NASA Procedures and Guidelines

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Effective Date: November 21, 2002
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NASA Program and Project Management Processes and Requirements

Responsible Office: AE/Office of Chief Engineer

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Preface

P.1 Purpose

This document establishes the management system for processes, requirements, and responsibilities for implementing NASA Policy Directive (NPD) 7120.4, Program/Project Management. This management system governs the formulation, approval, implementation, and evaluation of all Agency programs and projects established to Provide Aerospace Products and Capabilities (PAPAC). It is intended to support safe accomplishment of the NASA programs and projects, consistent with established Agency strategic planning, on schedule, and within budget, while satisfying the success criteria and requirements of multiple stakeholders and customers.

P.2 Applicability and Scope

P.2.1 This NASA Procedures and Guidelines (NPG) is applicable to NASA Headquarters and NASA Centers, including Component Facilities, and to the Jet Propulsion Laboratory to the extent specified in its contract.

P.2.2 This document provides the basic processes and requirements for the life cycle of all programs and projects. It shall be used specifically for programs/projects that provide aerospace products or capabilities, i.e., provide flight and ground systems, technologies, and operations for space and aeronautics. It is not required but may be used for other programs and projects.

P.2.3 While all requirements are to be addressed, program and project managers may tailor the approach to meeting the requirements to the specific needs of the program or project, consistent with program or project scope, complexity, visibility, cost, safety, and acceptable risk. Tailoring is a mechanism to encourage innovation in the development of products. All programs and projects shall comply with all applicable laws, regulations, Executive Orders, and Agency directives.

P.2.4 NPG 1000.2, the NASA Strategic Management Handbook; NPD 7120.4, Program/Project Management; and this NPG 7120.5 rank first, second, and third, respectively, in order of precedence for managing all NASA programs and projects, except if in conflict with statutory or regulatory requirements. Each Center is responsible for developing and implementing Center-level policies, processes, procedures, and requirements necessary to ensure successful program/project execution according to NPD 7120.4 and this document. This document contains references to laws, regulations, and other NPD's and NPG's, which provide more detailed information pertaining to these requirements and processes. Other references are provided for information.

P.3 Authority

P.3.1 42 U.S.C. 2473(c) (1), Section 203(c) (1) of the National Aeronautics and Space Act of 1958, as amended.

P.4 References

a. NPD 1000.1, NASA Strategic Plan.
b. NPG 1000.2, Strategic Management Handbook.
c. NPG 1000.3, The NASA Organization.
d. NPD 7120.4, Program/Project Management.
e. Additional references are inserted at the beginning of some chapters, and others are accessible in Appendix A.

P.5 Cancellation

NPG 7120.5A, NASA Program and Project Management Processes and Requirements, dated April 3, 1998.

/s/ Theron Bradley
NASA Chief Engineer

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CHAPTER 1. Overview

This chapter provides an introduction to the document, highlights the Agency's framework for managing programs and projects, specifies major themes which are reflected throughout the document, describes the PAPAC process, and describes the structure of the document.

1.1 Introduction

1.1.1 NASA defines programs as major activities within an Enterprise that have defined goals, objectives, requirements, and funding levels, and consist of one or more projects. Projects are significant activities designated by a program and characterized as having defined goals, objectives, requirements, Life-Cycle Costs (LCC), a beginning, and an end.

1.1.2 Successful management of programs and projects has always been a key requirement for NASA to meet its mission.

1.1.3 To accomplish this, NASA--

a. Emphasizes that safety of the public, its flight crews, its employees, and its critical assets are of paramount importance.

b. Relies upon individual and organizational commitment to responsibility and accountability for doing the job right the first time.

c. Fosters efficiency in process, and the application of innovative methods and tools to reduce product development cycle time and costs while ensuring that the resources to do the job are available.

d. Invests in an educated and empowered workforce to assure the application of sound program and project management and engineering practice.

e. Invests in sound technology programs aimed at future needs, and encourages the infusion of those technologies.

1.1.4 This document defines the requirements for formulating, approving, implementing, and evaluating programs and projects. It is intended to be flexible and adaptable to the many types of programs and projects that NASA manages. Program and project managers are challenged to use their expertise and apply innovative techniques to improve safety and quality, reduce cycle time, and reduce the cost of the delivered product or capability.

