a-1 Finding	**Post-accident resource planning appears reactive with available staff assigned to emerging tasks. Found no evidence of a documented, repeatable process for MK-SIO.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.6-1 Plan Stakeholder Involvement *Plan the involvement of identified stakeholders.*		
	MOA with USAF 45th Space Wing for photo documentation support, but haven't seen; MOA between AF & NASA established in 1958 (A)	
	Working groups chartered by NSTS 07700 Vol. II (bk2) directives; membership includes participating organizations (A); OMRS Directive 52K (DA)	
	SIP written for each task; defines reqts, schedule, membership (A)	
	"RTF Ground Camera Imagery Plan" identifies required stakeholders (DA)	
SP2.6-1 Finding	**Chartered working groups and formal integration plans ensure continual stakeholder involvement.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.7-1 Establish the Project Plan *Establish and maintain the overall project plan content.*		
	Plans exist for specific tasks - NSTS 08117 Appx M "SSSIO Flight Preparation Process Plan"; NSTS 08218 "Intercenter Photo & TV Analysis Contingency Action Plan"; NSTS 08240 "TV Plan"; NSTS 08110 "GSE Integration Plan" (DA)	
	SIP written for each task; defines reqts, schedule, membership (A)	
	PRCB approves new reqts/changes (A); "RTF Ground Camera Imagery Plan" presentation to PRCB (DA)	B
	Could find no overall MK-SIO plan (A)	
SP2.7-1 Finding	**There are a number of plans for specific tasks, but could find no overall plan that details the work activities and products of the integrated MK-SIO technical effort.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Review Plans that Affect the Project *Review all plans that affect the project to understand program commitments.*		
	SIPs required to be reviewed as required but schedule often not updated (A)	
	POP reviewed, revised annually (A); "POP04 Guidelines", 2/26/04 (DA)	
	Plans exist for specific tasks - NSTS 08117 Appx M "SSSIO Flight Preparation Process Plan"; NSTS 08218 "Intercenter Photo & TV Analysis Contingency Action Plan"; NSTS 08240 "TV Plan"; NSTS 08110 "GSE Integration Plan" (DA)	
	Annual audits against PDPs, used to do tech reviews quarterly (A)	
	Could find no overall MK-SIO plan (A)	
SP3.1-1 Finding	**MK-SIO is executing to several task plans. However, there is no overall MK-SIO plan on which to review and compare task plans for compatibility and no record of plan review.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Reconcile Work and Resource Levels *Reconcile the project plan to reflect available and estimated resources.*		
	Downsized SE&I in past 10 yrs from 850 -> 150, lost experience & skills (A)	
	Add'l resources needed to accomplish new Intercenter Photo WG tasks (A); "RTF Ground Camera Imagery Plan" presentation to PRCB (DA)	B
	RTF effort resulted in request for add'l resources, based on revitalization of old responsibilities (e.g., integrated hazards, element integration, T&E, Gnd Systems Ops Panel, need for a deputy) (A); 9/20/03 Kr proposal (DA)	
	Found no basis of estimate for resources on which to make adjustments (DA)	
SP3.2-1 Finding	**Work priorities are established and resource adjustments are made ad hoc, but could find no evidence of a documented process guiding reconciliation of resources.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Obtain Plan Commitment *Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.*		
	Signed PDPs (e.g., MS8-001) commit NASA centers, contractor (A, DA)	
	PRCB approval/directive commits responsible parties (A)	
	Tech panels chartered by NSTS 07700 Vol. II (bk2) directives; membership of participating organizations + roles & responsibilities defined (DA)	
	SIP written for each task; defines reqts, schedule, membership (A)	
	Working groups chartered by NSTS 07700 Vol. II (bk2) directives; membership includes participating organizations (A); OMRS Directive 52K (DA)	
SP3.3-1 Finding	**Chartered working groups, formal integration plans, and signed Project Development Plans formally commit stakeholders.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**6**
NI	**0**
NA	**0**
Total Practices:	**10**

Findings Summary

The organizational structure provides a basis to estimate the scope of effort. But no evidence was found of a documented process guiding this.

The project updates resource and funding requirements annually, including rationale, following the documented POP process.

Project budget and schedule are established and maintained according to a documented process.

There is a defined structure for formal documentation, but could find no evidence of a comprehensive data management structure for MK-SIO work products.

Post-accident resource planning appears reactive with available staff assigned to emerging tasks. Found no evidence of a documented, repeatable process for MK-SIO.

Chartered working groups and formal integration plans ensure continual stakeholder involvement.

There are a number of plans for specific tasks, but could find no overall plan that details the work activities and products of the integrated MK-SIO technical effort.

MK-SIO is executing to several task plans. However, there is no overall MK-SIO plan on which to review and compare task plans for compatibility and no record of plan review.

Work priorities are established and resource adjustments are made ad hoc, but could find no evidence of a documented process guiding reconciliation of resources.

Chartered working groups, formal integration plans, and signed Project Development Plans formally commit stakeholders.

Project Management

	Observations	Assessment
	SP1.1-1 Monitor Project Status ***Monitor project issues, risks, status, execution, funding, and expenditures against project plans.***	
	LCC & OMRS WGs review technical progress (A); LCC WG Minutes review of LCC Change Notices (3/3/04) (IA); OMRS & LCC WG presentations (DA)	
	"Top X" telecon with MS (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	Working groups (e.g., LCC, OMRS) review technical status regularly (A, DA)	
	Could find no evidence of funds expenditures tracking (DA)	
SP1.1-1 Finding	**Although technical status is monitored in working groups, could find no evidence that there is an integrated project perspective that is monitored, including expenditures.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Monitor Commitments ***Monitor commitments against those identified in the project plan.***	
	SIP written for each task; defines reqts, schedule, membership (A)	
	LCC & OMRS WGs review technical progress (A); LCC WG Minutes review of LCC Change Notices (3/3/04) (IA); OMRS & LCC WG presentations show stakeholder participation (DA)	
	Specific tasks plans identify participants - NSTS 08117 Appx M "SSSIO Flight Preparation Process Plan"; NSTS 08218 "Intercenter Photo & TV Analysis Contingency Action Plan"; NSTS 08240 "TV Plan"; NSTS 08110 "GSE Integration Plan" (DA)	
	Wkly MK-SIO staff meetings monitor status/progress (A)	
SP1.2-1 Finding	**Regular meetings of chartered working groups enable commitments to be monitored.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.4-1 Monitor Data Management *Monitor the management of project data against the project plan.*		
	USA LMS via SSPWeb maintained for LCC WG; OMRSCP Database Mgmt System for NSTS 08171 documentation (RCNs, waivers, reports, etc.) (DA)	
	SSPWeb repository for data (use by trial & error), important data not on the web, controlled by Kr - limited gov't access, password changes monthly & difficult for gov't to access (A)	
	MK-SIO products (e.g., briefings, working mat'ls) kept on individual computers, not openly distributed or posted on any shared drive (A)	
	While MK-SIO working materials (e.g., draft reports, presentations) are on a common drive there is no shared access (DA)	
	Found no data mgmt plan (DA)	
SP1.4-1 Finding	**Formal program documentation is closely monitored, but could find no evidence of comprehensive process to establish or monitor MK-SIO data or work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Monitor Stakeholder Involvement *Monitor stakeholder involvement against the project plan.*		
	Key orbiter rep to Intercenter Photo WG not an active member, "walked out" (A)	
	Meeting notifications, agendas posted on SSPWeb (DA)	
	Get/give video/imagery quality/performance feedback, critiques provided to image providers, goes into databases (A)	
	LCC & OMRS WGs review technical progress (A); LCC WG Minutes review of LCC Change Notices (3/3/04) (IA); OMRS & LCC WG presentations (DA)	
	Stakeholders coordinate on issues/changes at PRCB (A); SSP Form 4041 completed/signed + closed CR list, PRCB actions presentations (DA)	
SP1.5-1 Finding	**MK-SIO has both formal and informal interactions with stakeholders, following documented processes, that ensures continual involvement.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.6a-1 Conduct Periodic and Milestone Reviews *Periodically review the project's progress, performance, and issues and review the accomplishments and results of the project at selected project milestones.*		
	Milestones & organizational responsibilities for reviews defined in NSTS 08117, Appendix A "Orbiter Flight Preparation Process Plan" + other appendices (DA)	
	Support Design Certification Review, Top X meeting, Summit Review (A, DA)	
	We follow major reviews (e.g., LSRR, LSFR, FRR), follow SIP milestones (e.g., PDR, CDR, tests) (A); NSTS 07700 Vol IV (bk1) defines reviews (DA)	
	Found no evidence of an MK-SIO integrated system-level progress review (e.g., Project Mgmt Review) (DA)	
SP1.6a-1 Finding	**MK-SIO participates in projects and tasks formal reviews, but found no evidence of a documented process defining a coherent system-level review of MK-SIO activities.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Analyze Issues *Collect and analyze the issues and determine the corrective actions necessary to address the issues.*		
	LCC WG addresses & resolves changes (LCNs) & issues (A); LCC WG minutes (IA)	
	ICB, noon PRCB, PRCB resolves changes & issues (A); PRCB action item presentations (DA)	
	PRACA process used, NSTS 08216, MR form used for problem reporting (PMRB actions) (A, DA)	
	In-flight anomalies (IFA) are reported per documented criteria, require corrective action (A); STS-112 Consolidated Film/Video Report identifies IFA for PRACA followup (DA)	
	Unexplained anomalies require very detailed analysis (process defined in Kr SPIs), documented & presented to Unexplained Anomaly Board (UAB) (A)	
SP2.1-1 Finding	**Issues (e.g., RCNs, LCNs, IFAs) are identified, analyzed, reported, and recommendations are presented to review boards following strict, documented processes.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Manage Corrective Action *Take corrective action on identified issues and manage to closure.*		
	Formal actions/minutes from Summit Review documented (A, DA)	
	Action items formally documented from control Boards (ICB, PRCB, noon board); informal actions from Top X reviewed, documented on spreadsheets (A); action item presentations (DA)	
	Change requests analyzed, staffed, coordinated, closed at ICB, PRCB (A); SSP Form 4041 completed/signed + closed CR list, PRCB actions presentations (DA)	
	WG actions are informal, generally verbal (A)	
	Unexplained anomalies require very detailed analysis, documented, dispositioned by UAB (A)	
SP2.2-1 Finding	**Formal changes and corrective actions follow a documented set of processes. There is a concern that lower level action items may not surface or be tracked to completion.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	4
PI	3
NI	0
NA	0
Total Practices:	7

Findings Summary

Although technical status is monitored in working groups, could find no evidence that there is an integrated project perspective that is monitored, including expenditures.

Regular meetings of chartered working groups enable commitments to be monitored.

Formal program documentation is closely monitored, but could find no evidence of comprehensive process to establish or monitor MK-SIO data or work products.

MK-SIO has both formal and informal interactions with stakeholders, following documented processes, that ensures continual involvement.

MK-SIO participates in projects and tasks formal reviews, but found no evidence of a documented process defining a coherent system-level review of MK-SIO activities.

Issues (e.g., RCNs, LCNs, IFAs) are identified, analyzed, reported, and recommendations are presented to review boards following strict, documented processes.

Formal changes and corrective actions follow a documented set of processes. There is a concern that lower level action items may not surface or be tracked to completion.

Risk Management

	Observations	Assessment
	SP1.1-1 Determine Risk Sources and Categories ***Determine risk sources and categories.***	
	Not done "up front" - limited to assessing what's on paper at PMRB on risk. Agrees or disagrees (A)	
	Determination of board can be appealed to the next higher level (A)	
	Hardware criticality defined in QA database (Crit 1/2/3) (A); NSTS 08117 defines criticality (DA)	
	Risk Mgmt process defined in NPG 7120.5B, NSTS 37400 Vol 1 contains Risk Mgmt process flow (DA)	
	Found no evidence that programmatic & integration risks are being addressed (DA)	
	NSTS 07700 Vol. 1 (paras. 5.4.2, 5.4.3, 5.4.4) defines technical/safety, cost, schedule risk categories (DA)	
SP1.1-1 Finding	**MK-SIO supports, but does not appear to be proactively involved in, determination of risk sources and categories.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Define Risk Parameters ***Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.***	
	Probablistic risk assessment (PRA) used on upgrade programs, Langley independent assessment documented,1 in 500,000 type stuff, PRA not implemented yet (A)	
	CRIT levels defined in 07700 (A); NSTS 08117 defines "criticality" (DA)	
	SR2148 "Orbiter Debris Certification Risk Analysis Process" defines PRA (DA)	
	NSTS 7700 Vol XI System Integration & Assurance Plan; 5300.4 categorizes risk (DA)	
	NPR 8000.4 Risk Mgmt Procedures & Guidelines specifies parameters (DA)	
	07700 Vol II (bk2) defines threshholds (DA)	
SP1.2-1 Finding	**There is guidance for risk parameter determination but found no evidence that it is being used.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Establish a Risk Management Strategy *Establish and maintain the strategy to be used for risk management.*		
	Looks at trends (data mining), NESC doing (at Langley), NASA Eng & Safety Council (used to be done by Chief Engineer) (A)	
	Risk matrix used - USA fills out matrix for every item (A); Risk Posture Sheet (DA)	
	A top-level risk management guidance is defined and maintained in NSTS 07700 (Vol 1, sec 5) & 5300.4; NPR 8000.4 Risk Mgmt Procedures & Guidelines (DA)	
	Probablistic risk assessment (PRA) used on upgrade programs, PRA not implemented yet (A); SR2148 "Orbiter Debris Certification Risk Analysis Process" defines PRA (DA)	
	Two ways to deal with risk mgmt: (1) risk of hardware not operating (covered via "redundancy") & (2) do analysis & provide data (A)	
	SFOC PG9604 Risk Mgmt Plan (DA)	
SP1.3-1 Finding	**Although top-level risk management guidance exists, found no evidence of a MK-SIO risk management strategy.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Identify Risks *Identify and document the risks.*		
	Hazard Reports - lists controls like ORMS, LCC, practices, CILs, waivers (A); NSTS 22206 FMEA CIL (DA)	
	In NSTS 07700, uses G-Y-R ("avoids" R) (A); NSTS 07700 Vol I (DA)	
	RTF Ground Camera Imagery Plan presentation to PRCB identifies alternatives & assesses risk, using quality stds (A, DA)	
	Found no evidence that programmatic & integration risks are identified (DA)	
	SFOC Risk Assessment Form (S164046A) (DA)	
	Integration risks not being identified (A)	
SP2.1-1 Finding	**Technical risks are identified. However, could find no evidence that programmatic risks (e.g., budget, schedule, resources) are being identified and documented.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Evaluate, Categorize, and Prioritize Risks *Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.*		
	USA writes risk assessment for RCNs (Risk Scorecard) 5x5 matrix (A, DA)	
	Uses best engineering judgement & past history (A)	
	Kind of subjective - but documented in NSTS 07700 (A, DA)	
	Each piece of hardware has hardware & functional criticality (1/2/3) assigned (A)	
	Found no evidence that programmatic & integration risks are identified, found no priority listing of risks (DA)	
SP2.2-1 Finding	**Could find no evidence that risks are comprehensively (technical, cost, schedule, resources) evaluated, categorized, and prioitized.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Develop Risk Mitigation Plans *Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy.*		
	Risk of hardware not operating - has redundancy (A)	
	Board process is the "Risk Mitigation Plan", refer to Board meeting minutes on SSPWeb under "Meetings & Minutes", meetings are also recorded (A)	
	SFOC Risk Assessment Form (S164046A) with format for "risk handling" (DA)	
	Found no evidence that programmatic & integration risks are identified, found no priority listing of risks, found no mitigation plans (DA)	
	"Top X" addresses RTF priorities (A); meeting schedule (IA); priority list of RTF issues w/ POC & status (DA)	
	"RTF Ground Camera Imagery Plan" identifies risks & workarounds (DA)	
SP3.1-1 Finding	**"Top X" RTF issues are being addressed, but could find no evidence that MK-SIO is doing any independent, integrated risk identification, assessment, or mitigation.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Implement Risk Mitigation Plans *Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate, until closed.*		
	Only focal point is Space Shuttle Safety Review Panel (Tech Panel), change in Criticality, CIL, FEMA, etc. Chaired at JSC, doesn't know if MK-SIO regularly participates - may only when they have an item of interest (A)	
	"Top X" addresses RTF priorities (A); meeting schedule (IA); priority list of RTF issues w/ POC & status (DA)	
	"RTF Ground Camera Imagery Plan" submitted to PRCB, approved (DA)	
SP3.2-1 Finding	**Could find no evidence that MK-SIO is monitoring and implementing integrated risk mitigation activities, including programmatic risks (cost, schedule, resources).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Report Risk Status *Report the status of identified risks at project reviews.*		
	Reporting not done, may occasionally get "gee whiz" stuff, but not statused routinely (A)	
	"Top X" addresses RTF priorities (A); meeting schedule (IA); priority list of RTF issues w/ POC & status (DA)	
SP3.3-1 Finding	**Found no evidence of a consolidated or comprehensive risk reporting process that includes all identified risks.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**8**
NI	**0**
NA	**0**
Total Practices:	**8**

Findings Summary

MK-SIO supports, but does not appear to be proactively involved in, determination of risk sources and categories.

There is guidance for risk parameter determination but found no evidence that it is being used.

Although top-level risk management guidance exists, found no evidence of a MK-SIO risk management strategy.

Technical risks are identified. However, could find no evidence that programmatic risks (e.g., budget, schedule, resources) are being identified and documented.

Could find no evidence that risks are comprehensively (technical, cost, schedule, resources) evaluated, categorized, and prioitized.

"Top X" RTF issues are being addressed, but could find no evidence that MK-SIO is doing any independent, integrated risk identification, assessment, or mitigation.

Could find no evidence that MK-SIO is monitoring and implementing integrated risk mitigation activities, including programmatic risks (cost, schedule, resources).

Found no evidence of a consolidated or comprehensive risk reporting process that includes all identified risks.

Contractor Management

	Observations	Assessment
	SP2.1-1 Monitor Selected Processes ***Monitor and analyze selected processes used by the Contractor for effectiveness and compliance with agreements.***	
	NSTS 08117 Appx H (Shuttle Processing Flight Preparation Process Plan) scopes NASA managed activities & oversight of SFOC ground operations processes (DA)	
	Kr written (gov't approved) Project Development Plans (PDPs) prescribe processes to be monitored, ISO-9000 process guidance (A); various PDPs (DA)	
	Used to do annual audits against PDPs (A)	
	Semi-annual COTR feedback, annual audits against PDPs, used to do quarterly technical reviews, periodic call for award fee inputs, haven't done an audit since the accident (A)	
SP2.1-1 Finding	**There are contractor-developed, government approved plans for monitoring contractor processes, but it does not appear that they are presently in use.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP2.2-1 Evaluate Selected Work Products ***Evaluate selected work products to detect issues as early as possible.***	
	Performance based contract, Data Reqts Deliverable (DRD) defines what will be delivered (A)	
	Used to do annual audits against PDPs, gov't sometimes asks Kr to help with audits ("self audit"), used to do "done good/do better" letters to Kr (A)	
	Semi-annual COTR feedback, annual audits against PDPs, used to do quarterly technical reviews, periodic call for award fee inputs (A)	
	Wkly Kr internal review of products, independent greybeard reviews (A)	
SP2.2-1 Finding	**PDPs define a process to evaluate contractor work products. However, could not find evidence that work products are being regularly reviewed to detect issues early.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.3-1 Review Non-Developmental Items *Review candidate non-developmental items to ensure that they satisfy specified requirements.*		
	Gov't levies reqts, Kr searches for off-the-shelf equipment (e.g., GSE) before proposing development items, STE/tooling/shop aids can be COTS, SE&I role is to ask the hard questions on COTS use (A)	
	COTS/NDI usage (e.g., lease of heavy equipment) applies documented safety factors, reviewed in safety review process, ultimately a PRCB review (A)	
	MS just drafted COTS reqts change to NSTS 07700, driven by SRB camera problem (A)	
SP2.3-1 Finding	**Could find no evidence of a documented process for MK-SIO review of non-developmental items.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.4-1 Conduct Reviews and Interchanges *Conduct periodic and event-driven reviews and interchanges with the Contractor.*		
	Semi-annual COTR feedback, annual audits against PDPs, used to do quarterly technical reviews, periodic call for award fee inputs (A)	
	Wkly mgmt meeting with tech leads, minutes kept on Boeing database (A)	
	Used to do tech reviews qrtly (Integration Mgmt Review), now have Summit Reviews (A, DA)	
	Wkly mgmt meetings with tech leads, wkly Kennedy Integration Meeting w/ contractors (A)	
SP2.4-1 Finding	**Although reviews occur sporadically, found no evidence of a documented or consistent process guiding reviews and interchanges with the contractors.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.5-1 Compare Actual Technical Activities, Costs, and Schedule to Plans *Compare the actual technical activities, cost and schedule of the contractor's effort to planned schedules and budgets and identify issues and risks.*		
	Semi-annual COTR feedback, annual audits against PDPs, used to do quarterly technical reviews (Integration Mgmt Review), periodic call for award fee inputs (A)	
	Wkly mgmt meetings with tech leads, wkly Kennedy Integration Meeting w/ contractors (A)	
	USA has reported earned value in past when problems w/ schedules/$$, but not done routinely, gov't buys "talent"/LOE work, performance based contract (A)	
SP2.5-1 Finding	**Could find no evidence that the government is consistently comparing contractor technical activities, cost, and schedule to plans and identifying issues and risks.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.6-1 Track Sustainment Products *Review and track hardware and software products (e.g., tools, test sets, simulators, spares) required for life cycle sustainment of the acquired system or products and identify issues.*		
	MK-SIO supports KSC PM, Shuttle Processing Directorate responsible for integration and T&E, MK-SIO has no hardware or STE (A)	
	Imaging assets owned by other organizations, not controlled by MK-SIO (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	MK-SIO maintains databases for LCC & reqts (A)	
	MK-SIO (USA) used to track database for GSE (GSE Utilization List (GUL) but no longer maintained (A)	
SP2.6-1 Finding	**Could find no evidence that MK-SIO tracks sustainment products or identifies issues in accordance with a documented process.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP2.7-1 Ensure User Evaluation of System Performance *Ensure the user participates in the evaluation of system performance to determine the satisfaction of operational requirements.*		
	"Top X" telecon with MS, users participate (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	Change process described in NSTS 07700 Vol. IV, SICB & PRCB approvals required; stakeholders are board members (DA)	
	LCC & OMRS WGs review technical progress (A); LCC WG Minutes review of LCC Change Notices (3/3/04) (IA); OMRS & LCC WG presentations show stakeholder participation (DA)	
SP2.7-1 Finding	**Users are involved in review of technical progress. There is a concern that system performance evaluation is done by other organizations and may inhibit user evaluation.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.8-1 Take Appropriate Action *Track issues, risks and Contractor performance and take action as appropriate.*		
	Used to do "done good, do better letters" monthly (advisory letters) (A)	
	"Top X" telecon with MS (A); meeting schedule (IA); list of issues by priority w/ POC & status, Kr makes presentations (DA)	
	LCC & OMRS WGs review technical progress/actions (A); LCC WG Minutes review of LCC Change Notices (3/3/04) (IA); OMRS & LCC WG briefings (DA)	
	PRACA process used, NSTS 08216 (A, DA)	
	Used to do annual audits against PDPs, gov't sometimes asks Kr to help with audits ("self audit"), used to do "done good/do better" letters to Kr (A)	
SP2.8-1 Finding	**Although issues and risks are addressed in various ways, could find no evidence of a consistent, documented process to track issues, risks, and contractor performance.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.9-1 Accept Delivery of Products *Accept delivery products in accordance with Contractor agreements.*		
	Kr developed/gov't approved PDPs define deliverables, acceptance criteria, metric for tracking (A); various PDPs list product acceptance criteria (DA)	
	Acceptance criteria prescribed in NASA documentation for purchasing materials (A)	
	ODIN consolidated contract for comm/computer equipment is centralized (A)	
	Tech review of data pkgs (criteria = technically complete (thorough), on time) (A)	
SP2.9-1 Finding	**A formal, consistent process is used for acceptance of the contractor's work products.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**6**
NI	**1**
NA	**0**
Total Practices:	**9**

Findings Summary

There are contractor-developed, government approved plans for monitoring contractor processes, but it does not appear that they are presently in use.

PDPs define a process to evaluate contractor work products. However, could not find evidence that work products are being regularly reviewed to detect issues early.

Could find no evidence of a documented process for MK-SIO review of non-developmental items.

Although reviews occur sporadically, found no evidence of a documented or consistent process guiding reviews and interchanges with the contractors.

Could find no evidence that the government is consistently comparing contractor technical activities, cost, and schedule to plans and identifying issues and risks.

Could find no evidence that MK-SIO tracks sustainment products or identifies issues in accordance with a documented process.

Users are involved in review of technical progress. There is a concern that system performance evaluation is done by other organizations and may inhibit user evaluation.

Although issues and risks are addressed in various ways, could find no evidence of a consistent, documented process to track issues, risks, and contractor performance.

A formal, consistent process is used for acceptance of the contractor's work products.

Integrated Teaming

	Observations	Assessment
	SP1.1-1 Identify Team Tasks ***Identify and define the team's specific internal tasks to generate the team's expected output.***	
c	NSTS 07700 Vol II (bk2) Directive 140B defines LCC WG responsibilities (DA)	
	Directive 141 NSTS 07700 Vol II defines Intercenter Photo WG tasks (A, DA)	
	NSTS 07700/08171 establishes OMRS WG, charter, tasks (A, DA)	
	NSTS 08244 prescribes photo analysis, responsibilities, reports (A, DA)	
	Program Material Review Board (PMRB) well-defined, 25-yr process in place, NSTS 07700 (A, DA)	
SP1.1-1 Finding	**Working group charters, responsibilities, and operating procedures are defined in NSTS 07700 Vol. II Program Directives.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Identify Needed Knowledge and Skills ***Identify the knowledge, skills, and functional expertise needed to perform team tasks.***	
	Directive 141 NSTS 07700 charters Intercenter Photo WG, identifies membership & responsibilities (A, DA)	
	NSTS 07700 Vol II (bk2) Directive 140B defines LCC WG responsibilities & membership (DA)	
	LCC WG skills reqts are problem-specific, nature of problem determines skills required, often mgmt dictates who will be on team (A)	
	IPWG - everyone knows their responsibilities, experienced based (A)	
	Flow Review WG - "common sense" reqt for assignment, no specific functional expertise or skill reqt (A)	
SP1.2-1 Finding	**Although qualified MK-SIO members do participate on integrated teams, there does not appear to be a documented process for identifying specific skills needs.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Assign Appropriate Team Members *Assign the appropriate personnel to be team members based on required knowledge and skills.*		
	Had logistics & OMRS background, assigned to Intercenter Photo WG (A)	
	LCC WG skills reqts are problem-specific, nature of problem determines skills required, often mgmt dictates who will be on team (A)	
	OMRS WG assignments - each organization responsible, "tribal knowledge" on what the detailed responsibilities are (A)	
	Image Analysis Team - NASA & USA ground ops, Boeing & USA integration, elements (ET, SSME, SRB) but not orbiter (they stopped attending) (A); NSTS 08218 Photo TV Contingency Plan (DA)	
	IPWG - everyone knows their responsibilities, experienced based (A)	
SP1.3-1 Finding	**Team assignments are made based on task and organizational responsibility. Could find no documented technical qualifications or guidance for team assignments.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Establish a Team Charter *Establish and maintain a team charter based on the integrated team's shared vision and overall team objectives.*		
	NSTS 07700 Vol II (bk2) Directive 140B charters the LCC WG (A, DA)	B
	Directive 141 NSTS 07700 charters Intercenter Photo WG (A, DA)	B
	NSTS 07700 Vol II (bk2) Directive 52 charters the OMRS WG (A, DA)	B
SP2.2-1 Finding	**Team charters are established and clearly defined in NSTS 07700 Program Directives. *(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Define Roles and Responsibilities *Clearly define and maintain each team member's roles and responsibilities.*		
	NSTS 07700 Vol II (bk2) Directive 140B defines LCC WG responsibilities (A, DA)	B
	NSTS 07700 Vol II (bk2) Directive 52 specifies OMRS WG membership (A, DA)	B
	Directive 141 NSTS 07700 charters Intercenter Photo WG, everyone knows their responsibilities (e.g., imagery collection), based on experience (A, DA)	B
	NSTS 08244 prescribes photo analysis, responsibilities, reports (A, DA)	
	NSTS 08117 establishes processes for CoFR (DA)	B
SP2.3-1 Finding	**Team roles and responsibilities are specified in NSTS 07700 Program Directives. *(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.4-1 Establish Operating Procedures *Establish and maintain integrated team operating procedures.*		
	OMRS WG process flow, procedures (A); MK-UWI-07 (Rev C) (DA)	
	LCC Management Procedure (MK-UWI-04, Rev A) (DA)	
	NSTS 08244 prescribes photo analysis, responsibilities, reports (A, DA)	
SP2.4-1 Finding	**Chartered integrated teams (working groups) have operating procedures clearly defined in local work instructions.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.5-1 Collaborate Among Interfacing Teams *Establish and maintain collaboration among interfacing teams.*		
	LCC WG has interface to Loads Panel, PSIG, SSEIG, Thermal Panel, IWG (A)	
	NSTS 07700 Vol II (bk2) directive establishes SSEIG, defines role as technical integration (DA)	
	LCC WG & OMRS WG interface with PRCB for approval of changes (A)	
SP2.5-1 Finding	**NSTS 07700 establishes the SSEIG to specifically integrate all the technical panels. However, there is a concern that unchartered teams may not be fully integrated.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**5**
PI	**2**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

Working group charters, responsibilities, and operating procedures are defined in NSTS 07700 Vol. II Program Directives.

Although qualified MK-SIO members do participate on integrated teams, there does not appear to be a documented process for identifying specific skills needs.

Team assignments are made based on task and organizational responsibility. Could find no documented technical qualifications or guidance for team assignments.

Team charters are established and clearly defined in NSTS 07700 Program Directives. (Potential Best Practice)

Team roles and responsibilities are specified in NSTS 07700 Program Directives. (Potential Best Practice)

Chartered integrated teams (working groups) have operating procedures clearly defined in local work instructions.

NSTS 07700 establishes the SSEIG to specifically integrate all the technical panels. However, there is a concern that unchartered teams may not be fully integrated.

Requirements Development

	Observations	Assessment
	SP1.1a-2 Elicit and Collect Needs ***Elicit, identify, and collect stakeholder needs, expectations, constraints, and interfaces for all phases of the product life cycle.***	
	Imagery plan implements quality standards in lieu of specific requirements (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	OMRS & LCC WGs develop requirements with organization that requirements impact, iterate (A)	
	Attempt to pre-coordinate with stakeholders in advance of initiating an LCN, CRs put on-line, a "virtual system" (pre-coordination) (A)	
	Provide feedback to elements from post-flight photo comparison to baseline, asks stakeholders what products needed (A); Consolidated film/video reports (DA)	
	Could find no consistent process for data trending or reconstruction that feeds back into reqts development (DA)	
SP1.1a-2 Finding	**There is a process to collect and evaluate requirements changes. However, other than for imagery could find no consistent or documented process for requirements elicitation.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Develop the Customer Requirements ***Transform stakeholder needs, expectations, constraints and interfaces into customer requirements.***	
	OMRS & LCC WGs develop requirements with organization that requirements impact, analyze, iterate, coordinate (A)	
	Image Analysis Team & IPWG membership includes stakeholders (A); NSTS 08218 Photo TV Contingency Plan (DA)	
	Directive 141 --> NSTS 08244 L&L Photo Eng --> L&L PRD (A); Dir 141 (charter IPWG to develop L&L imagery reqts, maintain PRD), NSTS 08244 (DA)	
SP1.2-1 Finding	**Working groups and boards provide the program a documented process to transform needs into requirements, taking into account constraints and interfaces.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Establish Project Requirements *Establish and maintain project requirements, which are based on the customer requirements.*		
	Imagery plan implements quality standards in lieu of specific requirements (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	NSTS 07700, NSTS 08171, SES0073 (fluids procurement spec) are reqts sources (A, DA)	
	NSTS 08218 Photo/TV Analysis Contingency Action Plan contains reqts (A, DA)	
	NSTS 08171 & 16007 document established reqts, are maintained (DA)	
	Directive 141 --> NSTS 08244 L&L Photo Eng --> L&L PRD (A); Dir 141 (charters IPWG to develop L&L imagery reqts, maintain PRD), NSTS 08244 (DA)	
	Reqts identified, validated thru CR process --> PRCB approval --> NSTS 07700 Vol X (A, DA)	
	PRCBD S064024 CAIB ACTION 10.3-1 SSP CLOSEOUT PHOTOGRAPHY REQUIREMENTS & IMPLEMENTATION (DA)	
SP2.1-1 Finding	**Requirements are established by the PRCB and are maintained in numerous NSTS documents.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Allocate Project Requirements *Allocate the requirements for each project component.*		
	Directive 141 --> NSTS 08244 L&L Photo Eng --> L&L PRD (A); Dir 141 (charters IPWG to develop L&L imagery reqts, PRD), NSTS 08244 (DA)	
	PRDs document reqts (A, IA)	
	JSC 23540 Program Reqts Document Guidelines (DA)	
	Reqts identified, validated thru CR process --> PRCB approval --> NSTS 07700 Vol X (A, DA)	
	OMRS & LCC WGs develop requirements with organization that requirements impact, analyze, iterate, coordinate (A)	
SP2.2-1 Finding	**Requirements are allocated to the elements by the working groups and approved by PRCB action.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Identify Interface Requirements *Identify interface requirements.*		
	This is the primary responsibility of JSC, MK-SIO participates in resolution and coordination of issues, there is no documented process (learn by experience) (A)	
	Every element is a stakeholder in the integration process (A)	
	ICDs are handled by Boeing/KSC under the guidance of USA/Houston and JSC/SEIO (A)	
	ICD-2-12001 Orbiter Vehicle/ET (4/99) contains reqts & I/F design criteria (DA)	
	ICDs considered "design to" reqts that have waivers if required for compatibility with "ops reqts" in OMRS. Not required to have agreement before PRCB (PRCD mediates). CAIB report suggests a more proactive approach (A, DA)	
SP2.3-1 Finding	**JSC is responsible for interface requirements. MK-SIO reviews for completeness.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.4-1 Develop Verification Requirements *Develop program verification requirements in conjunction with the development of project requirements.*		
	Follows CR process (A)	
	NSTS 08244 defines verification (pass/fail) criteria (DA)	
	Test plan developed to verify imagery reqts mets (A)	
	Requirements verification for the integrated stack in Vol 10, 07700 MVP (DA)	
	SIP provides top level verification procedures/criteria for selected products (A, DA)	
	There is a verification table in 07700 for requirement verification, but imagery plans are not included in MVP (A); MVP (DA)	
SP2.4-1 Finding	**MK-SIO develops verification requirements for those project requirements for which it has responsibility.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.1-1 Establish Operational Concepts and Scenarios *Establish and maintain operational concepts and associated scenarios.*		
	Process not documented (A)	
	Coverage scenario development for imagery collection uses models & simulations (A); NSTS 08117 Appx M "SSSIO Flight Preparation Process Plan"; NSTS 08218 "Intercenter Photo & TV Analysis Contingency Action Plan"; NSTS 08240 "TV Plan" (DA)	
	Each Center has own laboratory with unique analytical approach, maintains imagery databases (A); NSTS 08244 requires data archiving (DA)	
SP3.1-1 Finding	**MK-SIO uses and maintains its databases. But could find no evidence of a documented process or guideline for how ops concepts and scenarios are to be established.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Establish a Definition of Required Functionality *Establish and maintain a definition of required functionality.*		
	Required functionality is defined in NSTS 07700 (Vol. X, bk1) (DA)	
	Working groups review requirements for functionality and integration into system (A); NSTS 07700 Vol II directives (e.g., Dir 141) (DA)	
SP3.2-1 Finding	**Required functionality is defined in NSTS 07700 Vol. X (bk1) and reviewed by working groups, as necessary.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.4a-3 Analyze Requirements to Achieve Balance *Analyze requirements to ensure that they are necessary and sufficient and to balance stakeholder needs and constraints.*		
	Negotiate with elements (stakeholders) involved, see how it "flows", & look at timeline (A)	
	CR process is documented, but mostly experience in how to do this (A)	
	If conflict in working group, goes to noon PRCB, PRCB needs rationale for change, people need to prove the RCN justification, people are counted on to do the right thing (A)	
	Imagery planning analyzed reqts to perform flight analysis (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	Working groups review & analyze requirements (A); NSTS 07700 Vol II directives (e.g., Dir 141) (DA)	
SP3.4a-3 Finding	**Requirements are analyzed across elements, but could find no evidence that requirements are analyzed to achieve balance (e.g., for risks, cost , schedule).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.5-2 Validate Requirements with Comprehensive Methods *Validate requirements to ensure the resulting system will perform as intended in the user's environment using multiple techniques as appropriate.*		
	Pre- and post-flight image baselines are established for comparison (A); Consolidated film/video reports (DA)	
	Can't trust just images, need instrumentation which is limited for post flight reconstruction (A)	
	Input required to do post-flight reconstruction - primarily ground site information & anomalies (ORMS & LCC WGs), data collected but no data reconstruction (A)	
	NSTS 08244 provides process for flight imagery comparison used to evaluate flight performance (DA)	
SP3.5-2 Finding	**Although working groups review requirements could find no evidence (other than for imagery) of a documented, consistent process for validating requirements.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**6**
PI	**4**
NI	**0**
NA	**0**
Total Practices:	**10**

Findings Summary

There is a process to collect and evaluate requirements changes. However, other than for imagery could find no consistent or documented process for requirements elicitation.

Working groups and boards provide the program a documented process to transform needs into requirements, taking into account constraints and interfaces.

Requirements are established by the PRCB and are maintained in numerous NSTS documents.

Requirements are allocated to the elements by the working groups and approved by PRCB action.

JSC is responsible for interface requirements. MK-SIO reviews for completeness.

MK-SIO develops verification requirements for those project requirements for which it has responsibility.

MK-SIO uses and maintains its databases. But could find no evidence of a documented process or guideline for how ops concepts and scenarios are to be established.

Required functionality is defined in NSTS 07700 Vol. X (bk1) and reviewed by working groups, as necessary.

Requirements are analyzed across elements, but could find no evidence that requirements are analyzed to achieve balance (e.g., for risks, cost , schedule).

Although working groups review requirements could find no evidence (other than for imagery) of a documented, consistent process for validating requirements.

Requirements Management

	Observations	Assessment
SP1.1-1 Obtain an Understanding of Requirements ***Develop an understanding with the requirements providers on the meaning of the requirements.***		
	Works to get inputs from the stakeholders (= people who want to make changes and the users) (A)	
	CR process used to get inputs from the users, working groups (OMRS, LCC, IP) also used (A); NSTS 07700 directives establish WGs/memberships (DA)	
	Requirements changes reviewed in daily or weekly PRCB (A, DA)	
SP1.1-1 Finding	**Changes to requirements are reviewed, following a documented process, for program impacts in boards and working groups.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	Observations	Assessment
SP1.2-2 Obtain Commitment to Requirements ***Obtain commitment to the requirements and requirements changes from the program stakeholders.***		
	Looks at "goodness" of req't and gets with stakeholder (="everybody"; "The Program"; anybody who could be affected) (A)	
	All config mgmt information available on STS website for all users, includes backup papers (DA)	**B**
	NSTS 07700 Vol II (bk2) Directive 140B defines LCC WG stakeholder membership (A, DA)	
	NSTS 07700 Vol II (bk2) Directive 52 specifies OMRS WG stakeholder membership (A, DA)	
	Reqts identified, validated thru CR process --> PRCB approval --> NSTS 07700 Vol X (A, DA)	
SP1.2-2 Finding	**Commitment to requirement changes is part of the board process with stakeholders.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3-1 Baseline Requirements *Baseline and maintain requirements and place them under change control.*		
	LCC example - submit change, get comments. Then get approval at daily PRCB. Get Directive published at JSC & put on website. Have hardcopies (A); NSTS 07700 Vol XIV (DA)	
	New umbilical (SRB). Got program buy-in & approval. Also Gnd Sys Int interface, (A)	
	Directive issued by program board; added to 07700, OMI, OMRS, LCC, etc as applicable. Each has its own Config Control (A, DA)	
	All requirements are baselined and maintained in NSTS 07700, Vol 10 (DA)	
	Changes to requirements are reviewed in Tech Panels and Boards. Once approved, the new requirements are put under CM and 07700 is changed (DA)	
	The CR identifies reviewers (DA)	
SP1.3-1 Finding	**Requirements are baselined and placed under CM, documented in NSTS 07700.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3a-1 Analyze Requirements Changes *Analyze all changes to the requirements for their impact and associated risk on product performance, architecture, supportability, system resource utilization, verification requirements, and schedule and cost.*		
	Looks at those who would be impacted (i.e. hazard control issues). 18 or 19 OMRS controls for each hazard, Part of review process (A)	
	Risk not addressed directly - impact is addressed. If a perceived risk problem, it's addressed. Documented in CR process in 07700. RCN, LCC, etc slightly different (A)	
	Bubbled up to PRCB. Parallel in KTR world - KTR writes directive too. (A)	
	Changes analyzed both formally & informally. Does concur/non-concur. Calls NASA engineer (A)	
	Criteria for analyzing requirement changes is described in NSTS 07700 Vol XIV (DA)	
	RTF Ground Camera Imagery Plan identifies reqts changes, resources, cost, risk, and schedule impact (A, DA)	
SP1.3a-1 Finding	**Could find no evidence that requirements are consistently analyzed by MK-SIO for impacts (e.g., product performance, supportability, resource, risk, schedule, cost).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-2 Maintain Bidirectional Traceability of Requirements *Maintain bidirectional traceability among the requirements and the project plans and work products.*		
	Tech people responsible for changes are typically responsible for ICDs, can best assess impacts, therefore it's somewhat bi-directional (A)	
	In OMRSD table; lists actions, Cross-reference table (A)	
	Requirements traceability to subordinate documents both up and down is directed in NSTS 07700, Vol 4, Bk 1, Appx B "definitions" (DA)	
	Found no evidence of any bidirectional traceability (DA)	
SP1.4-2 Finding	**Bidirectional traceability is required, but found no evidence of any implementation.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Identify Inconsistencies Between Project Work and Requirements *Identify inconsistencies between the project plans and work products and the evolving requirements and take appropriate action.*		
	MRB used on work products, assessed by USA, Boeing, resolved by working groups (LCC, OMRS, IP) (A)	
	Periodic updates (every few years - last was ~5 years ago). They scrub every req't. Fine-tooth comb on every req't. Example - CRTs to flat panel displays. (A)	
	NSTS 08126 Problem Reporting & Corrective Action (PRACA) defines process for problem resolution (DR)	
SP1.5-1 Finding	**Requirements database is reviewed for inconsistencies on a periodic basis, but there is no evidence that it is done consistently for every change.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**3**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

Changes to requirements are reviewed, following a documented process, for program impacts in boards and working groups.

Commitment to requirement changes is part of the board process with stakeholders.

Requirements are baselined and placed under CM, documented in NSTS 07700.

Could find no evidence that requirements are consistently analyzed by MK-SIO for impacts (e.g., product performance, supportability, resource, risk, schedule, cost).

Bidirectional traceability is required, but found no evidence of any implementation.

Requirements database is reviewed for inconsistencies on a periodic basis, but there is no evidence that it is done consistently for every change.

Technical Solution

	Observations	Assessment
SP2.3-1 Establish Interface Descriptions ***Establish and maintain the solution for product-component interfaces.***		
	This is the responsibility of JSC (A)	
	Every element is a stakeholder in the integration process (A)	
SP2.3-1 Finding	**This is a JSC function.**	
NA	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NA**

SP2.3a-3 Design and Analyze Interfaces Using Criteria ***Design and analyze comprehensive product-component interfaces in terms of established and maintained criteria.***		
	This is the primary responsibility of JSC, MK-SIO participates in resolution and coordination of issues, there is no documented process (learn by experience) (A)	
	Integration risk associated with interface definitions not always included in analysis (A)	
SP2.3a-3 Finding	**This is primarily a JSC function with KSC providing support. There is no evidence of a documented process identifying roles, responsibilities, or process flow.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**1**
NI	**0**
NA	**1**
Total Practices:	**2**

Findings Summary

This is a JSC function.

This is primarily a JSC function with KSC providing support. There is no evidence of a documented process identifying roles, responsibilities, or process flow.

Product Integration

	Observations	Assessment
	SP1.1-1 Determine Integration Sequence ***Determine the product-component integration sequence.***	
	NSTS 07700 provides guidance on SIP content (DA)	
	SEIO monitors integration planning is done using SIPs (an agreement on roles & responsibilities, technical activities, interfaces & schedules for a given interface activity), MK-SIO participates in flow working group (NSTS 60515) (A, DA)	
	KSC PH is responsible for establishing system integration activities & schedule (KICS). MK-SIO has USA monitor activity, NASA only spot checks (A, DA)	
SP1.1-1 Finding	**The SIP provides requirements for the integration process and interface activities. There is a concern that MK-SIO does not ensure adequacy of the developed sequence.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-2 Establish the Product Integration Environment ***Establish and maintain the environment needed to support the integration of the product components.***	
	This is a responsibility of KSC/PH (A); KICS (DA)	
	Verification product requirements primarily levied via PRCB Directive (A)	
SP1.2-2 Finding	**KSC/PH is responsible for establishing environment based upon formally identified verification requirements (MVP, SIP, PRCB Directive).**	
NA	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NA**

	SP1.3-3 Establish Product Integration Procedures and Criteria ***Establish and maintain procedures and criteria for integration of the product components.***	
	Other than top level guidance in the SIP, procedures/criteria are done by the KSC Shuttle Processing organization (A)	
	KSC/PH accepts the elements and implements the integration process. MK-SIO monitors activity, primarily through USA (NASA resources limited) (A)	
	A photographic baseline is established for both pre- and post-integration configurations (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
SP1.3-3 Finding	**KSC/PH is responsible for procedures (except for imagery), MK-SIO establishes criteria. Found no evidence that MK-SIO ensures that the criteria are followed.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Review Interface Descriptions for Completeness *Review interface descriptions for coverage and completeness.*		
	ICDs are handled by Boeing/KSC under the guidance of USA/Houston and JSC/SEIO (A)	
	ICD-2-12001 Orbiter Vehicle/ET (4/99) contains reqts & I/F design criteria (DA)	
	ICDs considered "design to" reqts that have waivers if required for compatibility with "ops reqts" in OMRS. Not required to have agreement before PRCB (PRCB mediates). CAIB report suggests a more proactive approach (A, DA)	
SP2.1-1 Finding	**MK-SIO reviews interface descriptions for completeness but found no evidence for a process to correct discrepancies. OMRS conflicts are processed as ICD waivers.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Manage Interfaces *Manage internal and external interface definitions, designs, and changes for products and product components.*		
	Interfaces are managed by JSC SEIO/USA (A)	
	Changes to the interface are monitored through the CR review process and interaction with USA reviews (A)	
	NSTS 07700 Vol. IV governs change process (DA)	
SP2.2-1 Finding	**This is a JSC/SEIO responsibility with active MK-SIO participation.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.3-1 Evaluate Assembled Product Components *Evaluate assembled product components for interface compatibility.*		
	Shuttle processing is KSC/PH led activity monitored by MK-SIO, primarily through USA because of limited resources (A)	
	Depend on the right people being there - but no check that they are (A)	
	Participate in the integration reviews for SRM/ET and Orb/ET (A)	
	Element primes have integration responsibility. Boeing does SE/integration/Orb with USA oversight. MK-SIO participation primarily through reviews (A)	
	Independent observation capability limited by MK-SIO staff resources. People follow specific jobs (A)	
	Perform verification analysis for DCR, using KSC/PH products, and report to JSC/SEIO (A); Requirement Verification Review Sheets (RVRS) (DA)	
SP3.3-1 Finding	**MK-SIO evaluation is primarily a review of KSC/PH products. Full evaluation is performed for some items but resources limit coverage.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**3**
NI	**0**
NA	**1**
Total Practices:	**6**

Findings Summary

The SIP provides requirements for the integration process and interface activities. There is a concern that MK-SIO does not ensure adequacy of the developed sequence.

KSC/PH is responsible for establishing environment based upon formally identified verification requirements (MVP, SIP, PRCB Directive).

KSC/PH is responsible for procedures (except for imagery), MK-SIO establishes criteria. Found no evidence that MK-SIO ensures that the criteria are followed.