1.1.5 This document reflects lessons learned from the experiences of program and project managers. Successful NASA managers define technical and management requirements early in the program or

project life, explicitly address strategies for risk mitigation, continuously assess the viability of meeting commitments, and involve customers extensively.

1.1.6 The disciplined approach of program and project management is applied to technology development programs and projects.

1.1.7 In this document, a requirement is identified by "shall," a good practice by "should," permission by "may" or "can," expectation by "will," and descriptive material by "is."

1.2 Framework

1.2.1 The Agency has developed the NASA Strategic Plan, which establishes a framework of five Strategic Enterprises through which we implement the mission and communicate with external customers and stakeholders. These Strategic Enterprises are as follows:

a. Aerospace Technology.
b. Biological and Physical Research.
c. Earth Science.
d. Human Exploration and Development of Space.
e. Space Science.

1.2.2 The means for each Enterprise to develop and deliver products and services to internal and external customers are established in the NASA Strategic Management Handbook in the form of the following four critical crosscutting processes. These processes are as follows:

a. Provide Aerospace Products and Capabilities (PAPAC).
b. Manage Strategically.
c. Generate Knowledge.
d. Communicate Knowledge.

1.2.3 The PAPAC process delivers space, ground, and aeronautical systems; technologies; services; and operational capabilities to NASA customers so they can conduct research, explore and develop space, and improve life on Earth. The PAPAC process includes both technology development to meet unique programmatic requirements, and crosscutting technology development programs that support multiple applications. The Manage Strategically process provides policy, objectives, priorities, and resources to allow the Agency to develop, conduct, and evaluate programs and projects. The Generate Knowledge crosscutting process provides a framework for ensuring that NASA's basic and applied research is consistent with the Agency's strategic plans and that the quality of the research is maintained to the highest standards. The Communicate Knowledge process serves to disseminate this knowledge to increase the understanding of science and technology, advance its broad application, and inspire achievement and innovation.

1.2.4 The Strategic Management Handbook defines the responsibilities of management officials for the processes. Responsibilities for oversight, insight, and execution of programs/projects are specifically assigned to officials at various levels of Agency management. As part of the strategic management process, NASA Program Managers are appointed or approved by the Enterprise Associate Administrators (EAA). The Program Manager is responsible for implementing the Program. Project Managers are responsible for implementing NASA's Projects within specific Programs. Project managers are appointed by the Center Director in consultation with the applicable Program Manager. See Appendix D for further definition of responsibilities.

1.2.5 The key management documents used to plan and control programs and projects are the Formulation Authorization Document (FAD), Program Commitment Agreement (PCA), Program Plan, and Project Plan. The FAD is authorized by the EAA as the formal initiation of formulation. The PCA is the agreement between the Administrator and the EAA that documents the Agency's commitment to implement the program requirements within established constraints. Additional commitments are documented in Program and Project Plans. The development and approval of these documents assure that all supporting organizations understand the programmatic, technical, and management requirements and commit to providing the necessary resources.

1.2.6 To ensure the appropriate level of management oversight, NASA has established a hierarchy of the Program Management Councils (PMC). One of these councils, referred to as the Governing PMC (GPMC), will have primary responsibility for evaluating the cost, schedule, and technical content of the program or project to assure that NASA is meeting the commitments specified in the key management documents described above. The Agency PMC is responsible for evaluating proposed programs, providing recommendations to the Administrator, and assessing the performance of approved programs. Other PMCs are established at the Enterprises and Centers, and may be established at lower levels. As programs are approved into implementation the Agency PMC may delegate evaluation authority/responsibility to one of these PMCs. That decision will be documented in the PCA and Program Plan. Regardless of where the GPMC resides (e.g., Agency, Enterprise, Center or other), it is responsible for evaluating the program and providing recommendations and direction to the Program Manager and, as applicable, the Center Director. Projects will be reviewed by a Center PMC and may also be reviewed by the Enterprise or Agency PMC.

1.2.7 Centers shall implement Center level policies, processes, procedures, and requirements to assure safe and successful program/project execution.