MK-SIO reviews interface descriptions for completeness but found no evidence for a process to correct discrepancies. OMRS conflicts are processed as ICD waivers.

This is a JSC/SEIO responsibility with active MK-SIO participation.

MK-SIO evaluation is primarily a review of KSC/PH products. Full evaluation is performed for some items but resources limit coverage.

Verification

	Observations	Assessment
SP1.1-1 Select Work Products for Verification ***Select the work products to be verified and the verification methods that will be used for each.***		
	SSP products for verification are identified in the MVP & SIP, but does not include imaging efforts (A)	
	KSC documents are all developed/coordinated through the applicable working groups (A)	
	Flt 105 was the last test plan done by integration ("frozen design", lack of people) (A) Document review found no subsequent test plan (DA)	
	Imagery plans are not included in MVP (A, DA)	
	Participate in reviews of element verification plans with specific attention to mating interfaces and environment (A)	
	No real direct input to KSC/PH verification planning. Requirements primarily levied via PRCBD. USA support coordinates with PH support (A)	
SP1.1-1 Finding	**MVP/SIP identify products/methods for system verification, but no evidence of direct MK-SIO-to-KSC/PH coordination. No guidance for identifying MK-SIO products to be verified.**	
PI	**<----Practice Finding** **Mini-Team Recommendation ---->**	**PI**

SP1.2-2 Establish the Verification Environment ***Establish and maintain the environment needed to support verification.***		
	SSP verification environment is the responsibility of the KSC Shuttle Processing organization (PH), MK-SIO participates in flow working group (A)	
	KSC documents are verified within established working groups (A)	
	MK-SIO is OPR for NSTS 08117 (CoFR) (A, DA)	
	Too much data for available staff to review (A)	
SP1.2-2 Finding	**Environments for system verification and MK-SIO products undergoing board review are established. But, environments for products not undergoing board action appear ad hoc.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Verification Procedures and Criteria *Establish and maintain verification procedures and criteria for the selected work products.*		
	SSP integration procedures/criteria are the responsibility of the KSC Shuttle Processing organization (PH) (A); web site review (DA)	
	Ver/Val have never been clearly differentiated (A); Summit briefings (1/04) (DA)	
	The 07700/MVP provides a documented process for verification, but imagery plans are not included in MVP (A, DA)	
	SIP provides top level verification procedures/criteria for selected products (A, DA)	
	Responsible for and approves NSTS 08117 (A, DA)	
	There is a verification table in 07700 for requirement verification, but imagery plans are not included in MVP (A); MVP (DA)	
SP1.3-3 Finding	**NSTS 07700/MVP and 08117 provide documented processes for verification. But there is no consistent definition for "verification" (e.g., imagery plans are not included in MVP).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Prepare For and Conduct Peer Reviews *Prepare for and conduct peer reviews on selected work products and identify issues resulting from the peer review.*		
	Working groups are used as peer reviews (A)	
	Independent reviews by "gray beards" provide peer type review (A)	
SP2.1-1 Finding	**Peer type reviews occur in informal reviews, working groups and independent reviews. But found no evidence of a documented process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Perform Verification *Perform verification on the selected work products.*		
	"what if" people were cut (A)	
	Actual verification done by Boeing for PH under USA oversight with minimal MK-SIO participation other than formal integration reviews (A)	
	Pre- and post-flight image baselines are established for comparison (A) Consolidated film/video reports (DA)	
SP3.1-1 Finding	**Found no evidence of any criteria to ensure selection of critical products for verification (e.g., as is done for imagery baselines).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1a-2 Prepare for and Conduct Internal Reviews *Prepare for and conduct internal reviews of selected project office work products.*		
	MK-SIO is responsible for & approves NSTS 08117 which establishes roles/responsibilities for system level integration (CoFR) (A, DA)	
	No evidence of a process for verifying internal MK-SIO products (A, DA)	
	Imagery planning includes integration verification reviews (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
SP3.1a-2 Finding	**Imagery baselining and reviews are conducted as part of integration verification, but there is no evidence of verification of internal MK-SIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-2 Analyze Verification Results and Identify Appropriate Action *Analyze the results of all verification activities and identify appropriate action.*		
	Unexplained anomaly (non-repeatable) is reviewed by KSC board (A)	
	Participate in formal ET/SRM and ET/Orbiter reviews but size of staff limits independent visibility into potential problems (A)	
	Shuttle processing is KSC/PH led activity monitored by MK-SIO, primarily through USA because of limited resources (A)	
	Depend on the right people being there - but no check that they are (A)	
	Participate in the integration reviews for SRM/ET and Orb/ET (A)	
	Element primes have integration responsibility. Boeing does SE/integration/Orb with USA oversight, MK-SIO participation primarily through reviews (A)	
	Independent observation capability limited by MK-SIO staff resources. People follow specific jobs (A)	
SP3.2-2 Finding	**Except for imagery, analysis of results is limited by staff resources.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**7**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

MVP/SIP identify products/methods for system verification, but no evidence of direct MK-SIO-to-KSC/PH coordination. No guidance for identifying MK-SIO products to be verified.

Environments for system verification and MK-SIO products undergoing board review are established. But, environments for products not undergoing board action appear ad hoc.

NSTS 07700/MVP and 08117 provide documented processes for verification. But there is no consistent definition for "verification" (e.g., imagery plans are not included in MVP).

Peer type reviews occur in informal reviews, working groups and independent reviews. But found no evidence of a documented process.

Found no evidence of any criteria to ensure selection of critical products for verification (e.g., as is done for imagery baselines).

Imagery baselining and reviews are conducted as part of integration verification, but there is no evidence of verification of internal MK-SIO products.

Except for imagery, analysis of results is limited by staff resources.

Validation

	Observations	Assessment
	SP1.1-1 Select Products for Validation ***Select products to be validated and the validation methods that will be used for each.***	
	NSTS 07700 Vol IV requires validation of all general items types (requirements, models, flight data, software) and approach, but provides no specific criteria for product selection (DA)	
	MK-SIO aware of its validation responsibilities and the methods it has & will use for each area (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	Imagery plan provides detailed description of products and methods (A); "RTF Ground Camera Imagery Plan" presentation (DA) ***(Potential Best Practice)***	**B**
	OMRS specifies film analysis but imagery planning limited by lack of formal requirements (A); No evidence of specific requirements could be found (DA)	
SP1.1-1 Finding	**Some general guidance exists in NSTS 07700 Vol IV, but could find no evidence of specific selection criteria (other than imagery quality standards) for products & methods.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-2 Establish the Validation Environment ***Establish and maintain the environment needed to support validation.***	
	Imagery planning is performed to establish/maintain the environment required to perform flight analysis (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	Imagery analysis resources & transport modeling are identified and made available for validation process (A); "RTF Ground Camera Imagery Plan" presentation, consolidated film/video reports (DA)	
	No rentry image coverage, need 5 flights to establish baseline (A); no evidence of plan for reentry coverage found (A)	
	Running one integrated test for new imaging configurations (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	Can't trust just images, need instrumentation which is limited for post flight reconstruction (A)	
	Could find no evidence that the scope of MK-SIO validation activities are defined (DA)	
SP1.2-2 Finding	**Although ground and imagery capability is established and maintained, could find no evidence that the scope of MK-SIO validation activities are defined (e.g., reentry?).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Validation Procedures and Criteria *Establish and maintain procedures and criteria for validation.*		
	Imagery procedures exist, but experience is key ingredient (A); consolidated film/video reports (DA)	
	No rentry image coverage, need 5 flights to establish baseline (A); no evidence of plan for reentry coverage found (A)	
	Can't trust just images, need instrumentation which is limited for post flight reconstruction (A)	
	Don't know of any validation procedures (A)	
SP1.3-3 Finding	**Procedures/criteria exist for only a part of the intended environment (powered flight but not reentry).**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Perform Validation *Perform validation on the selected products.*		
	Pre- and post-flight image baselines are established for comparison (A); Consolidated film/video reports (DA)	
	Perform post flight imagery analysis from pre-liftoff through powered flight for performance validation (A); Consolidated film/video reports (DA)	
	Can't trust just images, need instrumentation which is limited for post flight reconstruction (A)	
	Input required to do post-flight reconstruction - primarily ground site information and anomalies (ORMS, LCC), data collected but no data reconstruction (A)	
SP2.1-1 Finding	**Validation is performed using powered flight and post-flight imagery products. There is a concern that more flight instrumentation may be needed for corroboration.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Analyze Validation Results *Analyze the results of the validation activities and identify issues.*		
	Post flight analysis begins pre-liftoff, analysis led by launch team (A)	
	Provide feedback to elements from post-flight photo comparison to baseline and other missions (A); Consolidated film/video reports (DA)	
	Each Center has own laboratory with unique analytical approach (A); NSTS 08244 corroborates (DA)	**B**
	Post flight analysis reviewed by PRCB (A); Consolidated film/video reports (DA)	
	Can't trust just images, need instrumentation which is limited for post flight reconstruction (A)	
SP2.2-1 Finding	**Analysis is performed using imagery products. There is a concern that corroborating instrumentation is limited.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**5**

Findings Summary

Some general guidance exists in NSTS 07700 Vol IV, but could find no evidence of specific selection criteria (other than imagery quality standards) for products & methods.

Although ground and imagery capability is established and maintained, could find no evidence that the scope of MK-SIO validation activities are defined (e.g., reentry?).

Procedures/criteria exist for only a part of the intended environment (powered flight but not reentry).

Validation is performed using powered flight and post-flight imagery products. There is a concern that more flight instrumentation may be needed for corroboration.

Analysis is performed using imagery products. There is a concern that corroborating instrumentation is limited.

Configuration Management

	Observations	Assessment
SP1.1-1 Identify Configuration Items ***Identify the configuration items, components, and related work products that will be placed under configuration management.***		
	Everyone has to use the JSC 07700 CM process (A)	
	There is no evidence of an independent MK-SIO CM for internal MK-SIO products (A, DA)	
SP1.1-1 Finding	**System level items to be placed under configuration management are identified IAW NSTS 07700 Vol. IV. But found no CM system for internal MK-SIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.2-1 Establish a Configuration Management System ***Establish and maintain a configuration management and change management system for controlling work products.***		
	Vol IV of NSTS 07700 establishes the CM system used to support the SEIO (A, DA)	
	System of CCBs and PRCB used to maintain system configuration (A, DA)	
	CRs and PRCB Directives are used to implement and track changes (A, DA)	
	Versioning used informally, but no evidence found of CM process being used for KSC/SEIO internal products (A, DA)	
SP1.2-1 Finding	**The JSC SSP CM system is used for all major products, but no evidence found of CM process for internal MK-SIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Create or Release Baselines ***Create or release baselines for internal use and for delivery to the customer.***		
	This is primarily a JSC responsibility (A)	
	Imagery used pre-/post-integration and post-landing to establish visual baseline (A); "RTF Ground Camera Imagery Plan" presentation (DA)	
	NSTS 07700 Vol. IV, NSTS 08244 (DA)	
SP1.3-1 Finding	**Although primarily a JSC responsibility, KSC is responsible for establishing a visual "as built/flown" baseline.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Track Change Requests *Track change requests for the configuration items.*		
	Every CR is reviewed (e.g., LCC, OMRS) (A)	
	ICB and PRCB activities are monitored (A)	
SP2.1-1 Finding	**CRs are reviewed and status monitored following a documented process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Control Configuration Items *Control changes to the configuration items.*		
	This is a JSC responsibility for program level documents (A)	
	No evidence found of CM process being used for MK-SIO internal products (A, DA)	
SP2.2-1 Finding	**This is a JSC responsibility for system level products, but no evidence found of CM process for internal MK-SIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Establish Configuration Management Records *Establish and maintain records describing configuration items.*		
	All program documentation on web (A, DA)	
	This is a JSC responsibility (A)	
	No evidence found of CM process being used for MK-SIO internal products (A, DA)	
SP3.1-1 Finding	**JSC has a CM records system established and in operation, but no evidence found of CM process for internal MK-SIO products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**4**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

System level items to be placed under configuration management are identified IAW NSTS 07700 Vol. IV. But found no CM system for internal MK-SIO products.

The JSC SSP CM system is used for all major products, but no evidence found of CM process for internal MK-SIO products.

Although primarily a JSC responsibility, KSC is responsible for establishing a visual "as built/flown" baseline.

CRs are reviewed and status monitored following a documented process.

This is a JSC responsibility for system level products, but no evidence found of CM process for internal MK-SIO products.

JSC has a CM records system established and in operation, but no evidence found of CM process for internal MK-SIO products.

Decision Analysis and Resolution

	Observations	Assessment
	SP1.1-1 Establish Guidelines for Decision Analysis ***Establish and maintain guidelines to determine which issues are subject to a formal evaluation process.***	
	PRCB & working groups (LCC, OMRS) process determine required evaluations, assess programmatic impact (element, cost, sched, perf, risk), rely on working groups & Kr expertise to assess issues (A)	
	NSTS 07700 Vol 2 (bk2) Directives defines processes for decisions for various panels & organizations (A, DA)	
	Nothing specific - left to expertise of Sys Eng to make decision (A)	
	NSTS 07700, Vol XIV (bk1) defines which changes are presented to boards for decisions (DA)	
	NSTS 160007 LCC establishes criteria & guidelines (A, DA)	
	NSTS 08218 Photo/TV Analysis Contingency Action Plan contains guidelines (A, DA)	
SP1.1-1 Finding	**NSTS 07700 Vol 2 (bk2) Directives defines guidelines for decisions for various panels & organizations.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Establish Evaluation Criteria ***Establish and maintain the criteria for evaluating alternatives, and the relative ranking of these criteria.***	
	Nothing specific - left to expertise of Sys Eng to make decision, writes waiver or exception if needed (see SPI) (A)	
	Hardware criticality defined in QA database (Crit 1/2/3) (A); NSTS 08117 defines criticality (DA)	
	NSTS 07700 Vol. XIV (bk1, sec 8) defines criteria for presentations (DA)	
	OMRSD lays out reqts for formal (PRCB) decisions (A); NSTS 08171 (DA)	
	Quality stds applied to imagery plan (A, DA)	
	NSTS 16007 LCC establishes criteria (A, DA)	
	NSTS 37310 Safety Risk Ranking provides criteria for decision analysis (DA)	
SP1.2-1 Finding	**Formal criteria exists, is documented, and used to evaluate alternatives.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3-1 Identify Alternative Solutions *Identify alternative solutions to address issues.*		
	We aren't reqd to come to a solution before the PRCB, we can ask for mediation (A)	
	RTF Ground Camera Imagery Plan presentation to PRCB identifies alternatives (A, DA)	
SP1.3-1 Finding	**Alternatives are identified, but there was no evidence found for a documented process guiding identification of alternative solutions.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-1 Select Evaluation Methods *Select the evaluation methods.*		
	Evaluation criteria (testing methodology) is the responsibility of the Tech Panels per NSTS 07700 Vol II, Bk 2 (DA)	
	Probabilistic Risk Assessment (PRA) process (not implemented), introduced for upgrades program, an analytical basis for evaluation, program attempt to get away from "gut feel" approach (A)	
	SR2148 "Orbiter Debris Certification Risk Analysis Process" defines PRA (DA)	
	Kr writes risk assessment to each RCN, "scorecard" of 5X5 matrix (consequence v. prob of occurrence) (A); SSP Top Program Risk Matrix (DA)	
	Some assessments based on data/some on engr'g judgement, filling in the blocks depends on how you feel (A)	
SP1.4-1 Finding	**Evaluation methods are used but found no evidence of a documented process to select specific evaluation methods.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Evaluate Alternatives *Evaluate alternative solutions using the established criteria and methods.*		
	RTF Ground Camera Imagery Plan presentation to PRCB identifies alternatives & assesses risk, using quality stds (A, DA)	
	Have a topic list of specialists consulted for alternatives, use Kr expertise (A)	
SP1.5-1 Finding	**There was little documented evidence found for evaluating alternative solutions based on established criteria.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.6-1 Select Solutions *Select solutions from the alternatives based on the evaluation criteria.*		
	We aren't required to come to a solution before the PRCB, we can go to PRCB and ask for a decision (A)	
	NSTS 07700 prescribes decisions are to be made based on applied criteria (DA)	
	Topics presented to PRCB for decisions (A), PRCB agenda (IA); PRCB minutes, NSTS 07700 Directive establishes PRCB as a decision-making body (DA)	
	Each Center has own laboratory (for imagery analysis) with unique analytical approach which provides alternatives for PRCB consideration (A); NSTS 08244 corroborates (DA)	B
	OMRS WG & LCC WG coordinate presentation of issues to daily PRCB, make recommendation(s) (A, DA)	
SP1.6-1 Finding	**MK-SIO supports the decision-making process, selecting solutions (when necessary) to make recommendations to the PRCB.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**3**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

NSTS 07700 Vol 2 (bk2) Directives defines guidelines for decisions for various panels & organizations.

Formal criteria exists, is documented, and used to evaluate alternatives.

Alternatives are identified, but there was no evidence found for a documented process guiding identification of alternative solutions.

Evaluation methods are used but found no evidence of a documented process to select specific evaluation methods.

There was little documented evidence found for evaluating alternative solutions based on established criteria.

MK-SIO supports the decision-making process, selecting solutions (when necessary) to make recommendations to the PRCB.

Causal Analysis and Resolution

	Observations	Assessment
	SP1.1-1 Select Defect Data for Analysis ***Select the defects and other problems for analysis.***	
	MRB and PMRB used (MRB is Criticality 3; PMRB is Criticality 1 & 2) (A, DA)	
	MRB and PMRB well defined & in place 25 years. Subgroups of specialists decide how to fix problem. Process described in 07700 (contractor version in SPI (Shuttle Program Instruction) (A, DA)	
	Provide feedback to elements from post-flight photo comparison to baseline and other missions (A); Consolidated film/video reports (DA)	
SP1.1-1 Finding	**Processes for selecting defects and other problems for analysis is well established.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Analyze Causes ***Perform causal analysis of selected defects and other problems and propose actions to address them.***	
	MRB looks at what caused problem. "Shopping list" (in SPIs) based on history to help find out cause. Also get inputs from floor people "involved" in the problem. (A, DA)	
	In-flight anomalies reported (A); consolidated film/video reports (DA)	
	Each Center has own laboratory with unique analytical approach focus (A); NSTS 08244 corroborates (DA)	**B**
	Input required to do post-flight reconstruction - primarily ground site information and anomalies (ORMS, LCC), no data reconstruction (A)	
SP1.2-1 Finding	**There are documented processes for causal analysis which are used.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Implement the Action Proposals *Implement the selected action proposals that were developed in causal analysis.*		
	MRB used for doing this, NSTS 07700 charters PMRB (A, DA)	
	PRCB directs implementation via directives (A, DA)	
	IFAs identified for follow on action (A); STS-112 Consolidated Film/Review (DA)	
	S061954A/7-1 RTF Ground Camera Ascent Imagery Plan presentation to PRCB (DA)	
SP2.1-1 Finding	**The existing PRCB process reviews and directs action on proposals to correct defects and in-flight anomalies.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Evaluate the Effect of Changes *Evaluate the effect of changes on performance.*		
	Passed on to QA org. (A)	
	Provide feedback to elements & image providers from post-flight photo comparison to baseline and other missions (A); Consolidated film/video reports (DA)	
	NSTS 07700 Vol IV (bk1) change request process prescribes evaluation of change for impact, including the predicted impact (DA)	
	Could find no evidence of any evaluation or metrics for change impact (DA)	
SP2.2-1 Finding	**Some effects of process change resulting from causal analysis are being evaluated. But could find no guidance for metrics or measures to be applied.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.3-1 Record Data *Record causal analysis and resolution data for use across the project and organization.*		
	PRACA "generates" the data, (individual) files own copies for future reference (A); NSTS 08216 defines reporting reqts (DA)	
	Provide feedback to elements & image providers from post-flight photo comparison to baseline and other missions (A); Consolidated film/video reports (DA)	
	MK-SIO products (e.g., briefings, working mat'ls) kept on individual computers, not openly distributed or posted on any shared drive (A)	
SP2.3-1 Finding	**Could find little evidence that the causal analysis data is recorded in a readily available and accessible manner.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**3**
PI	**2**
NI	**0**
NA	**0**
Total Practices:	**5**

Findings Summary

Processes for selecting defects and other problems for analysis is well established.

There are documented processes for causal analysis which are used.

The existing PRCB process reviews and directs action on proposals to correct defects and in-flight anomalies.

Some effects of process change resulting from causal analysis are being evaluated. But could find no guidance for metrics or measures to be applied.

Could find little evidence that the causal analysis data is recorded in a readily available and accessible manner.

Organizational Training

	Observations	Assessment
SP1.1-1 Establish the Strategic Training Needs ***Establish and maintain the strategic training needs of the organization.***		
	No Strategic training plan (A, DA)	
SP1.1-1 Finding	**There is no evidence of strategic training planning.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP1.2-1 Determine Which Training Needs Are the Responsibility of the Organization ***Determine which training needs are the responsibility of the organization and which will be left to the individual project or support group.***		
	Establishing training needs are responsibility of each employee's supervisor (A); ISO 9000 training files on web site (DA)	
	Supervisors maintain individual training plans for each employee and discuss/amend it during the annual review (A)	
	KSC Training Office performs yearly web based needs survey and provides results, including priority to each individual office (A); Example of results (DA)	B
SP1.2-1 Finding	**The KSC Training Office does an annual survey and feeds results and training schedule to MK-SIO for implementation. *(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3-1 Establish an Organizational Training Tactical Plan ***Establish and maintain an organizational tactical training plan.***		
	Not required since we don't get new people straight from school (A)	
	KSC training office does yearly web based training survey to establish needs and schedule for the year, individual employees list need and priority (A)	
	Management provided survey results and KSC training office implementation plan (A); Survey example (DA)	
	Web training records/personal development plans (A, DA)	
SP1.3-1 Finding	**Results provided by KSC Training Office provides a basic tactical training plan.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.4-1 Establish Training Capability *Establish and maintain training capability to address organizational training needs.*		
	Although the KSC Training Office provides training based upon the yearly survey (A); there is no evidence of MK-SIO training capability found (DA)	
SP1.4-1 Finding	**There is no evidence of MK-SIO training capability found.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP2.1-1 Deliver Training *Deliver the training following the organizational training tactical plan.*		
	All kinds of courses available, KSC Training Office schedules training based on needs analysis & available funding (A)	
	Some training classes are made available if there is sufficient demand (e.g., INCOSE) (A)	
	Training delivered only for those needs identified by KSC Training Office survey (A)	
	Training primarily by continuous OJT and observation of board operations (A)	
SP2.1-1 Finding	**KSC Training Office delivers training to support the yearly survey results to the extent funding is available.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Establish Training Records *Establish and maintain records of the organizational training.*		
	Most staff members have ISO 9000 Personal Development Plans, Training plans on web site (A, DA)	
	Personal Development Plans are updated periodically and employees notified when certifications are about to run out (A, DA)	**B**
SP2.2-1 Finding	**ISO 9000 training records (Personal Development Plans) exist and are kept current.** ***(Potential Best Practice)***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Assess Training Effectiveness *Assess the effectiveness of the organization's training program.*		
	Questionaires used to assess KSC Training Office training, but effectiveness of training on employee not specifically evaluated, only reflected in yrly review (A)	
	No evidence found of a process to assess training effectiveness (DA)	
SP2.3-1 Finding	**Could find no evidence of any means to feed back or assess the effectiveness of training.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**0**
NI	**3**
NA	**0**
Total Practices:	**7**

Findings Summary

There is no evidence of strategic training planning.

The KSC Training Office does an annual survey and feeds results and training schedule to MK-SIO for implementation. (Potential Best Practice)

Results provided by KSC Training Office provides a basic tactical training plan.

There is no evidence of MK-SIO training capability found.

KSC Training Office delivers training to support the yearly survey results to the extent funding is available.

ISO 9000 training records (Personal Development Plans) exist and are kept current. (Potential Best Practice)

Could find no evidence of any means to feed back or assess the effectiveness of training.

Organizational Process Definition

	Observations	Assessment
	SP1.1-1 Establish Standard Processes ***Establish and maintain the organization's set of standard processes.***	
	NASA Procedures & Guidelines (NPG) 7120.5B establishes program mgmt processes & reqts for all NASA centers (DA)	
	NSTS 37358 Process Control & Mgmt Plan (Dec '00) defines methods for implementing process control reqts & best practices (DA)	
	NSTS 07700 lays out responsibilities & charters of all the various aspects of the program (A, DA)	B
	NSTS 08171 & 16007 lay out processes for OMRS & LCC (DA)	B
	NSTS 08117 establishes processes for CoFR (DA)	B
SP1.1-1 Finding	**There is a well-documented set of organizational standard processes for all NASA centers.** ***Potential Best Practice***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.5-1 Establish the Organization's Process Asset Library ***Establish and maintain the organization's process asset library.***	
	On-line Program Documentation Center (PDC) (A, DA)	
	Library of documented processes maintained on SSPWeb (A); for both gov't & contractor based in ISO 9000 (DA)	
	Config mgmt done by JSC, documented in NSTS 07700 Vol. IV (A, DA)	
	SSPWeb repository for data (use by trial & error), important data not on the web, controlled by Kr - limited gov't access, password changes monthly & difficult for gov't to access (A)	
SP1.5-1 Finding	**There are several libraries and databases for technical, programmatic, and process information. But found no "process asset library" that was accessible to all in MK-SIO.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

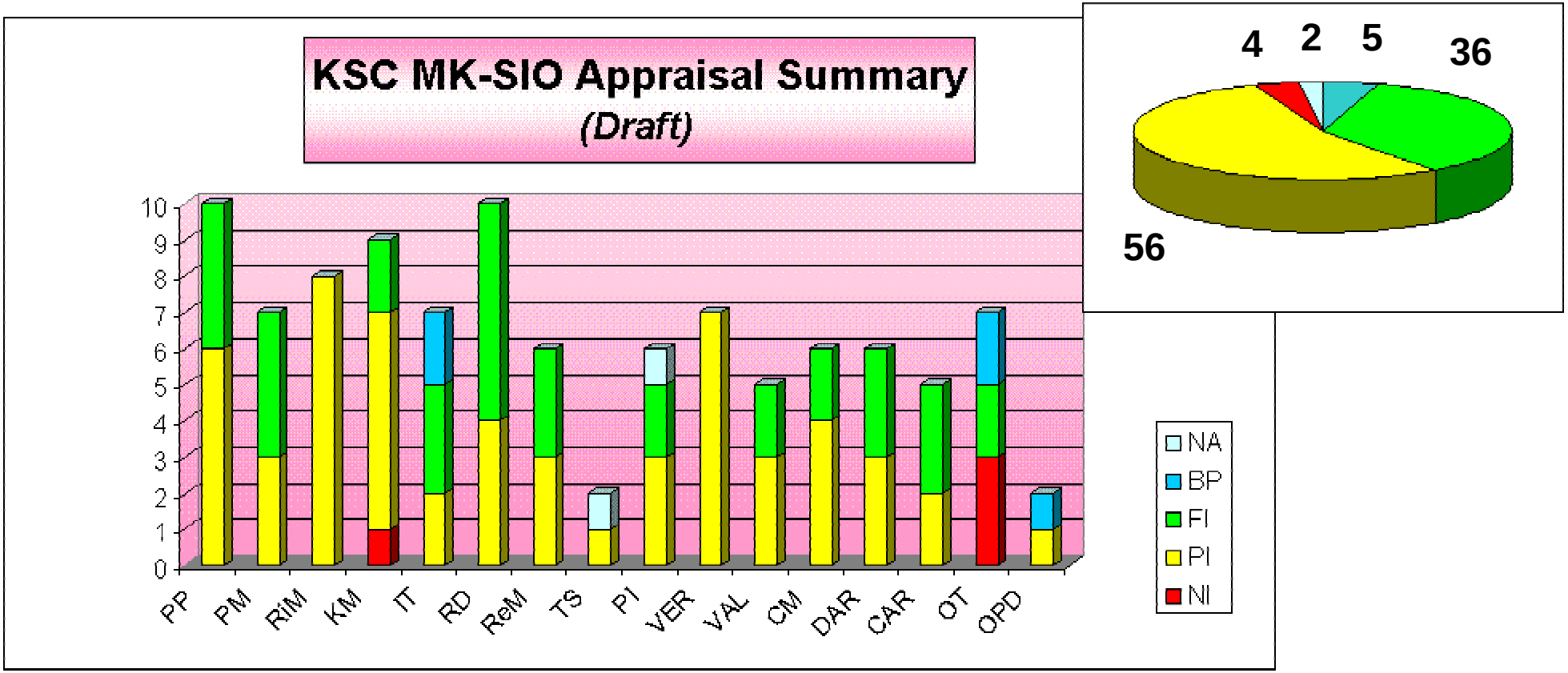
	Final
FI	**1**
PI	**1**
NI	**0**
NA	**0**
Total Practices:	**2**

Findings Summary

There is a well-documented set of organizational standard processes for all NASA centers. Potential Best Practice

There are several libraries and databases for technical, programmatic, and process information. But found no "process asset library" that was accessible to all in MK-SIO.

	PP	PM	RiM	KM	IT	RD	ReM	TS	PI	VER	VAL	CM	DAR	CAR	OT	OPD	
BP					2										2	1	5
FI	4	4	0	2	3	6	3	0	2	0	2	2	3	3	2	0	36
PI	6	3	8	6	2	4	3	1	3	7	3	4	3	2	0	1	56
NI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	4
NA	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
																	103



Appendix C3 - Completed MSFC Appraisal Worksheets

CMMI Process Area	What the Appraisal Found	Process Exists?	Is It Used?	Documented?	Others Know & Use?	Mgmt Aware & Review?	Resources?	Training?
Project Planning								
Project Management								
Risk Management								
Contractor Management								
Integrated Teaming								
Requirements Development								
Requirements Management								
Technical Solution								
Product Integration								
Verification								
Validation								
Configuration Management								
Decision Analysis & Resolution								
Causal Analysis & Resolution								
Organizational Training								
Organizational Process Definition								

- Yes, Potential Model
- Yes or Performed
- Partially Performed
- No or Not Performed
- Not Applicable or Not Appraised

Project Planning

	Observations	Assessment
SP1.1-1 Estimate the Scope of the Project ***Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.***		
	No govt WBS (A)	
	Govt WBS = MP-OWI-01 which establishes PSE&I responsibilities & procedures (A, DA)	
	Introductory PSE&I briefing identifies tasks (A, DA)	
	Element Leads Roles & Responsibilities brief attempts to define MP71 scope changes post-accident (A, DA)	
SP1.1-1 Finding	**Although there is no gov't WBS, an equivalent (MP-OWI-01) is used as a basis to estimate scope of the PSE&I work effort.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.4-1 Determine Estimates of Effort and Cost ***Estimate the project effort and cost for the work products and tasks based on estimation rationale.***		
	Annual POP process, based on historical/actuals, we research material costs & labor rates (A, DA)	
	POP Guidance provided, documented process (A, DA)	
	PSE&I POP detailed inputs (DA)	
SP1.4-1 Finding	**PSE&I updates resource and funding requirements annually, including rationale, following the documented POP process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Establish the Budget and Schedule ***Establish and maintain the project's budget and schedule.***		
	PSE&I has its own budget, does an annual bottom-up review, prepares & submits a POP (A, DA)	
	POP Guidance provided, documented process (A, DA)	
	Schedule of activities driven by RTF support & element schedules (A)	
	NSTS 60503 + change 9 (Jan 04) Integrated RTF Schedule (DA)	
	Elements work to their schedules, no integrated PSE&I schedule but buillding one now (A)	
	SSP Schedules (2/10/04) project status brief shows MSFC propulsion projects schedules & critical paths (DA)	
SP2.1-1 Finding	**PSE&I budget is established and maintained according to a documented process. Although there is no PSE&I schedule, MP71 follows element project schedules.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Plan for Data Management *Plan for the management of project data.*		
	MP-OWI-01 requires PSE&I to establish data mgmt integration (DA)	
	MWI 7120.5 "Data Mgmt Plans, Programs/Projects" provides instruction for how data mgmt will be implemented, requires a data mgmt plan be written (DA)	
	Unaware of any MP71 data mgmt plan or archive for internal products (A, DA)	
	SEA products posted on website *https://shuttleonline2.msfc.nasa.gov/sea* (A, DA)	
	Element leads post data on website; change pkg folders kept by CMO (JSC); evals, notes, rationale, ECPs kept at USA offsite by USA DM group (A)	
SP2.3-1 Finding	**There is center guidance requiring formal data management, but could find no evidence of a data management plan for MP71 work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.4a-1 Plan for Project Resources and Needed Knowledge and Skills *Plan for the necessary resources and needed knowledge and skills needed to perform the project.*		
	Collaborative Work Commitments (CWCs) identify skills/resources/LOE from sources outside MP71, establishes support levels from ED &TD (A)	
	CWC for MSFC/ED support, MOU with JSC (DA)	
	Documented process for MSFC agreements in MPG 1050.1 (DA)	
	We have identified the need for a tool to help identify the right expertise, we have difficulty identifying the right tech support (A)	
	PSE&I has its own budget, does an annual bottom-up review, identifies required resources, prepares & submits a POP (A, DA)	
	Gap analysis performed to identify shortfall (A)	
SP2.4a-1 Finding	**MP71 follows a documented process to plan for resources and needed knowledge and skills to perform the integration function.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.6-1 Plan Stakeholder Involvement *Plan the involvement of identified stakeholders.*		
	Signed SSP Interface Agreements/MOU commits JSC-MSFC (A, DA)	
	Internal Task Agreements (ITAs) for intracenter/intercenter support (A, DA)	
	CWCs used for MSFC resource commitments, signed (A, DA)	
	NSTS 37345 & 37366 (SEA Initiative implementation & pgm plans) define stakeholder membership (A, DA)	
SP2.6-1 Finding	**Formal, signed interface and internal agreements ensure continual stakeholder involvement.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.7-1 Establish the Project Plan *Establish and maintain the overall project plan content.*		
	MP-OWI-01 establishes PSE&I responsibilities & procedures, serves as the MP71 plan (A, DA)	
	NSTS 37345 & 37366 (SEA Initiative implementation & pgm plans) (A, DA)	
	MPG 7120.1 provides guidance & process for project planning (DA)	
	No project plan for MP71, we're "brushfired", need one (A)	
	Could find no current MP71 plan detailing the new organization (A)	
	Element Leads Roles & Responsibilities brief (draft) proposes the scope of the new organization (DA)	
SP2.7-1 Finding	**There are plans for specific tasks, but could find no overall plan that details the work activities and products of the new, integrated MP71 technical effort.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Review Plans that Affect the Project *Review all plans that affect the project to understand program commitments.*		
	Document control OWI requires Project Mgmt Plan to be reviewed annually (A)	
	POP reviewed & revised annually (A, DA)	
	Could find no current MP71 plan detailing the new organization (A)	
SP3.1-1 Finding	**Except for the budget review, could find no overall MP71 plan for basis of review and no record of any plan review.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Reconcile Work and Resource Levels *Reconcile the project plan to reflect available and estimated resources.*		
	Additional work can result from changes (LCNs, RCNs, CRs), must request more $$ during the FY (A)	
	Track contractor expenditures vs. plan (A); budget reported monthly (DA)	
	A lot of rework ongoing, spread thin, don't fully understand what we're supposed to be doing (A)	
	Need more people to cover project responsibilities (A)	
SP3.2-1 Finding	**Except for the contractor resources, could find no evidence of a documented process guiding reconciliation of internal MP71 and government resources.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Obtain Plan Commitment *Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.*		
	Signed SSP Interface Agreements/MOU commits JSC-MSFC (A, DA)	
	Internal Task Agreements (ITAs) for intracenter/intercenter support (A, DA)	
	CWCs used for MSFC resource commitments (A, DA)	
	Signed PMC charter commits membership (A, DA)	
SP3.3-1 Finding	**Signed Interface Agreements, Task Agreements, Collaborative Work Commitments, and MOU formally commit stakeholders.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**6**
PI	**4**
NI	**0**
NA	**0**
Total Practices:	**10**

Findings Summary

Although there is no gov't WBS, an equivalent (MP-OWI-01) is used as a basis to estimate scope of the PSE&I work effort.

PSE&I updates resource and funding requirements annually, including rationale, following the documented POP process.

PSE&I budget is established and maintained according to a documented process. Although there is no PSE&I schedule, MP71 follows element project schedules.

There is center guidance requiring formal data management, but could find no evidence of a data management plan for MP71 work products.

MP71 follows a documented process to plan for resources and needed knowledge and skills to perform the integration function.

Formal, signed interface and internal agreements ensure continual stakeholder involvement.

There are plans for specific tasks, but could find no overall plan that details the work activities and products of the new, integrated MP71 technical effort.

Except for the budget review, could find no overall MP71 plan for basis of review and no record of any plan review.

Except for the contractor resources, could find no evidence of a documented process guiding reconciliation of internal MP71 and government resources.

Signed Interface Agreements, Task Agreements, Collaborative Work Commitments, and MOU formally commit stakeholders.

Project Management

	Observations	Assessment
	SP1.1-1 Monitor Project Status ***Monitor project issues, risks, status, execution, funding, and expenditures against project plans.***	
	Wkly status tag ups, monthly status - compare expenditures vs. plan (A, DA)	
	SSP status telecon 3X wkly, wkly SRB RTF mtg, wkly MP71 staff mtg (A)	
	Monitor project status via TIMs (A)	
	Get wkly status from Tech Panels, do documented process (A)	
	Costs for SFOC & labs (MSFC/ED & TD) tracked (A); costs report (DA)	
	Regular, periodic SEA review of team activities (A, DA)	
SP1.1-1 Finding	**Although technical status is monitored routinely, could find little evidence of a formal or documented process guiding review from an integrated project perspective.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Monitor Commitments ***Monitor commitments against those identified in the project plan.***	
	CWCs establish lab support (MSFC/ED & TD), labs provide technical support to MP71 for WGs & panels (A)	
	Meeting notifications, agendas available on SSPWeb (DA)	
	NSTS 37345 & 37366 (SEA Initiative implementation & pgm plans) establish steering & working groups, includes stakeholders (A, DA)	
	Get wkly status from Tech Panels (co-chairs are from MSFC labs), get feedback from MP71 element leads (A)	
	Could find no documented process guiding how commitments are monitored (DA)	
SP1.2-1 Finding	**Could find no evidence of a formal process to monitor commitments or records showing that commitments are monitored.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-1 Monitor Data Management *Monitor the management of project data against the project plan.*		
	Unaware of any MP71 data mgmt plan or archive for internal products, no central repository that MP71 can access/communicate (A, DA)	
	SEA products posted & maintained (A); *https://shuttleonline2.msfc.nasa.gov/sea* website (DA)	
	MWI 7120.5 "Data Mgmt Plans, Programs/Projects" requires data be controlled according to a data mgmt plan (DA)	
SP1.4-1 Finding	**There is center guidance requiring formal data control, but could find no evidence of a data management plan or control of MP71 work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Monitor Stakeholder Involvement *Monitor stakeholder involvement against the project plan.*		
	Stakeholders review/assess changes, products, issues; wkly PRCB & status meetings (A); PRCB minutes (IA)	
	Found no evidence of a process for monitoring stakeholder involvement (DA)	
	Get wkly status from Tech Panels (co-chairs are from MSFC labs), get feedback from MP71 element leads (A)	
SP1.5-1 Finding	**Although there appears to be regular contact with internal and external stakeholders, could find no guideline or documented process to monitor stakeholder involvement.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.6a-1 Conduct Periodic and Milestone Reviews *Periodically review the project's progress, performance, and issues and review the accomplishments and results of the project at selected project milestones.*		
	Elements conduct milestone reviews, we support (A)	
	Found no evidence of an MP71 system-level integration progress review (such as a Project Mgmt Review) (DA)	
	SSP status telecon 3X wkly, wkly SRB RTF mtg, wkly MP71 staff mtg (A)	
	Get wkly status from Tech Panels (co-chairs are from MSFC labs), get feedback from MP71 element leads (A)	
SP1.6a-1 Finding	**MP71 conducts informal status meetings, but found little evidence of a documented process defining a coherent review of MP71 integration activities.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Analyze Issues *Collect and analyze the issues and determine the corrective actions necessary to address the issues.*		
	Issue Sheets used for SEA issues, identifies & analyzes risks/mitigations (A, DA)	
	Action list used for SEA Team activities, defines issues (A, DA)	
	NSTS 37366 provides guidance on issue analysis & resolution (A, DA)	b
	No centralized action collection/tracking (A)	
	Changes analyzed, staffed, coordinated, closed at ICB, PRCB (A); NSTS 07700 directive establishing PRCB (DA)	
SP2.1-1 Finding	**Issues (e.g., changes) are identified, analyzed, reported, and recommendations are presented to review groups following strict, documented processes.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Manage Corrective Action *Take corrective action on identified issues and manage to closure.*		
	Action list used for SEA Team activities, documents closure (A, DA)	
	PMC actions collected, tracked on a log (A, DA)	
	MPG 1280.4 *Corrective Action System* provides procedures for managing corrective actions (DA)	b
	Changes analyzed, staffed, coordinated, closed at ICB, PRCB (A); NSTS 07700 directive establishing PRCB (DA)	
	Newly formed Change Request Group (CRG) chaired by MP71, not chartered, established by email, will review changes before submitted to ICB/PRCB (A)	
SP2.2-1 Finding	**Formal changes and corrective actions follow a documented process. There is a concern that action items may not surface or be examined from an integration perspective.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding	Found no evidence of an MP71 system-level integration approach to its activities (e.g., for progress monitoring and action item tracking).	

	Final
FI	**2**
PI	**5**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

Although technical status is monitored routinely, could find little evidence of a formal or documented process guiding review from an integrated project perspective.

Could find no evidence of a formal process to monitor commitments or records showing that commitments are monitored.

There is center guidance requiring formal data control, but could find no evidence of a data management plan or control of MP71 work products.

Although there appears to be regular contact with internal and external stakeholders, could find no guideline or documented process to monitor stakeholder involvement.

MP71 conducts informal status meetings, but found little evidence of a documented process defining a coherent review of MP71 integration activities.

Issues (e.g., changes) are identified, analyzed, reported, and recommendations are presented to review groups following strict, documented processes.

Formal changes and corrective actions follow a documented process. There is a concern that action items may not surface or be examined from an integration perspective.

Risk Management

	Observations	Assessment
	SP1.1-1 Determine Risk Sources and Categories ***Determine risk sources and categories.***	
	Continuous Risk Management Process is contained in NSTS 37366 (A, DA)	
	NSTS 22254 describes methodology required for preparation of SSP hazard analyses, hazard reports, safety analysis reports, & Management Safety Assessments (DA)	
	Personnel utilize NSTS 07700 and other documents to help manage risk (A)	
	NSTS 37400 Vol 1 contains Risk Mgmt process flow (DA)	
	Tech panel charters require risk identification (DA)	
	NSTS 07700 Vol. 1 (paras. 5.4.2, 5.4.3, 5.4.4) defines technical/safety, cost, schedule risk categories (DA)	
	Traffic light risk status list is used for identifying risk categories (A)	
	Used CAIB report for risk identification (A)	
	Issue Sheets used for SEA issues, identifies & analyzes risks/mitigations (A, DA)	
	Action list used for SEA Team activities, defines issues (A, DA)	
SP1.1-1 Finding	**MP71 follows risk categories and sources defined and documented in NSTS 07700 Vol I and other documents.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Define Risk Parameters ***Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.***	
	See 07700 Vol XI Sys Int & Assurance Plan; also 5300.4 categorizes risk (DA)	
	Risk parameters are done in conjunction with the Tech Panels, engineers are required to do a risk matrix before going to board (A)	
	Use Stop Light Matrix (Chart) for each risk item (A)	
	Shuttle Environmental Assurance identifies risks using risk matrix (A, DA)	
	MWI 7120.6 defines threshholds, implements NPR 8000.4 (DA)	
	SEA issue sheets evidence risk parameters used for assessments (A, DA)	
	07700 Vol II (bk2) defines threshholds (DA)	
	NPR 8000.4 Risk Mgmt Procedures & Guidelines specifies parameters (DA)	
SP1.2-1 Finding	**There is guidance for risk parameter determination and evidence that it is being used.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3-1 Establish a Risk Management Strategy *Establish and maintain the strategy to be used for risk management.*		
	A risk management strategy is defined and maintained in NSTS 07700 (Vol 1, section 5) and 5300.4 (A, DA)	
	Process flow for Risk is in NSTS 37400 Vol 1 (A, DA)	
	No risk mgmt strategy, no SSP risk mgmt plan, nobody owned the foam problem, each element has own risk process but inconsistent across elements (A)	
	SEA continuous Risk Management Process is contained in NSTS 37366 (A, DA)	
SP1.3-1 Finding	**Risk management strategy is defined and maintained in NSTS 07700 Vol 1 and NSTS 37400 Vol 1. There is a concern that element risk processes are not integrated.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Identify Risks *Identify and document the risks.*		
	NASA Program & Project Management Processes and Requirements (NPG: 7120.5B) establishes risk identification (DA)	
	Risks are currently being identified and focused on, using fault trees (A); mainly responsive to issues, not proactive risk identification (A)	
	Looks at risks related to issues (A). Risks related to issues in SEA annual report and NSTS 07700, Vol1 (DA)	
	Process flow for Risk is in NSTS 37400 Vol 1 (A, DA)	
	SEA continuous Risk Management Process is contained in NSTS 37366 (A, DA)	
	Required to do a risk matrix before going to board (A). Shuttle Environmental Assurance identifies risks using risk matrix (A, DA)	
	Issue Sheets used for SEA issues, identifies & analyzes risks/mitigations (A, DA)	
	Found no evidence that programmatic & integration (SE&I technical) risks are identified (DA)	
	ET Shell Status 3/25/04 brief to PRCB, identifies cost/sched/tech risks (DA)	
SP2.1-1 Finding	**Although technical risks are identified, could find no evidence that programmatic risks (e.g., budget, schedule, resources) are being identified and documented.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Evaluate, Categorize, and Prioritize Risks *Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.*		
	Risks are evaluated, categorized, and prioritized according to NSTS 37366 (A); NSTS 37366 Appx B, SEA issues sheets (DA) (***Potential Best Practice)***	
	SEA issues (risks) are prioritized and contained in SEA annual report and NSTS 07700, Vol1 (A, DA)	
	No active process to identify new risks or to priortize risks (A)	
	5 x 5 matrix, risk ranking & reporting called out in Appendix D of NSTS 37400 Vol I (A, DA)	
	Found no evidence that programmatic & integration (SE&I technical) risks are identified, found no priority listing of risks (DA)	
SP2.2-1 Finding	**SEA risks are addressed *(Potential Best Practice)*. However, could find no evidence that programmatic and integration risks are identified and prioritized.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Develop Risk Mitigation Plans *Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy.*		
	Continuous Risk Management Process is contained in NSTS 37366 (A, DA)	
	Required to do a risk matrix and risk mitigation plan before going to board (A)	
	Process flow for Risk Mitigation Plans in NSTS 37400 Vol 1 (A, DA)	
	Mitigation planning is spotty, up to individual (A)	
	Risk is done in conjunction with the Tech Panels (A)	
	Issue Sheets used for SEA issues, identifies & analyzes risks/mitigations (A, DA)	
	Found no evidence that programmatic & integration (SE&I technical) risks are addressed (DA)	
SP3.1-1 Finding	**SEA risks are mitigated and controlled. However, could find no evidence that programmatic or integrated risks (i.e., cost, schedule, resources) are mitigated.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Implement Risk Mitigation Plans *Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate, until closed.*		
	Continuous Risk Management Process is contained in NSTS 37366 (A, DA)	
	Risks are not truly monitored other than at PRCB (A)	
	SEA issues (risks) and concerns are addressed in matrix and by SEA steering group and mitigation is directed by SSP management (A); SEA Annual Report (DA)	
	No evidence found that risk mitigation is monitored (DA)	
SP3.2-1 Finding	**Found no evidence that risk mitigation is consistently monitored or done in accordance with a documented process.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Report Risk Status *Report the status of identified risks at project reviews.*		
	Risks are tracked as part of ICB, and PRCB (A)	
	SEA issues (risks) and concerns are addressed in matrix to SEA steering group and to SSP management (A); SEA Annual Report (DA)	
	NSTS 07700 Vol 2 Directive 143D authorize PRCB as the risk review body (DA)	
	Risks are not truly monitored other than at PRCB (A)	
SP3.3-1 Finding	**Technical risk status is reported to boards. There is a concern that there does not appear to be a comprehensive risk reporting process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**4**
NI	**0**
NA	**0**
Total Practices:	**8**

Findings Summary

MP71 follows risk categories and sources defined and documented in NSTS 07700 Vol I and other documents.