1.3 Themes

Several important themes that embody lasting principles for executing program/project management in today's environment recur throughout this document. They are as follows:

a. Safety First. NASA will conduct its programs and projects with safety as the first priority. Safety and reliability will be an integral part of the total design, development, and operations. Processes will be in place to uncover potential failures throughout the life cycle. Decisions will be made on programs and

projects consistent with NASA safety principles. These principles include safety to the public, astronauts and pilots, the NASA workforce, and high-value equipment and property.

b. Exceptional People and Teams. Successful programs and projects are based upon a strong foundation of competent and capable people. NASA must invest in enabling team competency and improving personnel development capability to ensure an adequate foundation for current and future programs and projects. Ensuring that the team has the right people with the right skills at critical times during the life of the project is essential.

c. Tailoring the Process. PAPAC processes and requirements provide program and project managers with the framework to tailor the approach to comply with requirements for formulating and implementing the Agency's increasingly diverse programs and projects. While the PAPAC process and all requirements will be addressed, managers may tailor the approach to implementation of the requirements consistent with program or project characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk.

d. End-to-End Customer Involvement. Program and project managers will identify customers and assure that they are actively involved in program and project activities throughout the life cycle. Customer participation will increase the ability of the program or project to achieve customer objectives within established constraints.

e. Comprehensive Definition and Requirements Control. Programs and projects will have clearly defined objectives, be consistent with the NASA Strategic Plan, and have a comprehensive definition of cost, schedule, and content commitments. Agreements and requirements will be controlled throughout the program or project life cycle.

f. Risk Management. The program or project manager applies continuous risk management principles as a decision-making tool, which enables programmatic and technical success. A disciplined process, including the identification, assessment, mitigation, and disposition of risks throughout the life cycle, supports decisions. The entire team assesses risk early in formulation, and throughout the life cycle.

g. Missions Enabled by Technology. Enterprise objectives will be used to drive crosscutting technology programs by conducting end-to-end systems analysis of generic, reference missions. New technology products will expand mission horizons, and missions will evolve from a convergence of Enterprise objectives and technology. This will promote development and rapid infusion of cutting-edge technology to enhance performance, reduce risk, and lower cost.

h. Technology Commercialization. Programs and projects will strive to enable U.S. firms to use NASA technology for commercial application. Leveraging cooperative technologies and commercialization opportunities will maximize the commercial potential of new technology and its contribution to the national economy.

i. Security. Threats against our systems and assets have increased, making the protection of our data, information and high-value assets imperative.

1.4 Process Description

1.4.1 The PAPAC process consists of the following four subprocesses to accomplish activities for both programs and projects:

a. Formulation.
b. Approval.
c. Implementation.
d. Evaluation.

1.4.2 Figure 1-1 illustrates the interrelationships of the four PAPAC subprocesses with each other as well as with the Agency's three other crosscutting processes. PAPAC obtains its requirements from the Generate Knowledge and Communicate Knowledge Processes (by way of scientific or technical research) and the Manage Strategically Process (through strategic plans, policies, and resources). Within the PAPAC process, program and project concepts and plans, produced in the formulation subprocess, are evaluated and submitted for approval to proceed to the implementation subprocess. The evaluation subprocess supports the initial approval and continues to provide assessments by the customer, experts, and stakeholders. Similarly, the approval subprocess provides the initial approval and continues to support the change process of requirements and commitments. Throughout these processes, there is continuous interfacing with "Customers and Stakeholders."

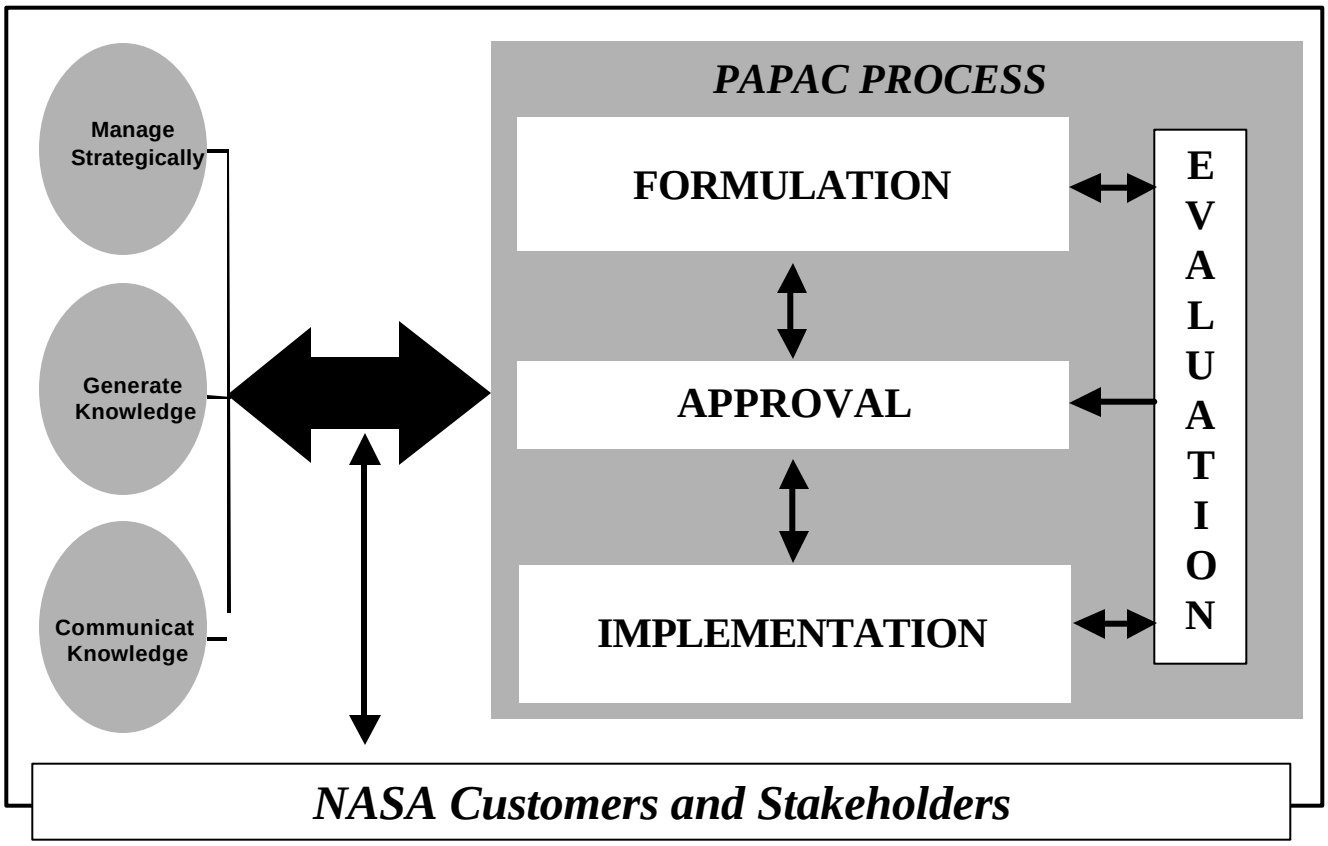


Figure 1-1. Interrelationships of PAPAC Subprocesses

1.4.3 The following section summarizes each of the four PAPAC subprocesses and describes the execution of the integrated process.

a. Formulation subprocess. The purpose of the formulation subprocess is to define a program or project concept and plan for implementation to meet mission objectives or technology goals specified in the Enterprise Strategic Plans. The formulation subprocess explores the full range of implementation options, including concepts, technologies, and operations approaches; establishes the internal management control functions that will be used throughout the life of the program or project; assesses the technology requirements and develops the plans for achieving the technology options, including options for partnering and commercialization, assesses the availability and budget requirements for infrastructure and other institutional requirements and performs LCC and performance analyses of feasible concepts. The outcome of the formulation subprocess, documented in the PCA and Program/Project Plans, is as follows:

(1) A comprehensive definition of the program or project concept and program/project performance objectives, including a clear definition of success criteria.

(2) Agreements, approaches, plans, and operational concepts for meeting the technical, budget, schedule, safety, security, risk management, commercialization, acquisition, and related management requirements.

b. Approval subprocess. The purpose of the approval subprocess is to decide initially on a program/project's readiness to proceed from formulation to implementation. Approval for a program or project to continue in the formulation subprocess may be provided where iterative formulation is required. This subprocess approves changes to the PCA and Program/Project Plans, caused by budgetary or technical issues, institutional issues or strategic redirection. NASA will only approve the baseline or rebaselining of those programs and projects that have firm life-cycle cost, schedule, and content commitments. The outcome of the approval subprocess is as follows:

(1) The commitment to support the program or project as specified in the baselined or amended PCA, Program Plan, and Project Plan.