There is guidance for risk parameter determination and evidence that it is being used.

Risk management strategy is defined and maintained in NSTS 07700 Vol 1 and NSTS 37400 Vol 1. There is a concern that element risk processes are not integrated.

Although technical risks are identified, could find no evidence that programmatic risks (e.g., budget, schedule, resources) are being identified and documented.

SEA risks are addressed (Potential Best Practice). However, could find no evidence that programmatic and integration risks are identified and prioritized.

SEA risks are mitigated and controlled. However, could find no evidence that programmatic or integrated risks (i.e., cost, schedule, resources) are mitigated.

Found no evidence that risk mitigation is consistently monitored or done in accordance with a documented process.

Technical risk status is reported to boards. There is a concern that there does not appear to be a comprehensive risk reporting process.

Contractor Management

	Observations	Assessment
	SP2.1-1 Monitor Selected Processes ***Monitor and analyze selected processes used by the Contractor for effectiveness and compliance with agreements.***	
	SFOC Surveillance Plan (Rev H, 9/02) defines process to monitor & report contractor performance (A, DA)	
	EVMS not used (A)	
	USA evaluated against contract & SOW, formal award fee process (A)	
	Monthly inputs to SFOC, "done good/do better" letters submitted (A); email transmitting evaluation letter (IA)	
SP2.1-1 Finding	**There is a formal process and a plan that are used for monitoring contractor processes.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP2.2-1 Evaluate Selected Work Products ***Evaluate selected work products to detect issues as early as possible.***	
	Monthly inputs to SFOC, "done good/do better" letters submitted (A); email transmitting evaluation letter (IA)	
	Metrics kept (e.g., "customer satisfaction"), USA prepares/gov't approves, award fee input, irregular checks - a lot of what we do is not specific products (A)	
	Don't get delivery of products, a lot of what we do is not specific products (A)	
	Product = annual SEA Report, plan developed w/Kr on report content, gov't reviews/concurs before signing (A, DA)	
	Gov't reviews & approves Flight Eval Summary Report (A, DA)	
SP2.2-1 Finding	**MP71 reviews selected work products, following documented processes, to detect issues early.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Review Non-Developmental Items *Review candidate non-developmental items to ensure that they satisfy specified requirements.*		
	No NDI (A)	
	Looking at changing how review of COTS is done, CR out now to clarify what can be used (e.g., for instrumentation), evaluate design changes IAW NSTS 07700 (either Vol IV or X) (A); NSTS 07700 Vol X (bk1) contains guidance for O-T-S usage (DA)	
SP2.3-1 Finding	**Formal guidance exists for non-developmental item use, but could find no evidence of MP71 review of such items.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.4-1 Conduct Reviews and Interchanges *Conduct periodic and event-driven reviews and interchanges with the Contractor.*		
	Monthly reviews, periodic (e.g., wkly) telecons, USA turns in self-eval, annual award fee (A)	
	SFOC Surveillance Plan (Rev H, 9/02) defines a process for the Technical Mgmt Representative (TMR) to monitor & report contractor performance (e.g., monthly, qrtrly) (DA)	
	No formal program mgmt review of contractor (A)	
	Annual JSC audit of contractor (A)	
SP2.4-1 Finding	**The government conducts regular review of the contractor following a documented process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.5-1 Compare Actual Technical Activities, Costs, and Schedule to Plans *Compare the actual technical activities, cost and schedule of the contractor's effort to planned schedules and budgets and identify issues and risks.*		
	Track contractor expenditures vs. plan (A); budget reported monthly (DA)	
	SFOC Surveillance Plan (Rev H, 9/02) defines the process for a TMR to monitor & report contractor performance (DA)	
	Monthly contractor budget report addresses expenditures (DA)	
	EVMS not used (A)	
	"Done good/do better" monthly reports to contractor identify issues (A, DA)	
SP2.5-1 Finding	**MP71 tracks contractor expenditures, comparing technical activities and schedule to plans, and identifies issues and risks.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.6-1 Track Sustainment Products *Review and track hardware and software products (e.g., tools, test sets, simulators, spares) required for life cycle sustainment of the acquired system or products and identify issues.*		
	MP71 has sustainment $$, doled out, there are new contracts to sustain (e.g., HOSC-SESC, DRC, MIDDS), collaborate w/ hardware & S/W owners (A); POP budget & CWC identifies other organizations' efforts (DA)	
	MP71 gives MSFC/ED $2M to operate & maintain (HOSC activities) (A)	
SP2.6-1 Finding	**Funds are programmed for other organizations to sustain resources, but could find little evidence that MP71 tracks sustainment products or identifies issues.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.7-1 Ensure User Evaluation of System Performance *Ensure the user participates in the evaluation of system performance to determine the satisfaction of operational requirements.*		
	User involved through TIMs & as members on boards, able to review products & issues (A); NSTS 07700 directive for PRCB (DA)	
	Users use/train in HOSC/SESC, input reqts for operations facilities, request data from DRC (A); site visit (DA)	
	Wkly status from Tech Panels (co-chairs are from MSFC labs), get feedback from MP71 element leads (A)	
	SEA Steering Group & WG members are users (A); NSTS 37366 (DA)	
	Product = annual SEA Report, plan developed w/Kr on report content, gov't reviews/concurs before signing (A, DA)	
SP2.7-1 Finding	**Users formally participate in technical panels, working groups, and operations.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.8-1 Take Appropriate Action *Track issues, risks and Contractor performance and take action as appropriate.*		
	Monthly inputs to SFOC via business office, "done good/do better" letters submitted (A); email transmitting evaluation letter (IA)	
	Could find no evidence of a gov't list of contractor actions & status (DA)	
SP2.8-1 Finding	**Although contractor issues and risks are reported monthly, could find no evidence of a consistent, documented process to track issues, risks, and contractor performance.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.9-1 Accept Delivery of Products *Accept delivery products in accordance with Contractor agreements.*		
	Don't get delivery of products, a lot of what we do is not specific products (A)	
	Product = annual SEA Report, plan developed w/Kr on report content, gov't reviews/concurs before signing (A, DA)	
	SFOC Surveillance Plan (Rev H, 9/02) defines product acceptance criteria as those contained in PDPs (DA)	
SP2.9-1 Finding	**Could find no evidence that a formal, consistent process is used to accept contractor work products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**5**
PI	**4**
NI	**0**
NA	**0**
Total Practices:	**9**

Findings Summary

There is a formal process and a plan that are used for monitoring contractor processes.

MP71 reviews selected work products, following documented processes, to detect issues early.

Formal guidance exists for non-developmental item use, but could find no evidence of MP71 review of such items.

The government conducts regular review of the contractor following a documented process.

MP71 tracks contractor expenditures, comparing technical activities and schedule to plans, and identifies issues and risks.

Funds are programmed for other organizations to sustain resources, but could find little evidence that MP71 tracks sustainment products or identifies issues.

Users formally participate in technical panels, working groups, and operations.

Although contractor issues and risks are reported monthly, could find no evidence of a consistent, documented process to track issues, risks, and contractor performance.

Could find no evidence that a formal, consistent process is used to accept contractor work products.

Integrated Teaming

	Observations	Assessment
	SP1.1-1 Identify Team Tasks ***Identify and define the team's specific internal tasks to generate the team's expected output.***	
	PSE&I supports the photo/imagery working group (A)	
	PSE&I participates in PSIG, some tech panels (A); NSTS 07700 charters tech panels (DA)	
	PSE&I support to tech panels comes from Engineering Directorate, PSE&I lead SE gets feedback from members (A)	
	Informal groups (temporary) form to address specific problems (e.g., SRB corrosion), unchartered, roles/responsibilities not written down (A)	
	SEA conducted IAW NSTS 37345 & 37366 (A); NSTS 37366 implements SEA WG, identifies team tasks (DA)	
SP1.1-1 Finding	**Formal teams are chartered and tasks defined. There is a concern that some of the informal groups may function ad hoc and not be fully integrated into MP71 operations.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Identify Needed Knowledge and Skills ***Identify the knowledge, skills, and functional expertise needed to perform team tasks.***	
	PSE&I supports photo/imagery working group, unsure how I got picked (A)	
	NSTS 37366 implements SEA Initiative, identifies team tasks, describes general technical qualifications (DA)	
	PSE&I has SE leads to interface with the elements, requires technical expertise & background in propulsion systems (A)	
SP1.2-1 Finding	**Although qualified MP71 staff do participate on integrated teams, could find no evidence of a documented process for identifying specific skills needs.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Assign Appropriate Team Members *Assign the appropriate personnel to be team members based on required knowledge and skills.*		
	Use who's available, we draw upon Engr'g Directorate for support, MSFC/ED supports tech panels (A)	
	PSE&I supports PSIG, interface is PSE&I lead systems engineer (A)	
	PSE&I supports photo/imagery working group, unsure how I got picked (A)	
	PSE&I has SE leads to interface with the elements (ET, SRB, SSME, MPS), requires technical expertise & background in propulsion systems (A)	
SP1.3-1 Finding	**Team assignments are made based on MP71 responsibility. Could find no documented technical qualifications or guidance for team assignments.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Establish a Team Charter *Establish and maintain a team charter based on the integrated team's shared vision and overall team objectives.*		
	Center-level Program Mgmt Council (PMC), chartered, MP71 a member (A)	
	MPD 1150.1 PMC Charter (7/11/02) but not current (DA)	
	SEA conducted IAW NSTS 37345 & 37366 (A); NSTS 37366 implements SEA WG (DA)	
	NSTS 07700 Vol II (bk2) Directive 24E charters the PSIG (DA)	
	MPD 1150.1 MC-16 charters the PMB (2/27/03) (DA)	
	MPD 1150.1 AD-01 guides establishment of boards, councils, committees (DA)	
	MP71 chairs the newly formed Change Review Group (CRG), not chartered (A)	
SP2.2-1 Finding	**Team charters are established and clearly documented following center policy.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Define Roles and Responsibilities *Clearly define and maintain each team member's roles and responsibilities.*		
	Informal groups (temporary) form to address specific problems (e.g., SRB corrosion) then dissolve, unchartered, roles/responsibilities not written down (A)	
	NSTS 37366 identifies SEA Steering Group & working group, defines roles & responsibilities (A, DA)	
	MPD 1150.1 PMC Charter (7/11/2002) defines membership responsibilities (DA)	
SP2.3-1 Finding	**Permanent teams have charters clearly defining membership, roles, and responsibilities. There is a concern that unchartered teams activities may not be fully integrated.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.4-1 Establish Operating Procedures *Establish and maintain integrated team operating procedures.*		
	NSTS 37366 identifies SEA Steering Group & working group, defines procedures (A, DA)	
	MPG 7120.1 & 7120.4 provide generic operating procedures for teams (DA)	
	MPD 1150.1 AD-01 policy provides general operating procedures for teams, boards, councils, committees (DA)	
	Informal groups (temporary) form to address specific problems (e.g., SRB corrosion) then dissolve; unchartered, roles/responsibilities not written down (A)	
SP2.4-1 Finding	**Chartered integrated teams have clearly defined operating procedures, but there is a concern that unchartered teams may not adhere to the same discipline.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.5-1 Collaborate Among Interfacing Teams *Establish and maintain collaboration among interfacing teams.*		
	PSE&I chief engineer gets feedback from MSFC/ED members/co-chairs on tech panels (A)	
	PSE&I participates in PSIG, element leads interface with MSFC/ED tech panel members (A)	
	Found no documentation that integrates teams or guides teams interfacing, nor evidence of such a process in the interviews (DA)	
SP2.5-1 Finding	**Informal collaboration occurs among interfacing teams, but could find no documented, formal process guiding this interaction.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

Formal teams are chartered and tasks defined. There is a concern that some of the informal groups may function ad hoc and not be fully integrated into MP71 operations.

Although qualified MP71 staff do participate on integrated teams, could find no evidence of a documented process for identifying specific skills needs.

Team assignments are made based on MP71 responsibility. Could find no documented technical qualifications or guidance for team assignments.

Team charters are established and clearly documented following center policy.

Permanent teams have charters clearly defining membership, roles, and responsibilities. There is a concern that unchartered teams activities may not be fully integrated.

Chartered integrated teams have clearly defined operating procedures, but there is a concern that unchartered teams may not adhere to the same discipline.

Informal collaboration occurs among interfacing teams, but could find no documented, formal process guiding this interaction.

Requirements Development

	Observations	Assessment
	SP1.1a-2 Elicit and Collect Needs ***Elicit, identify, and collect stakeholder needs, expectations, constraints, and interfaces for all phases of the product life cycle.***	
	Photography needs were directed in the CAIB report. Camera working group worked the needs and expectations with stakeholders (A, DA)	
	EMI/EME requirements in 07700 (A, DA)	
	07700 is fundamental document for requirements processes, which includes collecting stakeholder needs (A, DA)	
	Tech panels develop requirements with organization that requirements impact in an iterative process (A)	
	Battleship test article, flowliner, software plotting pkg resulted from reqts being elicited (A)	
SP1.1a-2 Finding	**There is a process to collect and evaluate requirements changes. There is a concern that requirements are not consistently being proactively identified and elicited.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Develop the Customer Requirements ***Transform stakeholder needs, expectations, constraints and interfaces into customer requirements.***	
	Camera working group transformed needs into customer and project requirements (A)	
	Tech panels chartered by NSTS 07700 Vol. II (bk2) directives; membership of participating organizations + roles & responsibilities defined (A, DA)	
	07700 is fundamental document for requirements processes, which includes developing customer requirements (A, DA)	
	SL-E-0002 captures EMC/I reqts, 07700 documents baseline reqts (A, DA)	
	ET reviews lower level requirements for traceability to higher level requirements and shown in end item spec. (#CPTO1M09A, End Item (CEI) spec) (A, DA)	
SP1.2-1 Finding	**The tech panels and boards provide the program a documented process to transform needs into requirements, taking into account constraints and interfaces.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Establish Project Requirements *Establish and maintain project requirements, which are based on the customer requirements.*		
	Camera working group transformed needs into customer and project requirements (A)	
	Project requirements are established and maintained in NSTS 07700 (A, DA)	
	New and changed requirements are defined in tables in NSTS 07700 Vol X (bk1) (A, DA)	
	PSEIO working day-to-day issues which flow into customer needs - transformation of requirements is done by SEIO and flowed down (A)	
	ET reviews lower level requirements for traceability to higher level requirements and kept in end item spec. (#CPTO1M09A, End Item (CEI) spec) (A, DA)	
SP2.1-1 Finding	**Project requirements are established and are maintained in NSTS 07700, Vol 10, Book and end item specs.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Allocate Project Requirements *Allocate the requirements for each project component.*		
g	Requirements are allocated in Tech Panels, then reviewed by ICB and PRCB. Process is mentioned in NSTS 07700, but not in depth (A, DA)	
	PSEIO working day to day issues which flow into customer needs - transformation of requirements is done by SEIO and flowed down (A)	
	Level 2 reqts kept at JSC, Level 3 reqts = project, Level 4 = SFOC, Level 5 = vendor (A)	
	MSFC HNBK 3173 Systems Engineering Handbook describes process for reqts development & allocation (DA)	
SP2.2-1 Finding	**Tech Panels allocate requirements among disciplines and elements.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Identify Interface Requirements *Identify interface requirements.*		
	Camera WG working with MS to identify interface requirements. (A)	
	Reqt for element-to-element ICDs is documented in 07700 Vol X. ICD's dealt with by IWGs (I/F WGs) (DA)	
	ET end item spec. (#CPTO1M09A, End Item (CEI) spec) shows requirement traceability including interface requirements (A, DA)	
	ICD-2-1201 Orbiter Vehicle /ET (4/99) Rev P (DA)	
	IWG & PSIG works interface issues, process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700 (A, DA)	
SP2.3-1 Finding	**Interface requirements are identified through IWGs and elements, documented in ICDs, in accordance with NSTS 07700.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.4-1 Develop Verification Requirements *Develop program verification requirements in conjunction with the development of project requirements.*		
	Requirements verification for the integrated stack in Vol 10, 07700 MVP, program and project level people know it (DA)	
	ET end item spec. (#CPTO1M09A, End Item (CEI) spec) captures types of verification & verification requirements (A, DA)	
	Verification Reqts Spec Doc (VRSD) captures verification reqts (A)	
	MSFC HNBK 2221 & 3173 requires verification reqts be established, lay out verification processes (DA)	
SP2.4-1 Finding	**There are documented processes for development of verification requirements and evidence that these processes are followed.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.1-1 Establish Operational Concepts and Scenarios *Establish and maintain operational concepts and associated scenarios.*		
	Camera Working Group developing ops concepts for new cameras (A)	
	Ops concepts developed in tech panels (e.g., avionics, loads, roll mnvr) (A)	
	10REQ-0043 Space Shuttle OMRSD Retrieval & Disassembly establishes reqts for SRB retrieval (DA)	
	Could find no evidence of MP71 involvement in any ops concepts maintenance, or verification (DA)	
	Mission ops concept for launch commit, ice debris, Mission Support Plan with JSC (A, DA)	
SP3.1-1 Finding	**There are ops concepts, but could find no evidence of a documented process that MP71 follows to establish and maintain operating concepts and scenarios.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-1 Establish a Definition of Required Functionality *Establish and maintain a definition of required functionality.*		
	Required functionality is defined in NSTS 07700 (Vol. X, bk1) (A, DA)	
	ET end item spec. (#CPTO1M09A, End Item (CEI) spec) shows requirement traceability including required functionality (A, DA)	
	Tech panels review requirements for functionality and integration into system (A)	
SP3.2-1 Finding	**Required functionality is defined in NSTS 07700 Vol. X (bk1) and captured in end item specifications.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.4a-3 Analyze Requirements to Achieve Balance *Analyze requirements to ensure that they are necessary and sufficient and to balance stakeholder needs and constraints.*		
	As part of review process for SEA, the steering group reviews requirements and identifies any inconsistencies (A)	
	Tech panels develop requirements with impacted organization in an iterative process (A)	
	MP01 holds a weekly program review which provides an opportunity to understand needs and expectations, as well as constraints (A)	
SP3.4a-3 Finding	**Could find no evidence that requirements are analyzed to achieve balance (e.g., for risks, cost , schedule).**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP3.5-2 Validate Requirements with Comprehensive Methods *Validate requirements to ensure the resulting system will perform as intended in the user's environment using multiple techniques as appropriate.*		
	SEIO updating environments, documenting in letters (A)	
	Tech panels review integrated requirements and present to ICB and PRCB (A)	
	ET end item spec. (#CPTO1M09A, End Item (CEI) spec) shows requirement traceability including including all testing and test data to verify against spec (A, DA)	
	HOSC used to train operators supporting flights, validates ops needs (A, IA)	
SP3.5-2 Finding	**Could find little evidence that MP71 validates requirements with any comprehensive techniques.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**7**
PI	**2**
NI	**1**
NA	**0**
Total Practices:	**10**

Findings Summary

There is a process to collect and evaluate requirements changes. There is a concern that requirements are not consistently being proactively identified and elicited.

The tech panels and boards provide the program a documented process to transform needs into requirements, taking into account constraints and interfaces.

Project requirements are established and are maintained in NSTS 07700, Vol 10, Book and end item specs.

Tech Panels allocate requirements among disciplines and elements.

Interface requirements are identified through IWGs and elements, documented in ICDs, in accordance with NSTS 07700.

There are documented processes for development of verification requirements and evidence that these processes are followed.

There are ops concepts, but could find no evidence of a documented process that MP71 follows to establish and maintain operating concepts and scenarios.

Required functionality is defined in NSTS 07700 Vol. X (bk1) and captured in end item specifications.

Could find no evidence that requirements are analyzed to achieve balance (e.g., for risks, cost , schedule).

Could find little evidence that MP71 validates requirements with any comprehensive techniques.

Requirements Management

	Observations	Assessment
	SP1.1-1 Obtain an Understanding of Requirements ***Develop an understanding with the requirements providers on the meaning of the requirements.***	
	ELVIS Document - has requirements for camera's on SRB (A)	
	Requirements reviewed by Tech Panels which include reps from elements (A); NSTS 07700 Vol. II (DA)	
	Requirements changes reviewed in ICB, daily or weekly PRCB (A, DA)	
	Camera requirements will go through ICB, PRCB to baseline and then go to CMO for change control and put into NSTS 07700 (A, DA)	
	MP01 holds weekly prog. Mgmt. Council - provides an opportunity for everybody to understand needs, expectations, & constraints (A); PMC charter (DA)	
	Change Review Group (CRG) reviews changes at level 2 before going to ICB & PRCB (A)	
SP1.1-1 Finding	**Changes to requirements are reviewed, following a documented process, for program impacts in technical panels and review groups prior to going to boards.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-2 Obtain Commitment to Requirements ***Obtain commitment to the requirements and requirements changes from the program stakeholders.***	
	Camera requirements will go through ICB, PRCB to baseline and then go to CMO for change control and put into NSTS 07700 (A, DA)	
	Requirements changes reviewed in ICB, daily or weekly PRCB (A, DA)	
	MP01 has monthly meeting with MSFC - his contact for requirements, etc. (A)	
SP1.2-2 Finding	**Commitment to requirement changes is part of the ICB and PRCB process with stakeholders.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3-1 Baseline Requirements *Baseline and maintain requirements and place them under change control.*		
	Camera requirements will go through ICB, PRCB to baseline and then go to CMO for change control and put into NSTS 07700 (A)	
	EMI/EME requirements are maintained in NSTS 07700 (A)	
	All requirements are baselined and maintained in 07700, Vol 10 (A, DA)	
	Changes to requirements are reviewed in Tech Panels and Boards. Once approved, new requirements are put under CM and 07700 is changed (A, DA)	
	The CR form identifies reviewers (DA)	
SP1.3-1 Finding	**Requirements are baselined and placed under CM. Changes to requirements are reviewed, approved, configuration controlled, and documented in NSTS 07700.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.3a-1 Analyze Requirements Changes *Analyze all changes to the requirements for their impact and associated risk on product performance, architecture, supportability, system resource utilization, verification requirements, and schedule and cost.*		
	Criteria for analyzing requirement changes is described in 07700 (A, DA)	
	Changes to requirements are reviewed and analyzed in Tech Panels, co-chaired by MSFC/ED, then reviewed by MSFC CRG, then approved in ICB, & PRCB (A)	
	MP71 recognizes it should analyze changes (ref: *Element Leads Roles & Resp.* brief) (A, DA); but could find no evidence that it's happening (DA)	
SP1.3a-1 Finding	**Tech Panels direct the review and analysis of requirements changes, but found little evidence that MP71 analyzes requirements for risk, supportability, and resource impacts.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-2 Maintain Bidirectional Traceability of Requirements *Maintain bidirectional traceability among the requirements and the project plans and work products.*		
	Camera requirement is driven from top down (CAIB report). It is a general requirement, gets defined in detail in camera WG. It is not necessarily traced back up because of general requirement (A, DA)	
	Traceability of requirements is directed in 07700, Vol 4, Book 1, and maintained in the tech panels, ICB, and PRCB (DA)	
	There are tools to do it, have seen it, but doesn't know the name - excellent traceability (A)	
	ET does bidirectional traceability - end item spec. (#CPTO1M09A, End Item (CEI) spec) shows requirement traceability down and back up to NSTS 07700 (A, DA)	
SP1.4-2 Finding	**End item specifications show requirement traceability down and back up to NSTS 07700.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP1.5-1 Identify Inconsistencies Between Project Work and Requirements *Identify inconsistencies between the project plans and work products and the evolving requirements and take appropriate action.*		
	NSTS 08126 Problem Reporting & Corrective Action (PRACA) defines process for problem resolution (DR)	
	ICB minutes document action items & issue resolution (A, IA)	
	SEA, as part of the review process, looks for inconsistencies (A)	
	Could find no evidence that MP71 identifies sources, conditions, rationale, or corrective actions for work inconsistencies (DA)	
	A lot of rework ongoing, spread thin, don't fully understand what we're supposed to be doing (A)	
	Need more people to cover project responsibilities (A)	
SP1.5-1 Finding	**Found little evidence that MP71 identifies disconnects and associated work inconsistencies (e.g., sources, rationale, corrective actions).**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**1**
NI	**1**
NA	**0**
Total Practices:	**6**

Findings Summary

Changes to requirements are reviewed, following a documented process, for program impacts in technical panels and review groups prior to going to boards.

Commitment to requirement changes is part of the ICB and PRCB process with stakeholders.

Requirements are baselined and placed under CM. Changes to requirements are reviewed, approved, configuration controlled, and documented in NSTS 07700.