(2) Authorization for the program or project to proceed to the implementation subprocess.

When programs or projects require significant changes to the baseline, reapproval must be obtained.

c. Implementation subprocess. The purpose of this subprocess is to deliver the products and capabilities specified in the approved program and project requirements and plans. The implementation subprocess develops, integrates, and provides management control for the overall implementation approach; works closely with customers to ensure mutual understanding of plans, objectives, and requirements; converts and controls project and program requirements into implementation specifications; develops the technology or systems design; conducts the manufacturing and testing; establishes supporting infrastructure; and conducts operations. The outcome of the implementation subprocess is the delivery of program and project products and capabilities, within approved resources, that meet the needs of the customer community.

d. Evaluation subprocess. The purpose of the evaluation subprocess is to provide independent assessments of the continuing ability of the program or project to meet its technical and programmatic commitments and to provide value-added assistance to the program/project managers. The evaluation subprocess occurs throughout the life cycle of the program or project to ensure the successful completion of the formulation, approval, and implementation subprocesses. It uses the benefits of peer experiences, customer appraisal, and management expertise and tools in independent reviews and assessments of program or project concepts, plans, status, risk and performance. The approach should be tailored based on factors such as program and project scope, complexity, visibility, cost, safety, and acceptable risk. Planned reviews and assessments conducted during the evaluation subprocess are to be identified in appropriate program and project level documentation. The outcome of the evaluation subprocess is a set of conclusions regarding the ability to meet commitments and recommendations for proceeding with, modifying, or terminating the program or project. Where appropriate, recommendations are also provided for enhancing overall technical and programmatic performance.

1.5 Document Structure

1.5.1 For programs and projects, chapters 2 and 3, respectively, detail each of the four subprocesses. These chapters recognize the similarities and differences between programs and projects. The use of separate chapters provides a standalone description of each for the convenience of the program and project managers. Subprocess flows provide detail on inputs, activities, and outputs. These process flows are not serial or time dependent, but they reflect the dynamic and iterative nature of the overall program and project management process.

1.5.2 Chapter 4 provides details and applicable references for certain key management requirements that relate directly to the program/project life cycle. Appendix A also provides references to the NASA Online Directives Information System (NODIS) for other NASA regulations and directives that may apply.

1.5.3 Appendices B through F provide other supplemental information to assist the program and project managers in understanding and executing all requirements.

CHAPTER 2. Program Management Process and Functional Requirements

2.0 Introduction

NASA programs are major activities within an Enterprise having defined goals, objectives, requirements, and funding levels, and consisting of one or more projects. As explained below, programs vary significantly in scope, complexity, cost, and criticality; however, each is the core of the work that NASA delivers. The Program Manager is responsible for ensuring that program goals address the Enterprise Strategic Plan and that projects, technology, infrastructure, or services supported by the program address the program goals. The Program Manager coordinates program content with the Enterprise, provides leadership and is responsible for the successful accomplishment of the program that meets the needs of the customer. The Program Manager reports directly to the Enterprise unless the program is assigned to the Center Director. This chapter further delineates the requirements for the management of programs, described in four subprocesses: formulation, approval, implementation, and evaluation.

2.0.a The Program Manager is responsible for the total range of program activities, from supporting formulation of program requirements through delivery of the final program products. The Program Manager is responsible for integration, oversight, and assistance to the program's constituent project(s). Responsibilities may include supporting capabilities (e.g., technology development, operations, infrastructure development and maintenance, and data processing and archiving).

2.0.b The program management integration role varies as a function of the level of interdependence of the projects within the program. The following examples illustrate several types of programs. A single-project program (e.g., Cassini) delivers a major capability through completion of one project; in this program type, the Program Manager may also serve in the role of Project Manager and must meet the PAPAC requirements applicable to both programs and projects. For a program which accomplishes its goals and objectives through completion of multiple, synergistic projects wherein each project individually provides a unique product (e.g., EOS), the Program Manager ensures that the projects collectively contribute to an integrated program objective. For programs that deliver an integrated system composed of multiple interdependent projects (e.g., Space Station), end-to-end system integration and delivery is performed at the program level (i.e., the sum of the project deliveries does not produce the system in the absence of program integration). The program management integration role is more limited in other types of programs where the degree of interdependence is less. Examples are Discovery, in which each project stands alone in contributing to a very broad program objective; New Millennium, in which the projects are interdependent in contributing to technology validation but are not synergistically integrated; and technology programs, which can provide a new capability.

2.0.c The Program Manager is responsible for the program safety, cost, schedule, technical performance, and other management requirements contained in chapters 2 and 4. The Program Manager should be knowledgeable in all these areas and utilize the experts from line or functional organizations to assist in program formulation and implementation.

2.0.d The Program Manager should develop a cooperative and performance-oriented team that includes the project managers. It is imperative that team members be mutually supporting and empower each other to do their functions with full and open communication.

2.0.e The relationship between the Program Manager and the Project Manager is critical to the success of both managers. The Program Manager works with the Enterprise to advocate for the totality of the program, including advocacy for projects. The EAA and Program Manager will ensure an effective interface across Government agencies and with the political stakeholders. The Program Manager must monitor the project implementation to relate it to NASA as a whole and the integrated program perspective. The Project Manager focuses on the day-to-day execution of the project by industrial contractors, universities, NASA personnel, and others. It is imperative that both program managers and project managers be mutually supporting and empower each other to do their functions with full and open communication.

2.1 Program Formulation

2.1.a The formulation subprocess establishes the success criteria and defines an affordable program concept and plan for implementation. The formulation subprocess explores the full range of implementation options to meet the overall objectives. Through this subprocess, the top-level requirements are generated for incorporation into the PCA, Program Plans, and/or Project Plans.

2.1.b The primary input to the program formulation subprocess is the FAD, authorized by the EAA, which approves formulation resources, the scope of work, the period of performance, and goals and objectives. The EAA shall assure that the contents of the FAD are appropriate to meet Agency needs and are reasonably achievable within available resources. During program formulation, the PCA, Program Plan, and Project Plans (as appropriate) are developed to define and document the program concept, requirements and success criteria. The responsibility for project formulation is defined in the Program Plan. The content of the FAD, PCA, Program Plan, and Project Plan are described in Appendix E.

2.1.c The program formulation subprocess is the responsibility of the EAA, although the EAA may delegate specific activities. The EAA relies on the advice and recommendations of NASA-chartered panels and scientific advisory committees, which, in many cases, represent customers of the Enterprise. The EAA assignment of projects within the program will be made to Centers in a manner consistent with their mission assignments. Expertise from NASA Centers of Excellence will be integrated into the program as appropriate.

2.1.d All NASA programs, regardless of their size, shall execute the formulation subprocess, addressing all requirements, to provide high confidence that the program is ready to proceed into implementation. The approach to addressing the requirements may be tailored to meet the specific needs of the program, including critical characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. The formulation activities are executed consistent with the cognizant organization's policies and procedures. The formulation subprocess is an iterative activity rather than a discrete set of linear steps. It begins with customer requirements and strategic planning goals and objectives, all of which are incorporated in the FAD. It continues with interactive execution of its activities, normally concurrently, until subprocess output products have matured and are acceptable to the EAA.

2.1.e The program formulation subprocess activities and the approach to functional requirements can be tailored to match the needs of the unique program. There may be a different approach developed for space and Earth science missions, human space flight, and aeronautics technology, or for different types of programs within these categories, as long as the tailoring is described within the approved FAD, PCA, and Program Plan.

2.1.f As programs are being implemented, they may be impacted by external forces (budget modifications, schedule, or requirements changes) and internal situations (technology challenges, new requirements) and may need to revisit the formulation subprocess to ensure that the planning is consistent with schedule commitments and resource availability. If necessary, agreements (PCA and Program Plan) shall be modified and approved in accordance with the approval subprocess.

2.1.g The formulation subprocess is described in Figure 2-1, which also depicts the principal interfaces with the other three Agency crosscutting processes and the other PAPAC subprocesses. The primary outputs of program formulation are a proposed PCA and Program Plan. A brief summary of the program activities contained within the formulation subprocess is as follows:

(1) Program Planning (paragraph 2.1.1). This activity develops the detailed definition of the program requirements and establishes program control to manage the program formulation subprocess.

(2) Systems Analysis (paragraph 2.1.2). This activity provides the systems analysis and life-cycle costing for concepts and options to meet program objectives.