Tech Panels direct the review and analysis of requirements changes, but found little evidence that MP71 analyzes requirements for risk, supportability, and resource impacts.

End item specifications show requirement traceability down and back up to NSTS 07700.

Found little evidence that MP71 identifies disconnects and associated work inconsistencies (e.g., sources, rationale, corrective actions).

Technical Solution

	Observations	Assessment
	SP2.3-1 Establish Interface Descriptions ***Establish and maintain the solution for product-component interfaces.***	
	Not involved in interface description, Accumulate inputs at MSFC for JSC, No evidence of a documented process for accumulating inputs (A)	
	A process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700 (A) (DA)	
	We get into it; depth is individual dependent. Process is in place, but no checklist or criteria for defining interfaces (ICDs) (A)	
	MOU limited responsibilities/budget/resources pre-Columbia, Very expanded now, no evidence of documented process identifying MSFC support role, responsibilities, process flow. Would like roles/responsibilities in the MOU (A) (DA)	
	P/L is treated differently from the stack (A)	
	No evidence could be found that "soft" (not connected electrically/mechanically) interfaces other than EMI/EMC are subject to normal interface control (e.g.,ICD-2-12001 Orbiter Vehicle/ET (4/99), Rev P; references SL-E-0002, Books 1,2,3) (A) (DA)	
SP2.3-1 Finding	**This is primarily a JSC function with MSFC providing support. There is no evidence of a documented process identifying MSFC support role, responsibilities, or process flow.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP2.3a-3 Design and Analyze Interfaces Using Criteria ***Design and analyze comprehensive product-component interfaces in terms of established and maintained criteria.***	
	Involved in PDR/CDR on any inter-element action (A)	
	IWG and PSIG works interface issues, A process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700 (A, DA)	
	We get into it; depth is individual dependent. Process is in place, but no checklist or criteria for defining interfaces (ICDs), ill-defined roles (A)	
	PIRN is the basis for ICD discussions (A)	
	ICD-2-12001 Orbiter Vehicle/ET (4/99) contains reqts & I/F design criteria (DA)	
SP2.3a-3 Finding	**This is primarily a JSC function with MSFC providing support. There is no evidence of a documented process identifying MSFC roles, responsibilities, or process flow.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**2**
NI	**0**
NA	**0**
Total Practices:	**2**

Findings Summary

This is primarily a JSC function with MSFC providing support. There is no evidence of a documented process identifying MSFC support role, responsibilities, or process flow.

This is primarily a JSC function with MSFC providing support. There is no evidence of a documented process identifying MSFC roles, responsibilities, or process flow.

Product Integration

	Observations	Assessment
	SP1.1-1 Determine Integration Sequence ***Determine the product-component integration sequence.***	
	No real delivery and integration role (A)	
	The SIP is an agreement on the roles and responsibilities, technical activities, interfaces and schedules for a given interface activity (NSTS 60515) (DA)	
	MP71 supports KSC (when requested). Found no evidence of a documented process identifying MSFC support role, responsibilities, or process flow for integration of elements they are responsible for developing (DA)	
SP1.1-1 Finding	**The SIP provides requirements for the integration process and interface activities. Could find no evidence that MP71 ensures adequacy of the developed sequence.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-2 Establish the Product Integration Environment ***Establish and maintain the environment needed to support the integration of the product components.***	
	No real delivery and integration role for the elements they are responsible for developing (DA)	
	The SIP is an agreement on the roles and responsibilities, technical activities, interfaces and schedules for a given interface activity (NSTS 60515) (DA)	
	MP71 supports KSC (when requested). Found no evidence of a documented process identifying MSFC support role, responsibilities, or process flow for integration of elements they are responsible for developing (DA)	
SP1.2-2 Finding	**KSC is responsible for establishing environment. However, MP71 does not ensure adequacy of the environment for the elements under their development responsibility.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Product Integration Procedures and Criteria *Establish and maintain procedures and criteria for integration of the product components.*		
	No real delivery and integration role for the elements they are responsible for developing (A, DA)	
	The SIP is an agreement on the roles and responsibilities, technical activities, interfaces and schedules for a given interface activity (NSTS 60515) (DA)	
	MP71 supports KSC (when requested). Found no evidence of a documented process identifying MSFC support role, responsibilities, or process flow for integration of elements they are responsible for developing (DA)	
SP1.3-3 Finding	**Although MP71 is not responsible for the integration, it does not ensure adequacy of procedures/criteria for elements under their development responsibility.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Review Interface Descriptions for Completeness *Review interface descriptions for coverage and completeness.*		
	We get into it; depth is individual dependent. Process is in place, but no checklist or criteria for reviewing interfaces (ICDs), ill-defined roles (A)	
	MOU limited responsibilities/budget/resources pre-Columia. Very expanded now. However, there is no evidence of a documented process identifying MSFC support role, responsibilities, or process flow (A, DA)	
	Involved in PDR/CDR on any inter-element action (A)	
	IWG and PSIG works interface issues. Process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700 (A, DA)	
SP2.1-1 Finding	**This is primarily a JSC function with MSFC providing support. There is no evidence of a documented process identifying MSFC support role, responsibilities, or process flow.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Manage Interfaces *Manage internal and external interface definitions, designs, and changes for products and product components.*		
	Interfaces are managed by JSC SEIO/USA (A)	
	Changes to the interface are monitored through the CR review process and interaction with USA reviews (A)	
	NSTS 07700 Vol. IV governs change process (DA)	
	WG and PSIG works interface issues. PIRN is the basis for ICD discussions. A process to establish & maintain interfaces is established, documented, executed via chartered Interface Working Group IAW 07700. (A) (DA)	
	No evidence could be found that "soft" (not connected electrically/mechanically) interfaces other than EMI/EMC are subject to normal interface control (e.g.,ICD-2-12001 Orbiter Vehicle/ET (4/99), Rev P) (DA)	
	We get into it; depth is individual dependent. Process is in place, but no checklist or criteria for defining interfaces (ICDs), ill-defined roles (A)	
SP2.2-1 Finding	**This is a JSC/SEIO responsibility with active MFSC participation. No evidence found that "soft" interfaces (e.g., debris, aerodynamic) are not subject to normal interface control.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.3-1 Evaluate Assembled Product Components *Evaluate assembled product components for interface compatibility.*		
	No real delivery and integration role for the elements they are responsible for developing (DA)	
	MSFC is not involved in integrated testing of elements under their developmental responsibility. No evidence found of a process requiring MFSC involvement in ensuring the performance of their elements in an integrated state (A, DA)	
	NSTS 08117 Appx E identifies MSFC organizations as potential flight certification participants, however no MP71 role is defined (DA); no one talked about such a role in the interviews (A)	
SP3.3-1 Finding	**MSFC is involved in establishing the verification requirements for their element, but MP71 has no role in ensuring the adequacy of MSFC elements when integrated.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**5**
NI	**1**
NA	**0**
Total Practices:	**6**

Findings Summary

The SIP provides requirements for the integration process and interface activities. Could find no evidence that MP71 ensures adequacy of the developed sequence.

KSC is responsible for establishing environment. However, MP71 does not ensure adequacy of the environment for the elements under their development responsibility.

Although MP71 is not responsible for the integration, it does not ensure adequacy of procedures/criteria for elements under their development responsibility.

This is primarily a JSC function with MSFC providing support. There is no evidence of a documented process identifying MSFC support role, responsibilities, or process flow.

This is a JSC/SEIO responsibility with active MFSC participation. No evidence found that "soft" interfaces (e.g., debris, aerodynamic) are not subject to normal interface control.

MSFC is involved in establishing the verification requirements for their element, but MP71 has no role in ensuring the adequacy of MSFC elements when integrated.

Verification

	Observations	Assessment
	SP1.1-1 Select Work Products for Verification ***Select the work products to be verified and the verification methods that will be used for each.***	
	CDR is reviewed to see that appropriate products are identified. Test verification matrix used to ensure products identified at CDR (A)	
	The MVP provides top level guidance on selecting products for verification, including a verification matrix (A, DA)	
	Internal papers are reviewed, but no evidence of process documentation on how to select PSE&I work products for internal reviews (A) (DA)	
	Found no evidence of any criteria to ensure selection of critical products for verification (DA)	
	The SIP is an agreement on the roles and responsibilities, test activities, interfaces and schedules for a given interface activity (NSTS 60515) (DA)	
SP1.1-1 Finding	**MVP and SIP identify products and methods for system verification. Could find no evidence for identification of MP71 products to be verified.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-2 Establish the Verification Environment ***Establish and maintain the environment needed to support verification.***	
	Make sure correct people are involved - people are the weak link (A)	
	MVP, Book 2, Section 4 defines the multiple verification environments needed for the combined system verification (DA)	
	There is a process for test planning and the test plan specifies the environment, but verification planning should be done "up front" (A)	
	Responsibilities defined in NSTS 08117 (Requirements and Procedures for CoFR) and the MVP (DA)	
	Found no evidence of verification for products not undergoing board action (A)	
SP1.2-2 Finding	**Verification environments for system verification and MP71 products undergoing board review are established, but are ad hoc for products not undergoing board action.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-3 Establish Verification Procedures and Criteria *Establish and maintain verification procedures and criteria for the selected work products.*		
	The 07700/MVP provides a documented process for verification (A, DA)	
	SIP provides top level verification procedures/criteria for selected products (DA)	
	There is a verification table in 07700 for requirement verification (A); MVP (DA)	
	MSFC-HDBKI-2221, Verification Handbook", Feb 94, defines verification process from reqts definition to acceptance testing, Detailed requirements & criteria are documented in VRSD, RVM and compliance documented in VRCD (DA)	
SP1.3-3 Finding	**NSTS 07700/MVP and MSFC HDBK-2221 provide documented processes for verification.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Prepare For and Conduct Peer Reviews *Prepare for and conduct peer reviews on selected work products and identify issues resulting from the peer review.*		
	No documented ground rules or processes were found for peer reviews (DA)	
	Peer reviews used to verify PSE&I work products (A)	
SP2.1-1 Finding	**Peer reviews are used for MP71 products, but there is no evidence of a documented process and criteria.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1-1 Perform Verification *Perform verification on the selected work products.*		
	Too much work to cover w/o contractor support; limits internal verification (A)	
	MSFC is POC for elements, but KSC responsible for integrated stack verification (A)	
	Responsibilities defined in NSTS 08117 (Requirements and Procedures for CoFR) (DA)	
	MSFC-HDBKI-2221, Verification Handbook", Feb 94, defines verification process from requirements definition to acceptance testing, Detailed reqts and criteria are documented in VRSD, RVM and compliance documented in VRCD (DA)	
	No evidence found that verification performed on MP71 internal products (e.g., briefings, memos, analyses, reports) (DA)	
SP3.1-1 Finding	**Verification is performed on selected contractor work products but not consistently on internal MP71 products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.1a-2 Prepare for and Conduct Internal Reviews *Prepare for and conduct internal reviews of selected project office work products.*		
	"Top X" SEIO internal review of priority task progress, provides incremental verification of work products (A); meeting schedule (IA); list of issues by priority w/ POC & status (DA)	
	No documented ground rules or processes were found for peer process reviews (DA)	
	Internal papers are reviewed, but no evidence of process documentation on how to select PSE&I work products for internal reviews (A, DA)	
SP3.1a-2 Finding	**Some internal reviews appear are used for verification of MP71 products. However, no evidence found of a consistent or documented process/criteria for internal reviews.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP3.2-2 Analyze Verification Results and Identify Appropriate Action *Analyze the results of all verification activities and identify appropriate action.*		
	Verification visibiity of integrated performance is limited to review of reported anomalies (A)	
	Changes to requirements are reviewed and analyzed in Tech Panels, then reviewed and approved in ICB, and PRCB (A)	
	Too much work to cover w/o contractor support; limits internal verification (A)	
SP3.2-2 Finding	**MP71 has a limited role and limited resources for analysis of verification results. Only reported anomalies and/or requirement changes can be analyzed.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**1**
PI	**6**
NI	**0**
NA	**0**
Total Practices:	**7**

Findings Summary

MVP and SIP identify products and methods for system verification. Could find no evidence for identification of MP71 products to be verified.

Verification environments for system verification and MP71 products undergoing board review are established, but are ad hoc for products not undergoing board action.

NSTS 07700/MVP and MSFC HDBK-2221 provide documented processes for verification.

Peer reviews are used for MP71 products, but there is no evidence of a documented process and criteria.

Verification is performed on selected contractor work products but not consistently on internal MP71 products.

Some internal reviews appear are used for verification of MP71 products. However, no evidence found of a consistent or documented process/criteria for internal reviews.

MP71 has a limited role and limited resources for analysis of verification results. Only reported anomalies and/or requirement changes can be analyzed.

Validation

	Observations	Assessment
SP1.1-1 Select Products for Validation ***Select products to be validated and the validation methods that will be used for each.***		
	Do not monitor on-orbit environment (A)	
	Solid burn time most critical (A)	
	Don't know of any validation plan. It would be a JSC task (A)	
	NSTS 07700 Vol IV requires validation of all general items types (requirements, models, flight data, software) and approach, but provides no specific criteria (DA)	
SP1.1-1 Finding	**Some general guidance exists in NSTS 07700 Vol IV, but could find no evidence of specific selection criteria for products or methods.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	Observations	Assessment
SP1.2-2 Establish the Validation Environment ***Establish and maintain the environment needed to support validation.***		
	Have very good photo analysis shop (A)	
	Using Eglin and AEDC environmental facilities (A)	
	Shuttle is "blue sky" - lightning not included (A)	
	Could find no evidence that the scope of PSE&I validation activities are defined (DA)	
SP1.2-2 Finding	**Although some validation occurs, no evidence was found that the scope of MP71 validation activities are defined.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	Observations	Assessment
SP1.3-3 Establish Validation Procedures and Criteria ***Establish and maintain procedures and criteria for validation.***		
	Criteria currently contained in SEIO letter to Lockheed-Martin. Should be in 07700 (A, DA)	
	Use NASA handbooks in lieu of old MIL-STDs (A); MSFC HDBK 2221/3173 (DA)	
	No evidence of validation procedures/criteria specifically addressing the elements under MFSC responsibility could be found (e.g., no handbook like MSFC HDBK 2221) (DA)	
SP1.3-3 Finding	**Although some validation occurs, no evidence of validation procedures/criteria specifically addressing the elements under MP71 responsibility could be found.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Perform Validation *Perform validation on the selected products.*		
	3% wind tunnel test being used to validate aerodynamic models. MSFC is co-chair of effort (A)	
	ET doing aerothermal and load test based upon predicted environment, Using Eglin and AEDC environmental facilities (A)	
	Have very good photo analysis shop (A)	
	No evidence of a documented process describing how validation is to be consistently performed, although validation is sometimes included in verification process (DA); difference between validation/verification lacks clarity (A)	
	EMI monitored during launch, not monitored on-orbit, can't tell if environment exceeded (A)	
SP2.1-1 Finding	**Validation occurs, but found no evidence of a documented process describing how it is to be consistently performed. Sometimes validation is included in verification.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.2-1 Analyze Validation Results *Analyze the results of the validation activities and identify issues.*		
	3% wind tunnel test being used to validate aerodynamic models. MSFC is co-chair of effort (A)	
	No evidence found of a process other than an ad hoc approach to validation (DA)	
	Post-flight data reduction mostly done by JSC (A)	
	Have very good photo shop for imagery analysis (A)	
SP2.2-1 Finding	**Although results are analyzed, no evidence of a process or documented guideine to ensure consistency in analyzing validation results and identifying issues was found.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**0**
PI	**5**
NI	**0**
NA	**0**
Total Practices:	**5**

Findings Summary

Some general guidance exists in NSTS 07700 Vol IV, but could find no evidence of specific selection criteria for products or methods.

Although some validation occurs, no evidence was found that the scope of MP71 validation activities are defined.

Although some validation occurs, no evidence of validation procedures/criteria specifically addressing the elements under MP71 responsibility could be found.

Validation occurs, but found no evidence of a documented process describing how it is to be consistently performed. Sometimes validation is included in verification.

Although results are analyzed, no evidence of a process or documented guideine to ensure consistency in analyzing validation results and identifying issues was found.

Configuration Management

	Observations	Assessment
SP1.1-1 Identify Configuration Items ***Identify the configuration items, components, and related work products that will be placed under configuration management.***		
	Vol IV of NSTS 07700 establishes the CM system, and items to be reviewed, used to support the SEIO (DA)	
	No evidence could be found for comparable direction for Level 3 (DA)	
	There is no evidence of an independent PSE&I CM for internal PSE&I products (A, DA)	
SP1.1-1 Finding	**Level 2 items under configuration management are identified IAW NSTS 07700 Vol IV. No evidence of a comparable system was found for Level 3 and internal MP71 products.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.2-1 Establish a Configuration Management System ***Establish and maintain a configuration management and change management system for controlling work products.***		
	NSTS 07700 Vol IV establishes CM system used to support SEIO, augmented by MSFC procedures; MSFC Shuttle Propulsion Configuration Management Manual, CM-017-022-2H, Rev I, 7/7/03 (DA) ***Potential Best Practice***	**B**
	System of CCBs and PRCB used to maintain system configuration (A, DA)	
	PRCB Directive used to implement and track changes (A, DA)	
	MSFC has Change Engineering Review Board for Level 3 (A)	
	There is no evidence of an independent PSE&I CM for internal PSE&I products, but version control done using revision numbers and/or dates (A, DA)	
SP1.2-1 Finding	**A configuration/change management system that includes MSFC specific guidance is established and in operation *(Potential Best Practice)* but is not internally applied.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Create or Release Baselines *Create or release baselines for internal use and for delivery to the customer.*		
	07700 Vol IV Table F.1 lists all documents forming the baseline for level 2 which is controlled by the PRCB (DA)	
	NSTS 08102 provides a continually updated list of all documents referenced in the 07700 baseline (DA)	
	MSFC has Change Engineering Review Board for Level 3 (which controls the baseline for level 3) (A)	
	SSPWeb provides electronic access for baselined products (DA)	
SP1.3-1 Finding	**A baseline is electronically available and continually updated as each CR/directive is approved. There is a concern about how Level 3/Level 2 compatibility is ensured.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Track Change Requests *Track change requests for the configuration items.*		
	System of CCBs and PRCB used to maintain system configuration (A, DA)	
	PRCB Directive used to implement and track changes (A, DA)	
	MSFC has Change Engineering Review Board for Level 3 (which controls the baseline for level 3) (A)	
SP2.1-1 Finding	**A change management system is established and in operation.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Control Configuration Items *Control changes to the configuration items.*		
	System of CCBs and PRCB used to maintain system configuration (A, DA)	
	PRCB Directive used to implement and track changes (A, DA)	
	MSFC controls at element (level 3) level. JSC controls at system (level 2) level. Level 4 (USA) control was eliminated but is being restored with its own CCB (A)	
	MSFC has Change Engineering Review Board for Level 3 (A)	
SP2.2-1 Finding	**The CR process and PRCB Directives provide positive change control of configuration items. There is a concern about how Level 3/Level 2 compatibility is ensured.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP3.1-1 Establish Configuration Management Records *Establish and maintain records describing configuration items.*		
	All board processed data (including backups) for approved or disapproved items are retained and available for review (A); CM database at JSC (DA)	
	All information available on STS website for all users, includes backup papers (A, DA)	
	Keep personal copies of items you work on (A)	
	Could not find a comparable (as for level 2) database for level 3 products (DA)	
SP3.1-1 Finding	**A CM records system is established and in operation for Level 2. Note: unable to determine if a comparable database exists for Level 3.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**4**
PI	**2**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

Level 2 items under configuration management are identified IAW NSTS 07700 Vol IV. No evidence of a comparable system was found for Level 3 and internal MP71 products.

A configuration/change management system that includes MSFC specific guidance is established and in operation (Potential Best Practice) but is not internally applied.

A baseline is electronically available and continually updated as each CR/directive is approved. There is a concern about how Level 3/Level 2 compatibility is ensured.

A change management system is established and in operation.

The CR process and PRCB Directives provide positive change control of configuration items. There is a concern about how Level 3/Level 2 compatibility is ensured.

A CM records system is established and in operation for Level 2. Note: unable to determine if a comparable database exists for Level 3.

Decision Analysis and Resolution

	Observations	Assessment
	SP1.1-1 Establish Guidelines for Decision Analysis ***Establish and maintain guidelines to determine which issues are subject to a formal evaluation process.***	
	All changes that go to formal boards (ICB, PRCB) are subject to a formal evaluation process (A)	
	Vol IV (CM) of 07700 is used to guide decisions (DA)	
	NSTS 07700 Vol 2 (bk2) Directive 128B defines process for risk decisions (DA)	
	LCC = guidance (A); NSTS 16007 (DA)	
	Working on a decision checklist (A)	
	NSTS 08126, Problem Reporting and Corrective Action (PRACA) System Requirements contains guidelines to determine which issues are subject to a formal evaluation process (DA)	
SP1.1-1 Finding	**There are documented and maintained formal guidelines requiring board action for decisions.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.2-1 Establish Evaluation Criteria ***Establish and maintain the criteria for evaluating alternatives, and the relative ranking of these criteria.***	
	Evaluation criteria is part of the risk matrix (A)	
	Criteria for RTF not clear (A)	
	No published guidelines, no formal process in the orgn for decision-making (A)	
	Experience & common sense used to make decisions (A)	
	Evaluation criteria for integration is contained in ICB RTF-Integrated-Schedule (DA)	
	SEA issues (risks) are prioritized with some evaluation criteria in SEA annual report, NSTS 37345 SEA Initiative, and NSTS 07700, Vol1 (A, DA)	
SP1.2-1 Finding	**Some decisions use established evaluation criteria, but could find no documented guidance providing consistent criteria to evaluate alternatives.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Identify Alternative Solutions *Identify alternative solutions to address issues.*		
	During one analysis, there were about eight different possible solutions (A)	
	On his projects, they always had many possible solutions (e.g. cool gas in nozzles) (A)	
	Issue Sheets used for SEA issues, identifies & analyzes risks/alternative approaches (A, DA)	
	No evidence of a documented process guiding alternatives identification (DA)	
SP1.3-1 Finding	**Although alternatives are identified, could find no evidence of a documented process guiding identification of alternative solutions.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.4-1 Select Evaluation Methods *Select the evaluation methods.*		
	NSTS 22254, Hazard Analysis Methodology describes evaluation methods (DA)	
	Testing is performed against the derived requirement, but needs to be shown it satisfies the higher level requirement also (A)	
SP1.4-1 Finding	**Little evidence was found that a documented process exists to select evaluation methods.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.5-1 Evaluate Alternatives *Evaluate alternative solutions using the established criteria and methods.*		
	Usually run to ground the different solutions to get the best solution (A)	
	Experience & common sense used to make decisions (A)	
	No published guidelines, no formal process in the orgn for decision-making (A)	
	Issue Sheets used for SEA issues, identifies & analyzes risks & alternative approaches (A, DA)	
SP1.5-1 Finding	**There was some evidence of evaluating alternative solutions based on established criteria, but no consistent process was found.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.6-1 Select Solutions *Select solutions from the alternatives based on the evaluation criteria.*		
	Formal procedures/guidance for PRCB decisions (A); NSTS 07700 prescribes decisions are to be made based on applied criteria (DA)	
	MSFC Corrective Action System Doc. (MPG 1280.4) describes process for selecting solutions based on specific criteria in the document (DA)	
	Experience & common sense used to make decisions (A)	
	Look at multiple solutions & try to get best fit (A)	
SP1.6-1 Finding	**Decisions happen, but no evidence was found that a consistent process is applied.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**1**
PI	**5**
NI	**0**
NA	**0**
Total Practices:	**6**

Findings Summary

There are documented and maintained formal guidelines requiring board action for decisions.

Some decisions use established evaluation criteria, but could find no documented guidance providing consistent criteria to evaluate alternatives.

Although alternatives are identified, could find no evidence of a documented process guiding identification of alternative solutions.

Little evidence was found that a documented process exists to select evaluation methods.

There was some evidence of evaluating alternative solutions based on established criteria, but no consistent process was found.

Decisions happen, but no evidence was found that a consistent process is applied.