(3) Technology Assessment (paragraph 2.1.3). This activity examines the program concepts and assesses the technology requirements for feasibility, availability, security, technology readiness, opportunities for leveraging research, and new technologies.

(4) Technology and Commercialization Planning (paragraph 2.1.4). This activity develops the technology options and partnering and commercialization options that satisfy the identified needs of candidate concepts.

(5) Development and Operations Business Opportunities (paragraph 2.1.5). This activity identifies business opportunities for partnerships in the development and operations elements of the program.

(6) Assess Infrastructure, and Plan Upgrades/Development (paragraph 2.1.6). This activity minimizes program LCC through utilization of existing or modified infrastructure of NASA, other national and international agencies, industry, and academia to satisfy program requirements.

(7) Capture Knowledge (paragraph 2.1.7). This activity collects and evaluates process performance and identifies process lessons learned.

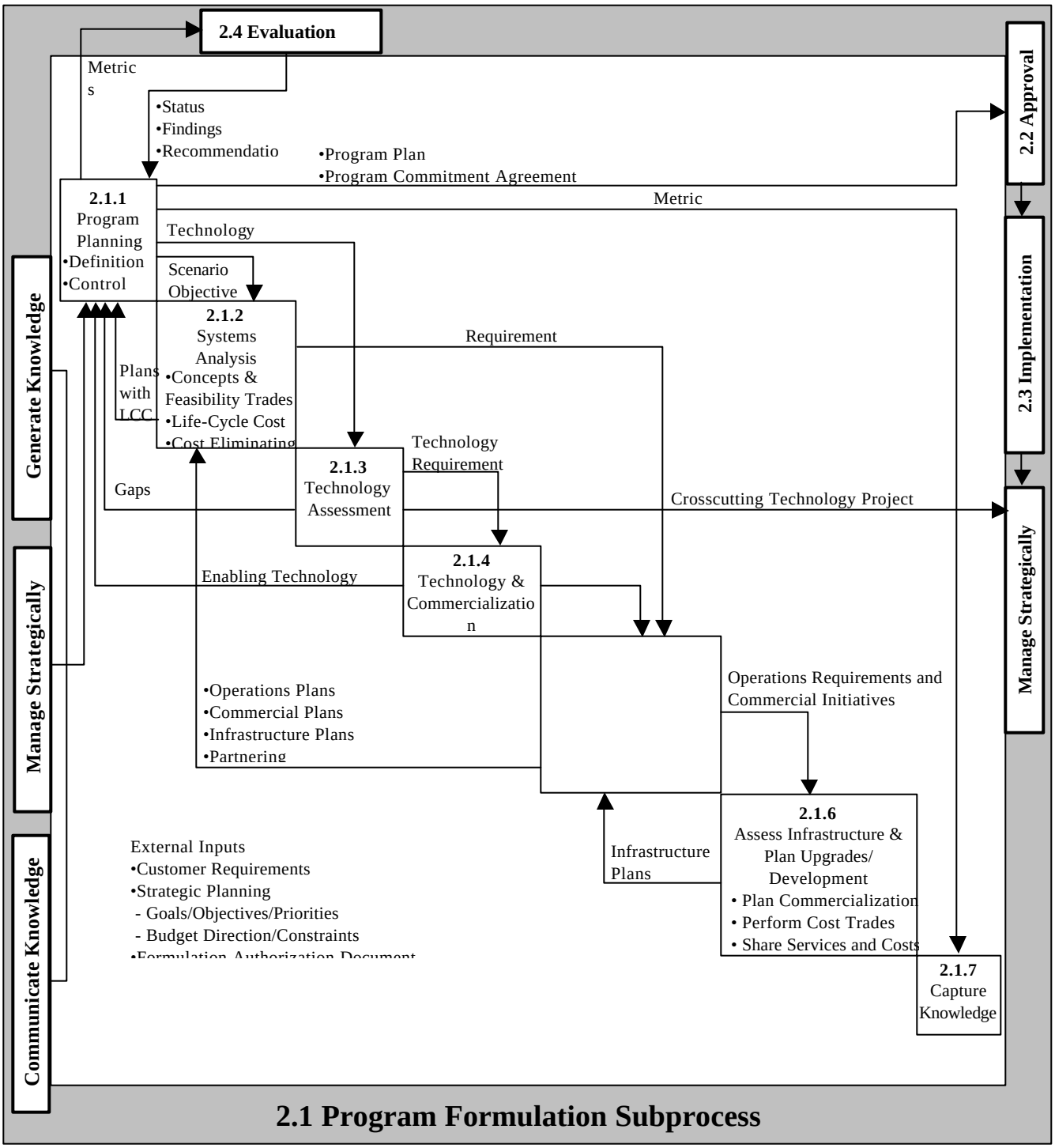


Figure 2-1. Program Formulation Subprocess

2.1.1 Program Planning

2.1.1.1 The Program Manager shall assure that the program team is staffed with personnel with the appropriate skills, abilities, and experience to successfully execute the program. In forming the program team, particular consideration should be given to skills such as financial and acquisition management, risk management, performance management, environmental management, safety, security, and mission assurance (see paragraph 4.1.2.b).

2.1.1.2 As part of the program control activity, the Program Manager shall establish oversight and reporting systems, which integrate the cost, schedule, and technical performance of the program. The Program Manager supports the annual Program Operating Plan (POP) cycle through the program control activity by providing assessments of affordability as input to NASA funding requirements. Preparation of the program's technical, management, cost, safety, security, risk management, acquisition, and institutional support approach enables a firm Agency commitment to accomplish the program's goals and objectives on schedule and within budget. The program obtains its formal external direction and provides formal internal direction through the Program Planning activity.

2.1.1.3 To accomplish program planning, the program team shall perform the following:

a. As applicable, develop concepts, mission development strategies, data management plans, acquisition strategies, implementation plans, space operations service agreements, launch services agreements, and management plans and incorporate into a preliminary Program Plan (see Appendix E.3).

b. Ensure that the program, for itself and for its constituent project(s), establishes program control and management systems that provide for Work-Breakdown Structure (WBS) development, acquisition management, information technology management, resource management, Earned-Value Management (EVM), facilities, environmental, logistics and schedule management.