Causal Analysis and Resolution

	Observations	Assessment
	SP1.1-1 Select Defect Data for Analysis ***Select the defects and other problems for analysis.***	
	Anomaly resolution "process" in NSTS 22206 FMEA CIL (DA)	
	PRACA (NSTS 08126) describes the problem cause process (DA)	
	Anomalies or problems drive defect analysis (A)	
	MSFC Corrective Action System Doc. (MPG 1280.4) describes process for selecting defects and problems for analysis (DA)	
	SEA team selects data for analysis (A); SEA issue sheets (DA)	
	Could find no guidance for defect selection (DA)	
SP1.1-1 Finding	**Although problems are identified and analyzed, could find no evidence of a process for selecting defects and problems.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

	SP1.2-1 Analyze Causes ***Perform causal analysis of selected defects and other problems and propose actions to address them.***	
	NSTS 22206 provides detailed instructions in preparing FMEAs (DA)	
	Use fault tree analysis, also described in PRACA (NSTS 08126) (A, DA); NSTS 22254, Appx A defines fault tree analysis methodology (DA)	
	MSFC Corrective Action System Doc. (MPG 1280.4) addresses process for performing root cause analysis (DA)	
	SEA team oversees engineering performing causal analysis of defects (A); NSTS 37366 guidance, SEA issues sheets w/ alternative actions (DA)	
SP1.2-1 Finding	**There are documented processes for causal analysis and they appear to be followed. There is a concern that the process may not be followed by all element leads.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.1-1 Implement the Action Proposals *Implement the selected action proposals that were developed in causal analysis.*		
	NSTS 08126 Problem Reporting & Corrective Action (PRACA) defines process for problem resolution and implementing action proposals (A, DA)	
	MSFC Corrective Action System Doc. (MPG 1280.4) describes process for analysis and implementing actions (DA)	
	SEA team oversees implemetation of correction action for defects (A); SEA issues sheets w/ alternative actions (DA)	
	SEA action items (IA); NSTS 37366 guidance, SEA PSI team mtg & action matrix (DA)	
SP2.1-1 Finding	**Selected SEA action proposals are being implemented IAW guidance. There is a concern that other element leads may not follow a rigorous process.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.2-1 Evaluate the Effect of Changes *Evaluate the effect of changes on performance.*		
	NSTS 07700 Vol IV (bk1) change Request process prescribes evaluation of change for impact, including the predicted impact (DA)	
	Could find no evidence of any evaluation or metrics for process change impact (DA)	
	RTF Instrumentation brief to PRCB (Mar 04) addresses impacts (DA)	
SP2.2-1 Finding	**Some effects of process change resulting from causal analysis are being evaluated. But could find no guidance for metrics or measures to be applied.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.3-1 Record Data *Record causal analysis and resolution data for use across the project and organization.*		
	Control Boards and Panels (PRCB, ICB, Tech Panels, SSEIG) maintain a record of results (DA)	
	No central database for CAR - typically kept by Thiokol (A); don't know where data is recorded (A); Unaware of any lessons learned databases or where to find past analyses (A)	
	MSFC Corrective Action System Doc. (MPG 1280.4) describes process for analysis, implementing actions and recording into the CAS database on the MSFC website (DA)	
SP2.3-1 Finding	**There is no evidence that the causal analysis data is recorded in a readily available and easily usable manner.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**3**
NI	**0**
NA	**0**
Total Practices:	**5**

Findings Summary

Although problems are identified and analyzed, could find no evidence of a process for selecting defects and problems.

There are documented processes for causal analysis and they appear to be followed. There is a concern that the process may not be followed by all element leads.

Selected SEA action proposals are being implemented IAW guidance. There is a concern that other element leads may not follow a rigorous process.

Some effects of process change resulting from causal analysis are being evaluated. But could find no guidance for metrics or measures to be applied.

There is no evidence that the causal analysis data is recorded in a readily available and easily usable manner.

Organizational Training

	Observations	Assessment
SP1.1-1 Establish the Strategic Training Needs ***Establish and maintain the strategic training needs of the organization.***		
	There is no strategic plan. No evidence of strategic planning found. MSFC training guidelines are supervisor/employee based (A, DA)	
	There are no resource estimates for needs. No estimate found for training needs (A) (DA)	
	07700 addresses training needs of only operations personnel (A)	
SP1.1-1 Finding	**There is no NSTS 07700 requirement nor planning for training of non-operations personnel. A position based skill/training needs assessment should be performed.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP1.2-1 Determine Which Training Needs Are the Responsibility of the Organization ***Determine which training needs are the responsibility of the organization and which will be left to the individual project or support group.***		
	MSFC training guidelines are supervisor/employee based (A)	
	Individual Development Plans are maintained for each employee (A)	
	Office identifies minimum requirements based upon generic position description plus specifics identified by employee (A); MPG 3410.1 Training Guidance defines responsibilities (DA)	
	Some PSE&I training needs have been identified but job requirements are uncertain. No strong institutional knowledge (A)	
	Found no evidence of any orgn'l needs analysis to determine what training would be provided by MP71 (DA)	
SP1.2-1 Finding	**Although there are training guidelines, could find no evidence of an organizational training needs analysis that justifies relegating training to the individual/supervisor level.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP1.3-1 Establish an Organizational Training Tactical Plan *Establish and maintain an organizational tactical training plan.*		
	There is no tactical plan. No evidence of tactical planning found. (A, DA)	
	Need to get aggressive in providing training (A)	
	There is no resource estimates for needs. No estimate found for training needs (A, DA)	
	07700 addresses training needs of only operations personnel (A)	
SP1.3-1 Finding	**The only organizational planning is the requirement for supervisors to review each individual's training plan on an annual basis. No tactical training plan exists.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP1.4-1 Establish Training Capability *Establish and maintain training capability to address organizational training needs.*		
	There is a training facility (bldg 4200) (DA)	
	System tries to make classes available but they are difficult to fit into the work schedule. Announcements are made and posted on the web (A, DA)	
SP1.4-1 Finding	**Although some courses are offered on an ad hoc basis, could find no evidence of specific training needs against which capabilities are established.**	
PI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**PI**

SP2.1-1 Deliver Training *Deliver the training following the organizational training tactical plan.*		
	No evidence of a tactical plan was found (DA)	
	System tries to make classes available but they are difficult to fit into the work schedule. Announcements are made and posted on the web (A, DA)	
SP2.1-1 Finding	**Because there is no organizational tactical training plan the selection, scheduling, delivery, and tracking of training is not performed.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

SP2.2-1 Establish Training Records *Establish and maintain records of the organizational training.*		
	Individual Development Plans exist for indivual employees (password protected). Center training office tracks training from date of hire. Shown example on web (A) (DA)	
	IDP form (A, DA)	
	MPG 3410.1 *Training Guidance* establishes reqt for record keeping (DA)	
SP2.2-1 Finding	**ISO 9000 training records (Personal Development Plans) exist and are kept current.**	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

SP2.3-1 Assess Training Effectiveness *Assess the effectiveness of the organization's training program.*		
	No evidence found of process to assess training effectiveness (DA)	
	Get credit for showing up. No utility assessment or type of test except when certification involved (A)	
	Feel constrained by ignorance. Need year of training to feel adequate (A)	
SP2.3-1 Finding	**Could find no requirement for or evidence of any means to feed back or assess the effectiveness of supervisor monitored training.**	
NI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**NI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**1**
PI	**2**
NI	**4**
NA	**0**
Total Practices:	**7**

Findings Summary

There is no NSTS 07700 requirement nor planning for training of non-operations personnel. A position based skill/training needs assessment should be performed.

Although there are training guidelines, could find no evidence of an organizational training needs analysis that justifies relegating training to the individual/supervisor level.

The only organizational planning is the requirement for supervisors to review each individual's training plan on an annual basis. No tactical training plan exists.

Although some courses are offered on an ad hoc basis, could find no evidence of specific training needs against which capabilities are established.

Because there is no organizational tactical training plan the selection, scheduling, delivery, and tracking of training is not performed.

ISO 9000 training records (Personal Development Plans) exist and are kept current.

Could find no requirement for or evidence of any means to feed back or assess the effectiveness of supervisor monitored training.

Organizational Process Definition

	Observations	Assessment
	SP1.1-1 Establish Standard Processes ***Establish and maintain the organization's set of standard processes.***	
	NSTS 07700 lays out responsibilities & charters of all the various aspects of the program (DA)	**B**
	Website *shuttleonline.msfc.nasa.gov* is the PAL (MSFC policies, directives, standard process descriptions, work instructions, QA plans, process aids), management directives master list (DA)	**B**
SP1.1-1 Finding	**There is a well-documented set of organizational standard processes for all NASA centers.** ***Potential Best Practice***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

	SP1.5-1 Establish the Organization's Process Asset Library ***Establish and maintain the organization's process asset library.***	
	Website *shuttleonline.msfc.nasa.gov* is the PAL (MSFC policies, standard process descriptions, work instructions, QA plans, process aids, etc.) (DA)	**B**
	Organizational guidance produced in response to ISO 9000, but most documents have little content for use in accomplishing tasks (A)	
SP1.5-1 Finding	**There is an online process asset library of MSFC policies, standards, processes, work instructions, plans templates, and process aids.** ***Potential Best Practice***	
FI	**<----Practice Finding** ***Mini-Team Recommendation ---->***	**FI**

Generic Goals and Practices		
Generic Finding		

	Final
FI	**2**
PI	**0**
NI	**0**
NA	**0**
Total Practices:	**2**

Findings Summary

There is a well-documented set of organizational standard processes for all NASA centers. Potential Best Practice

There is an online process asset library of MSFC policies, standards, processes, work instructions, plans templates, and process aids. Potential Best Practice

	PP	PM	RiM	KM	IT	RD	ReM	TS	PI	VER	VAL	CM	DAR	CAR	OT	OPD	
BP																2	2
FI	6	2	4	5	4	7	4	0	0	1	0	4	1	2	1	0	41
PI	4	5	4	4	3	2	1	2	5	6	5	2	5	3	2	0	53
NI	0	0	0	0	0	1	1	0	1	0	0	0	0	0	4	0	7
NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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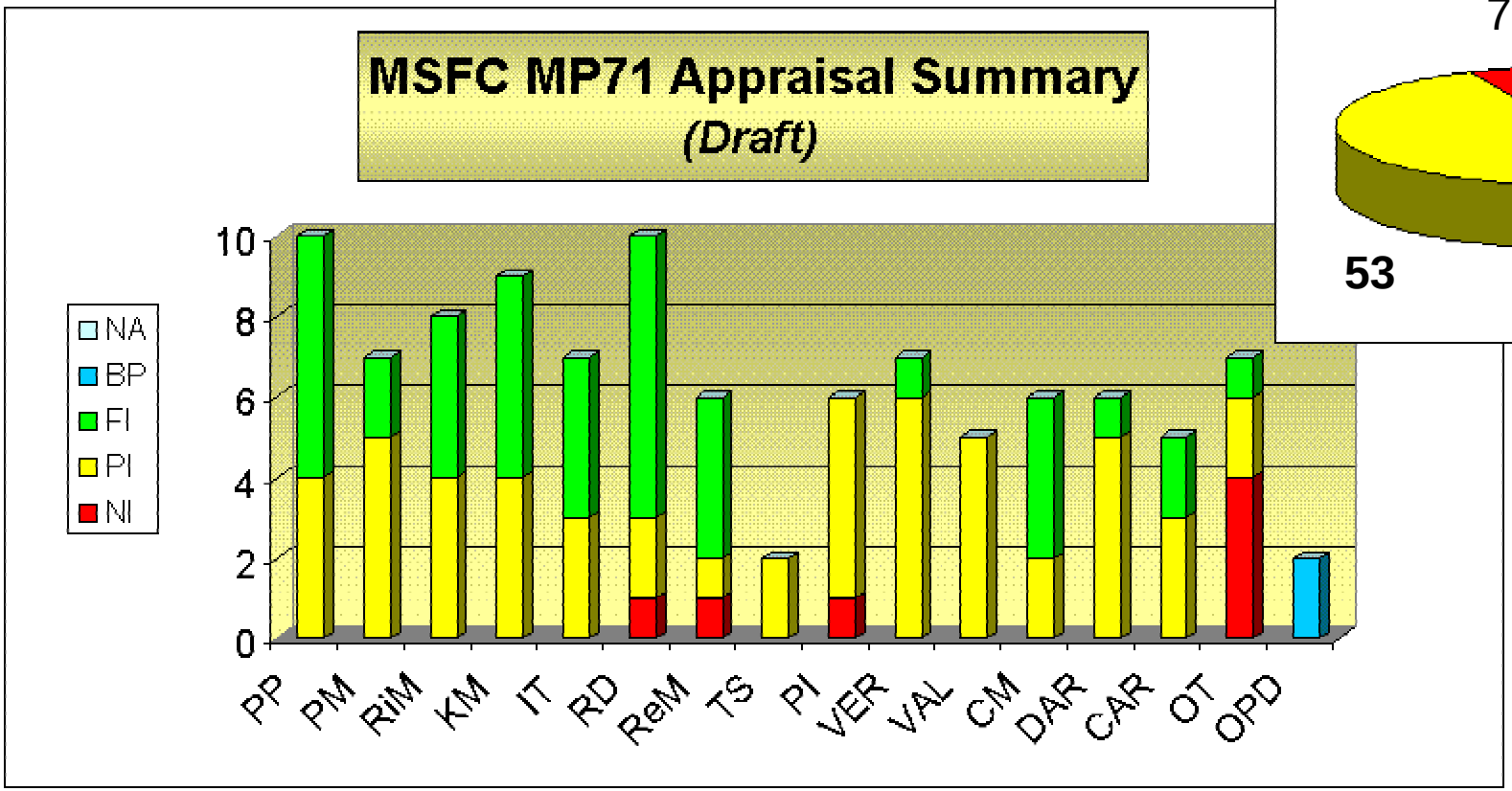

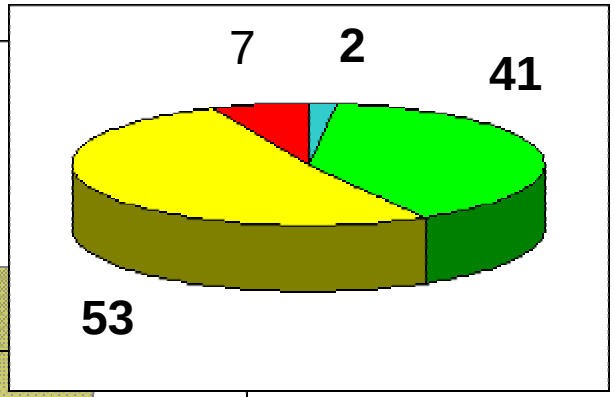

Appendix D1 – SEIO Composite Worksheets

The data contained in the "Appraisal Worksheets" (Appendix C) was integrated into two types of "Composite Worksheets" to facilitate the assessment of the integrated SEIO operation. The first worksheet, shown in this appendix, contains a condensed version of the best practices (bold blue), strengths (green), and weaknesses (red) of each special practice (SP), organized by process area and process goal, for each location (JSC, KSC, and MSFC). The text colors indicate whether the practice is a best practice (blue), fully implemented (green; documented, known and used practice that has no significant weaknesses), partially implemented (yellow; minimally performed (e.g., not sufficiently documented and/or known)), or not implemented (red; no significant aspects are implemented). The format appears below:

	SEIO CMMI-NS Model							
	SP	**Practice**	**JSC**	**Strength/Weakness**	**KSC**	**Strength/Weakness**	**MSFC**	**Strength/Weakness**
Process	***Goal # and Title***							
	SP #	SP Title	**Practice Implementation**	***Best Practice (B)*** ***Strength (G)*** ***Weakness (R)***	**Practice Implementation**	***Best Practice (B)*** ***Strength (G)*** ***Weakness (R)***	**Practice Implementation**	***Best Practice (B)*** ***Strength (G)*** ***Weakness (R)***

	SEIO CMMI-NS Model							
	SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
PROJECT MANAGEMENT / PROJECT PLANNING	***SG1 Establish Estimates***							
	1.1-1	Estimate project scope	y	No govt WBS	y	No govt WBS	g	OWI (MP-OWI-01) equivalent used
	1.4-1	Determine estimates of effort & cost	g	POP process, historical basis	g	POP process, Gnd Imagery Plan	g	POP process, historical basis
	SG2 Develop a Project Plan							
	2.1-1	Establish budget & schedule	g	RTF schedule, POP budget	g	POP budget, RTF schedule, KICS	g	RTF schedule, POP budget
	2.3-1	Plan for data management	y	no data mgmt plan, SFOC plan	y	LMS, OMRSCP data, no SIO plan	y	SEA products, no MP71 plan
	2.4a-1	Plan resources, knowledge & skills	y	no needs analysis	y	Gnd Imagery Plan, no process	g	CWCs. POP cycle
	2.6-1	Plan stakeholder involvement	g	Tech panels, SIPs, ITAs	g	07700 directives, SIPs	g	MOU, CWCs, ITAs, NSTS 37345
	2.7-1	Establish the project plan	y	NSTS 47008, not maintained	y	Gnd Imagery Plan, no overall plan	y	OWI-01, 37345/37366, no MP71 plan
	SG3 Obtain Commitment to the Plan							
	3.1-1	Review plans that affect the project	y	PDPs/Surveillance Plan suspended	y	Task plans, no overall plan	y	POP review, no MP71 plan to review
	3.2-1	Reconcile work & resource levels	y	ITAs, SFOC augmentation	y	Gnd Imagery Plan, no SIO guidance	y	No documented process
	3.3-1	Obtain plan commitment	b	***NSTS 07700 Vol II directives***	g	07700 Vol II directives	g	Signed MOU/ITAs/CWCs

	SEIO CMMI-NS Model							
	SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
PROJECT MANAGEMENT / PROJECT MGMT	***SG1 Monitor Project Against Plans***							
	1.1-1	Monitor project status	g	Top X, tech panels	y	LCC/OMRS WGs, funds tracking?	y	Wkly status, no formal process
	1.2-1	Monitor commitments	g	Tech panels, SSEIG, SIPs, ITAs	g	LCC/OMRS WGs via task plans	y	Wkly status/SEA, no formal process
	1.4-1	Monitor data management	y	No data plan, strong CMO	y	Kr data, no MK-SIO data sharing	y	SEA products, no MP71 data control
	1.5-1	Monitor stakeholder involvement	g	Tech panels, SSEIG, SICB, PRCB	g	LCC/OMRS WGs, PRCB actions	y	PRCB, wkly status, no process
	1.6a-1	Conduct periodic / milestone reviews	y	No integrated progress review	y	DCR, Summit, no integrated review	y	No integrated progress review
	SG2 Manage Corrective Action to Closure							
	2.1-1	Analyze issues	g	Tech panels, IHRs, PRACA	g	LCNs, PRACA, IFAs, UABs, PRCB	g	NSTS 37366, SEA issue sheets
	2.2-1	Manage corrective action	g	Top X, PRCB, CoFR, IHRs	g	Summit, ICB, PRCB, Top X	g	MPG1280.4, CRG, SEA issue sheet
RISK MANAGEMENT	***SG1 Prepare for Risk Management***							
	1.1-1	Determine risk sources / categories	g	NSTS 22254/37400, tech panels	y	NSTS 08117, MK-SIO not proactive	g	07700 Vol I, 37400 Vol 1
	1.2-1	Define risk parameters	y	Programmatic risks not addressed	y	08117/5300.4, no integration risks	g	NPR 8000.4, SEA issue sheets
	1.3-1	Establish risk mgmt strategy	g	07700 Vol I sec. 5 defines	y	07700 Vol I sec5, no SIO strategy	g	07700 Vol I, 37400 Vol 1
	SG2 Identify and Analyze Risks							
	2.1-1	Identify risks	y	IHRs (safety), no other risks	y	IHRs, 07700 Vol I, no program risks	y	SEA issue sheets, no program risks
	2.2-1	Evaluate, categorize, prioritize risks	y	5X5 matrix, not prioritized	y	Not comprehensively addressed	y	***NSTS 37366,*** no pgm risks/priorities
	SG3 Mitigate Risks							
	3.1-1	Develop risk mitigation plans	y	Programmatic risks not addressed	y	SFOC form, no independent risks	y	SEA issue sheets, no program risks
	3.2-1	Implement risk mitigation plans	y	No evidence of non-safety risks	y	Imagery Plan, no evidence of monitor	y	SEA sheets, no evidence of monitor
	3.3-1	Report risk status	g	PRCB, no consolidated process	y	No comprehensive reporting	g	PRCB, no comprehensive reporting

	SEIO CMMI-NS Model							
	SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
PROJECT MANAGEMENT / CONTRACTOR MGMT	***SG2 Coordinate Work with Contractor***							
	2.1-1	Monitor selected processes	y	PDPs, Surveillance Plan suspended	y	PDPs & 08117, audits suspended	g	SFOC Surv Plan, award fee
	2.2-1	Evaluate selected work products	y	PDPs, Top X, tech panels	y	No regular review	g	SEA report, Flight Summary Report
	2.3-1	Review non-developmental items	y	07700 Vol X, but no evidence	y	No documented process	y	07700 Vol X bk1, lack evidence
	2.4-1	Conduct reviews & interchanges	y	Top X, semi-annual inputs	y	Summit, but no consistent process	g	SFOC Surveillance Plan, JSC audit
	2.5-1	Compare cost, sched, tech to plans	y	Qrtrly metrics, no Surveillance Plan	y	Not done consistently	g	SFOC Surveillance Plan, monthly letters
	2.6-1	Track sustainment products	y	Models review, ad hoc process	r	Did not find a process	y	Track products/identifies issues?
	2.7-1	Ensure user eval of system perf	g	Tech panels, Top X, PRCB, CoFR	g	LCC/OMRS WGs, Top X	g	TIMs, HOSC, SEA WG
	2.8-1	Take appropriate action	y	Top X, PRCB, no Surveillance Plan	y	Top X, WGs review, no audits	y	No consistent process
	2.9-1	Accept delivery of products	y	PDPs, but suspended	g	PDPs used & followed	y	SEA report, inconsistent process
INTEGRATED TEAMING	***SG1 Establish Team Composition***							
	1.1-1	Identify team tasks	g	07700, tech panels, SIPs	g	07700, WGs, PMRB	g	SEA WG
	1.2-1	Identify needed knowledge & skills	y	Tech panels, skills not documented	y	WGs, skills not documented	y	37366, no documented process
	1.3-1	Assign appropriate team members	y	No documented process	y	No guidance for assignment	y	No guidance for assignment
	SG2 Govern Team Operation							
	2.2-1	Establish a team charter	b	***NSTS 07700 charters tech panels***	b	***NSTS 07700 charters WGs***	g	PMC, SEA, MPD 1150.1 (AD-01)
	2.3-1	Define roles & responsibilities	g	NSTS 07700 directives	b	***NSTS 07700 directives***	g	37366, MPD 1150.1 PMC
	2.4-1	Establish operating procedures	g	NSTS 07700 directives	g	Work instructions	g	37366, MPG 7120.1 & 7120.4
	2.5-1	Collaborate among interfacing teams	g	SSEIG responsibility	g	WG interfaces, SSEIG	y	PSIG, no documented guidance

	SEIO CMMI-NS Model							
	SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
ENGINEERING / REQUIREMENTS DEVELOPMENT	***SG1 Develop Customer Requirements***							
	1.1a-2	Elicit & collect needs	y	Tech panels, not proactive/consistent	y	Imagery, inconsistent process	g	EMC/I, flowliner
	1.2-1	Develop customer requirements	g	Tech panels, PRCB approves	g	Chartered OMRS/LCC/IP WGs,	g	ET End Item Spec
	SG2 Develop Project Requirements							
	2.1-1	Establish project requirements	g	Captured in NSTS 07700 volumes	g	07700, 08171, 16007, 08244	g	07700 Vol X, ET Spec
	2.2-1	Allocate project requirements	g	Tech panels allocate	g	WGs actions --> PRCB approval	g	MSFC Hdbk 3173
	2.3-1	Identify interface requirements	g	IWGs, ICDs	g	JSC responsible, MK-SIO reviews	g	IWG, PSIG, 07700 Vol X
	2.4-1	Develop verification requirements	g	07700 Vol X MVP	g	SIP, MVP (minus imagery)	g	07700 MVP, MSFC Hdbks 2221 & 3173
	SG3 Analyze & Validate Requirements							
	3.1-1	Establish ops concepts & scenarios	y	Models & databases, not kept current	y	Databases,no documented process	y	LCC mission ops, no documented process
	3.2-1	Establish reqd functionality definition	g	07700 Vol X	g	07700 Vol X, WG review	g	07700 Vol X, ET Spec
	3.4a-3	Analyze reqts to achieve balance	y	no evidence of balanced look	y	WGs review, no process to balance	r	No evidence or MP71 reqts analysis
	3.5-2	Validate w/ comprehensive methods	y	Tech panels, no documented process	y	Imagery data, inconsistent process	y	HOSC, no comprehensive methods
REQTS MGMT	***SG1 Manage Requirements***							
	1.1-1	Obtain reqts understanding	g	Tech panel/PRCB review	g	CR process, PRCB approval	g	Tech panels, CRG, PRCB
	1.2-2	Obtain commitment to reqts	g	SSPWeb CM data, SSEIG, ICB, PRCB	g	SSPWeb CM data, WGs, PRCB	g	ICB/PRCB control
	1.3-1	Baseline requirements	g	07700 Vol X, PRCB	g	07700 Vol X, PRCB, CM control	g	07700 Vol X, PRCB, CM control
	1.3a-1	Analyze requirements changes	y	Tech panels, lack some impacts	y	07700 Vol XIV criteria, inconsistent	y	Tech panels, no evidence MP71 does
	1.4-2	Maintain bidirectional traceability	y	Downward but not upward	y	07700 Vol IV bk1 requires, not done	g	07700 Vol IV requires, ET end item spec
	1.5-1	Identify pgm work inconsistencies	g	PRCB, PRACA processes identify	y	MRB, PRACA process, inconsistent	r	No evidence MP71 does

	SEIO CMMI-NS Model							
	SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
ENGINEERING / T SOLN	***SG2 Develop the Design***							
	2.3-1	Establish interface descriptions	b	***NSTS 07700 & DI, IWG,*** ICDs	NA	JSC function	y	JSC function, unclear MP71 role
	2.3a-3	Design/analyze interfaces w/ criteria	b	***ICD process,*** ICDs	y	No process for roles or flow	y	IWG & PSIG, unclear MP71 role
ENGINEERING / PRODUCT INTEGRATION	***SG1 Prepare for Product Integration***							
	1.1-1	Determine integration sequence	g	SIPs used	g	SIPs guide, concern on MK-SIO role	y	SIPs guide, unclear MP71 responsibility
	1.2-2	Establish integration environment	y	Integrated models, unsure about I&T	NA	KSC/PH responsible	y	SIPs guide, no clear MP71 process/role
	1.3-3	Establish procedures & criteria	y	PDPs not updated	y	Imagery Plan, unsure criteria used	y	SIPs guide, no clear MP71 role
	SG2 Ensure Interface Compatibility							
	2.1-1	Rev I/F descriptions for completeness	b	***NSTS 07700 Vol IV, ICD process***	y	No process to fix discrepancies	y	IWG & PSIG, unclear MP71 process/role
	2.2-1	Manage interfaces	g	NSTS I/F control (ICD, ICD, IRN), IWG	g	JSC performs. KSC supports	y	JSC function, concern w/ "soft" I/Fs
	SG3 Assemble Product Components & Deliver Product							
	3.3-1	Evaluate assembled components	y	MVP guidance, but no SEIO role	y	RVRS, limited resources to perform	r	No delivery, no role in evaluation
ENGINEERING / VERIFICATION	***SG1 Prepare for Verification***							
	1.1-1	Select work products for verification	y	No process for selection/peer review	y	No process for product selection	y	MVP, SIP, no product selection process
	1.2-2	Establish verification environment	y	MVP/PRCB, non-board actions ad hoc	y	Ad hoc for non-board products	y	08117, MVP, internal products ad hoc
	1.3-3	Establish verif procedures/criteria	y	Peer review, but no process	y	MVP & 08117, inconsistent definition	g	MSFC Hdbk 2221, VRSD, MVP
	SG2 Perform Peer Reviews							
	2.1-1	Prepare/conduct peer reviews	y	Done, but no documented process	y	WGs perform, informal process	y	Done, but no documented process
	SG3 Verify Selected Work Products							
	3.1-1	Perform verification	y	MVP, SIP, CoFR, many are unaware	y	Imagery, product selection criteria?	y	Inconsistent process for MP71 products
	3.1a-2	Prepare/conduct internal reviews	y	Top X, no documented processes	y	Imagery, internal products not done	y	Top X, inconsistent internal process
	3.2-2	Analyze verif results/identify action	y	Limited role in analysis of verif results	y	Imagery, staff resources limited	y	Limited role & resources

		SEIO CMMI-NS Model							
		SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
ENGINEERING	VALIDATION	***SG1 Prepare for Validation***							
		1.1-1	Select products for validation		Guidance lacks selection criteria		***Imagery Plan,*** lack selection criteria		Guidance lacks selection criteria
		1.2-2	Establish validation environment		Instrumentation/models out-of-date		No evidence of scope of validation		Scope of MP71 validation not defined
		1.3-3	Establish val procedures/criteria		Procedures not maintained		Imagery, but not for reentry		MP71 responsibility not defined
		SG2 Validate Products							
		2.1-1	Perform validation		Inconsistent Ver/Val definitions		Imagery/video		Undocumented process, Ver/Val definition
		2.2-1	Analyze validation results		No documented process/guideline		Imagery, Centers complement		Inconsistent process
SUPPORT	CONFIG MGMT	***SG1 Establish Baselines***							
		1.1-1	Identify configuration items		NSTS 07700 Vol IV, no internal CM		07700 CM process, no internal CM		07700, no evidence of internal CM
		1.2-1	Establish config mgmt system		***JSC CM system,*** no internal SEIO CM		JSC CM, no internal MK-SIO CM		***CM-017-022-2H guidance,*** not used
		1.3-1	Create or release baselines		07700 Vol IV Tbl F, electronic use		07700 Vol IV, Imagery Plan		07700 Vol IV, level 2/3 compat concern
		SG2 Track and Control Changes							
		2.1-1	Track change requests		CCBs/PRCB tracks		OMRS/LCC WGs monitor, PRCB trks		PRCB, CRB
		2.2-1	Control configuration items		PRDB directives, no internal SEIO CM		No internal MK-SIO CM		CRB/PRCB, level 2/3 compat concern
		SG3 Establish Integrity							
		3.1-1	Establish config mgmt records	b	***CM records system, electronic***		No internal MK-SIO CM		JSC database, level 3 database?

	SEIO CMMI-NS Model							
	SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
SUPPORT / DECISIONS	***SG1 Evaluate Alternatives***							
	1.1-1	Establish dec. analysis guidelines	y	07700 Vol II bk2, no rules or database	g	07700 Vol II bk2, 16007, 08218	g	ICB/PRCB, 07700 Vols II/IV, 16007, 08126
	1.2-1	Establish evaluation criteria	y	Some decision criteria ad hoc	g	16007/37310/08171, 07700 Vol XIV	y	SEA issues, 37345, inconsistent criteria
	1.3-1	Identify alternative solutions	y	No documented guidelines	y	Imagery Plan, undocumented process	y	SEA issue sheets, undocumented process
	1.4-1	Select evaluation methods	y	Lacks documented process	y	Tech panels, undocumented process	y	NSTS 22254, undocumented process
	1.5-1	Evaluate alternatives	y	Not based on established criteria	y	Imagery Plan, undocumented process	y	SEA issue sheets, inconsistent process
	1.6-1	Select solutions	y	Process unstructured, ad hoc	g	Imagery labs, PRCB decides	y	MPG 1280.4 guides, inconsistent process
SUPPORT / CAUSE ANALYSIS	***SG1 Determine Causes of Defects***							
	1.1-1	Select defect data for analysis	y	Safety guidance, all else ad hoc	g	MRB/PMRB, post-flight imagery	y	MPG 1280.4 guides, no process to select
	1.2-1	Analyze causes	y	Processes exist, used inconsistently	g	Imagery labs, MRB	g	22206/22254/37366, MPG 1280.4
	SG2 Address Causes of Defects							
	2.1-1	Implement the action proposals	y	PRACA, all else inconsistent process	g	PMRB/PRCB direct	g	MPG 1280.4, SEA issues sheets, 08126
	2.2-1	Evaluate the effect of changes	y	07700 guidance, no metrics/measures	y	07700 guidance, no metrics/measures	y	07700 guidance, no metrics/measures
	2.3-1	Record data	y	Data no available or readily usable	y	Imagery, data not readily usable	y	MPG 1280.4 requires, unable to locate

		SEIO CMMI-NS Model							
		SP	Practice	JSC	Strength/Weakness	KSC	Strength/Weakness	MSFC	Strength/Weakness
PROCESS MGMT	TRAINING	***SG1 Establish Orgn'l Training Capability***							
		1.1-1	Establish strategic training needs		No strategic plan or goals		No evidence of strategic planning		No strategic plas/training for non-ops
		1.2-1	Determine orgn tng responsibility		No needs analysis or justification	b	***Annual web survey***		MPG 3410.1, no needs analysis
		1.3-1	Establish orgnl tactical training plan		No tactical plan		Training office surveys needs		No tactical plan
		1.4-1	Establish training capability		Courses, mentoring, ad hoc		No MK-SIO training capability		Training facility, w ork conflicts
		SG2 Provide Necessary Training							
		2.1-1	Deliver training		No organized training, no plan		KSC training office, outside courses		No tactical plan, w ork conflicts
		2.2-1	Establish training records		HR tracks ITPs, not w ithin SEIO	b	***Personal Development Plans***		MPG 3410.1, IDPs kept
		2.3-1	Assess training effectiveness		No evidence found		No evidence found		No evidence found
	OPD	***SG1 Establish Organizational Process Assets***							
		1.1-1	Establish standard processes	b	***NSTS 07700,*** NPG 5120.5B	b	***NASA-wide standard processes***	b	***NASA-wide standard processes***
		1.5-1	Establish process asset library		SSPWeb, PDC, no central PAL		SSPWeb, PDC, no central PAL	b	***Process Asset Library***

Appendix D2 – SEIO Composite Worksheets

The data contained in the "Appraisal Worksheets" (Appendix C) was integrated into two types of "Composite Worksheets" to facilitate the assessment of the integrated SEIO operation. The second worksheet, shown in this appendix, was used to assist in developing the integrated SEIO operations-level process summaries (best practices, strengths, weaknesses, concerns) contained in the "SEIO Results and Recommendations Briefing" (Appendix B) backup slides and in the formulation of the overall recommendation contained in that briefing. As in the case of the first worksheet shown in Appendix D1, the data is organized by process area and process goal. However, this data is compiled at the SEIO operations level rather than for each location. The format used appears below:

	SEIO CMMI-NS Model		***Best Practices***	***Deficiency***	***Recommendations for Improvement***	***References (Examples or Models to Follow)***
	SP	**Practice**				
Process Area	***Goal # and Title***					
	SP #	SP Title	**BP Identifica-tion**	Deficiency description	Specific recommendation to correct deficiency	Recommen-dation support documenta-tion

		SEIO CMMI-NS Model		Best Practices	Deficiency	Recommenda-tions for Improvement	References (Examples or Models to Follow)
		SP	Practice				
PROJECT MANAGEMENT	PROJECT PLANNING	***SG1 Establish Estimates***					
		1.1-1	Estimate project scope		Lack a documented basis on which to estimate project scope, resources	Establish a WBS (task descriptions, work products)	MP-OWI-01 Propulsion Systems Integration Project *PSE&I Element Leads Overview* briefing
		1.4-1	Determine estimates of effort & cost				
		SG2 Develop a Project Plan					
		2.1-1	Establish budget & schedule		· No plan for internal data mgmt (types, media, file plan) · No project plan	· Develop data mgmt plan for internal products · Define roles/responsibilities, eliminate intercenter MOU · Establish/maintain overall SEIO plan (addresses tasks, budget, products, risks, schedule, resources, stakeholder involvement)	*RTF Ground Imagery Plan* presentation NSTS 37366 SEA Initiative Implementation Plan NSTS 07700 Vol II (bk1) retired WBS
		2.3-1	Plan for data management				
		2.4a-1	Plan resources, knowledge & skills				
		2.6-1	Plan stakeholder involvement				
		2.7-1	Establish the project plan				
		SG3 Obtain Commitment to the Plan					
		3.1-1	Review plans that affect the project		Reconcile work/resources are ad hoc when adjustments required	Provide guidance for resource priority/reconciliation	
		3.2-1	Reconcile work & resource levels				
		3.3-1	Obtain plan commitment	***07700 Vol II directives***			
	PROJECT MGMT	***SG1 Monitor Project Against Plans***					
		1.1-1	Monitor project status		· No process for monitoring & contolling internal data · No process for an integrated review of activities	Conduct periodic internal integrated reviews (monitor against the project plan - resources, tasks, products, schedules)	
		1.2-1	Monitor commitments				
		1.4-1	Monitor data management				
		1.5-1	Monitor stakeholder involvement				
		1.6a-1	Conduct periodic / milestone reviews				
		SG2 Manage Corrective Action to Closure					
		2.1-1	Analyze issues			Consider centralized action item management	MPG1280.4 Corrective Action Guideline
		2.2-1	Manage corrective action				

		SMC CMMI-A Model		Best Practices	Deficiency	Recommendations for Improvement	References (Examples or Models to Follow)
		SP	Practice				
PROJECT MANAGEMENT	RISK MANAGEMENT	***SG1 Prepare for Risk Management***					
		1.1-1	Determine risk sources / categories		Programmatic & integration risks not addressed	· Develop an overall Risk Management process to be used across all three SEIO organizations · Include programmatic & integration risks as risk sources	NPR 8000.4 Risk Mgmt Procedures & Guidelines
		1.2-1	Define risk parameters				
		1.3-1	Establish risk mgmt strategy				
		SG2 Identify and Analyze Risks					
		2.1-1	Identify risks		· Programmatic risks not identified · Risks not being prioritized	Develop an overall Risk Management process to be used across all three SEIO organizations	NSTS 37366 SEA Initiative Implementation Plan
		2.2-1	Evaluate, categorize, prioritize risks	***NSTS 37366***			
		SG3 Mitigate Risks					
		3.1-1	Develop risk mitigation plans		No evidence that risks are monitored	Develop an overall Risk Management process to be used across all three SEIO organizations	NSTS 37366 SEA Initiative Implementation Plan
		3.2-1	Implement risk mitigation plans				
		3.3-1	Report risk status				
	CONTRACTOR MGMT	***SG2 Coordinate Work with Contractor***					
		2.1-1	Monitor selected processes		· Suspended contractor process monitoring · Suspended contractor progress monitoring · No process for review of non-developmental items	· Re-establish contractor surveillance per published plans · Apply criteria & metrics identified in PDPs · Consider Program Management Reviews of contractor performance (cost, schedule, technical) · Establish consistent guidelines for review of NDI	SFOC Surveillance Plan (Oct 02) SMC PMR template (tailored)
		2.2-1	Evaluate selected work products				
		2.3-1	Review non-developmental items				
		2.4-1	Conduct reviews & interchanges				
		2.5-1	Compare cost, sched, tech to plans				
		2.6-1	Track sustainment products				
		2.7-1	Ensure user eval of system perf				
		2.8-1	Take appropriate action				
		2.9-1	Accept delivery of products				
	INTEGRATED TEAMING	***SG1 Establish Team Composition***					
		1.1-1	Identify team tasks		No process to determine skills needs (e.g., gap analysis)	Establish skills guidelines for team & WG assignments	
		1.2-1	Identify needed knowledge & skills				
		1.3-1	Assign appropriate team members				
		SG2 Govern Team Operation					
		2.2-1	Establish a team charter	***07700 charters***			
		2.3-1	Define roles & responsibilities	***07700 directives***			
		2.4-1	Establish operating procedures				
		2.5-1	Collaborate among interfacing teams				

		SMC CMMI-A Model		Best Practices	Deficiency	Recommenda-tions for Improvement	References (Examples or Models to Follow)
		SP	Practice				
ENGINEERING	REQUIREMENTS DEVELOPMENT	***SG1 Develop Customer Requirements***					
		1.1a-2	Elicit & collect needs		Requirements not proactively elicited & identified	Develop a common process to work proactively w/ Tech Panels, WGs, & teams to develop, analyze, & validate inter-element requirements	
		1.2-1	Develop customer requirements				
		SG2 Develop Project Requirements					
		2.1-1	Establish project requirements				MSFC Hdbk 2221 Verification Handbook MSFC Hdbk 3173 Project Mgmt & Systems Eng'g Handbook
		2.2-1	Allocate project requirements				
		2.3-1	Identify interface requirements				
		2.4-1	Develop verification requirements				
		SG3 Analyze & Validate Requirements					
		3.1-1	Establish ops concepts & scenarios		· No process or guidelines to maintain & execute ops concepts · Reqt's are not analyzed to achieve balance (supportability, risks, resource impacts)	Develop a process for analyzing, maintaining, and executing operational concepts & scenarios	
		3.2-1	Establish reqd functionality definition				
		3.4a-3	Analyze reqts to achieve balance				
		3.5-2	Validate w/ comprehensive methods				
	REQTS MGMT	***SG1 Manage Requirements***					
		1.1-1	Obtain reqts understanding		· Requirements traceability uni-directional, not bi-directional · Little effort to identify inconsistencies between work products & requirements	Utilize a traceability matrix for any new or changed requirement	
		1.2-2	Obtain commitment to reqts				
		1.3-1	Baseline requirements				
		1.3a-1	Analyze requirements changes				
		1.4-2	Maintain bidirectional traceability				
		1.5-1	Identify pgm work inconsistencies				
	T SOLN	***SG2 Develop the Design***					
		2.3-1	Establish interface descriptions	***07700, desk instruction, IWG***	· Element integrator roles/responsibilities to establish & maintain I/F not well known or defined · No overall disciplined I/F control process applied at integrated system level that includes all potential element interactions	(1) Define I/F mgmt process flow (reqts definition thru verif) with SEIO offices & element integrators roles & responsibilities (2) Place all potential interactions among elements under positive bilateral control of interacting element orgns	(1) MSFC HDBK 2221 (2) Current ICDs expanded to include "soft" interfaces.(e.g., EME approach)
		2.3a-3	Design/analyze interfaces w/ criteria	***ICD process***			

		SMC CMMI-A Model		Best Practices	Deficiency	Recommenda-tions for Improvement	References (Examples or Models to Follow)
		SP	Practice				
ENGINEERING	PRODUCT INTEGRATION	***SG1 Prepare for Product Integration***					
		1.1-1	Determine integration sequence		Element integrators not ensuring correctness of integration sequence, not identifying verif criteria & procedures for PI environment, not establishing element integration & eval criteria	Define I/F mgmt process flow (reqts definition thru verif) with SEIO offices & element integrators roles & responsibilities	
		1.2-2	Establish integration environment				
		1.3-3	Establish procedures & criteria				
		SG2 Ensure Interface Compatibility					
		2.1-1	Rev I/F descriptions for completeness	***07700 Vol IV, ICD process***	Element integrators not involved in reviewing I/F data for completeness, not ensuring I/Fs are marked to ensure easy/correct connection, & not explicitly involved in assessment & resolution of I/F anomalies	Define I/F mgmt process flow (reqts definition thru verif) with SEIO offices & element integrators roles & responsibilities	
		2.2-1	Manage interfaces				
		SG3 Assemble Product Components & Deliver Product					
		3.3-1	Evaluate assembled components		· Element integrators are not assessing product integration process · Element integrators not involved in checking assembled product components for correct interoperation	Element integrators need to assess integrated performance of the stacked elements	

		SMC CMMI-A Model		Best Practices	Deficiency	Recommenda-tions for Improvement	References (Examples or Models to Follow)
		SP	Practice				
ENGINEERING	VERIFICATION	***SG1 Prepare for Verification***					
		1.1-1	Select w ork products for verification		No process to ensure products are selected for verification based on risk	Use risk assessment results to guide the verification process	NSTS 07700 Vol X MVP MSFC Hdbk 2221 Verification Handbook
		1.2-2	Establish verification environment				
		1.3-3	Establish verif procedures/criteria				
		SG2 Perform Peer Reviews					
		2.1-1	Prepare/conduct peer review s		Internal products have no verification process prior to board system action	Define an internal review process to be follow ed to ensure quality of internal products	NSTS 07700 Vol X MVP MSFC Hdbk 2221 Verification Handbook
		SG3 Verify Selected Work Products					
		3.1-1	Perform verification		No integrated SEIO (JSC/KSC/MSFC) process flow that clearly depicts respective responsibilities & interactions	Document a process flow & define SEIO offices & element integrator verification roles & responsibilities from launch through landing	NSTS 07700 Vol X MVP MSFC Hdbk 2221 Verification Handbook
		3.1a-2	Prepare/conduct internal review s				
		3.2-2	Analyze verif results/identify action				
	VALIDATION	***SG1 Prepare for Validation***					
		1.1-1	Select products for validation	***Imagery Plan***	· No defined SEIO role/responsibility in validating SSP elements · No overall plan for element validation in the operational environment (e.g., MVP stops at liftoff)	Document a process flow & define SEIO offices & element integrator validation roles & responsibilities from launch through landing	MSFC Hdbk 2221 Verification Handbook
		1.2-2	Establish validation environment				
		1.3-3	Establish val procedures/criteria				
		SG2 Validate Products					
		2.1-1	Perform validation		· No overall process to ensure that all aspects of SSP stack are validated in operation (I.e., including on-orbit, reentry) · No defined SEIO role/responsibility in validating SSP elements	Document a process flow & define SEIO offices & element integrator validation roles & responsibilities from launch through landing	
		2.2-1	Analyze validation results				

		SMC CMMI-A Model		Best Practices	Deficiency	Recommenda-tions for Improvement	References (Examples or Models to Follow)
		SP	Practice				
SUPPORT	CONFIG MGMT	***SG1 Establish Baselines***					
		1.1-1	Identify configuration items		No CM system for internal SEIO offices products	Establish a means to identify & track internal SEIO products to maintain version control & facilitate access/communication	MSFC CM Manual CM-017-022-2H
		1.2-1	Establish config mgmt system	***JSC/MA CM, MSFC CM-017-022-2H***			
		1.3-1	Create or release baselines				
		SG2 Track and Control Changes					
		2.1-1	Track change requests				
		2.2-1	Control configuration items				
		SG3 Establish Integrity					
		3.1-1	Establish config mgmt records	***CM records system, electronic***			
	DECISIONS	***SG1 Evaluate Alternatives***					
		1.1-1	Establish dec. analysis guidelines		No formal process or guidelines for making decisions (applying evaluation criteria, selecting evaluation methods, identifying alternative solutions)	Set clear guidelines for decisions requiring a formal process Consider use of Analysis of Alternatives approach as a method	
		1.2-1	Establish evaluation criteria				
		1.3-1	Identify alternative solutions				
		1.4-1	Select evaluation methods				
		1.5-1	Evaluate alternatives				
		1.6-1	Select solutions				
	CAUSE ANALYSIS	***SG1 Determine Causes of Defects***					
		1.1-1	Select defect data for analysis		No consistent, documented process or guidelines for selecting defects for analysis	· Establish a centralized data archiving system to support the causal analysis process · Establish a process to determine which defects to analyze, impacts, frequency of occurrence, similarity between defects, cost of analysis, time & resources, safety considerations	NSTS 22254 outlines methods MPG 1280.1 describes a process
		1.2-1	Analyze causes				
		SG2 Address Causes of Defects					
		2.1-1	Implement the action proposals		No process to identify causes of defects & other problems or take action to prevent future occurrence	Establish a centralized data archiving system to support the causal analysis process	
		2.2-1	Evaluate the effect of changes				
		2.3-1	Record data				

		SMC CMMI-A Model		Best Practices	Deficiency	Recommenda-tions for Improvement	References (Examples or Models to Follow)
		SP	Practice				
PROCESS MGMT	TRAINING	***SG1 Establish Orgn'l Training Capability***					
		1.1-1	Establish strategic training needs		There is no significant management priority for training (strategic planning, consistent tactical planning, work-based needs assessment, need-to-training traceability)	• Establish training needs based on assessment of integrated SEIO roles/responsibilities • Develop and execute a training philosophy & plan to deliver the training	KSC web-based tactical planning
		1.2-1	Determine orgn tng responsibility	***KSC annual web survey***			
		1.3-1	Establish orgnl tactical training plan				
		1.4-1	Establish training capability				
		SG2 Provide Necessary Training					
		2.1-1	Deliver training				
		2.2-1	Establish training records	***KSC PDPs***			
		2.3-1	Assess training effectiveness				
	OPD	***SG1 Establish Organizational Process Assets***					
		1.1-1	Establish standard processes	***NASA-wide std processes***			
		1.5-1	Establish process asset library	***MSFC PAL***			

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