c. Establish a configuration management system that provides visibility and control of performance, functional and physical characteristics over the program and product life cycle. Configuration management is applied to requirements, documentation, and software and hardware (qualification, protoflight, flight and ground support).

d. Identify program cost elements, schedule, risks, and performance baseline, and refine throughout the formulation subprocess (see paragraphs 4.2 and 4.4). Program baseline plans are to include project Requirements Reviews (RR) and an Independent Life-Cycle Cost Analysis (ILCCA) when appropriate.

e. Ensure that program success criteria are defined as a portion of the top-level program requirements and flow down as appropriate to lower-level program elements.

f. Ensure that the basic concept of the program is defined and synergistic activities with other NASA, industry, academia, and international parties are considered.

g. Maintain effective communication with the program customers regarding the interpretation and accommodation of requirements.

h. Develop and manage acquisition strategy for the conduct of the formulation subprocess and generate a preliminary acquisition strategy for program implementation (see paragraph 4.5).

i. Define an integrated and comprehensive continuum of reviews (see Appendix F) tailored to the scope, complexity, visibility, cost, safety, and acceptable risk associated with the program.

j. Define the independent review requirements for constituent projects and specify the GPMC consistent with Agency direction.

k. Use risk management planning as a basis for decisions (e.g., to release reserves) to mitigate cost, schedule, technical, environmental, security or safety risks (see Paragraph 4.3).

l. Define metrics for assessment of program performance (see paragraph 4.4.2.2).

m. Review, approve, and monitor progress of all program formulation products.

n. Beginning in early program formulation, work with the Office of External Relations and the EAA to identify potential non-NASA partners and necessary agreements for international or interagency cooperation; all activities and documentation shall be consistent with policy guidelines and with Enterprise or Agency-level agreements with the partners. All commitments shall be obtained prior to Approval for Implementation.

o. Prepare and maintain a preliminary PCA (see Appendix E.-2).

2.1.2 Systems Analysis

This activity provides the systems analysis and LCC analysis necessary to produce feasible concepts and explore a wide range of implementation options to meet program objectives. It considers risks, technology alternatives, operations, business opportunities, schedule, and infrastructure useful to the program. To accomplish systems analysis, the program team shall accomplish the following:

a. Perform trade studies among candidate program concepts that consider content, safety, affordability, risk, technology, security, environmental impact (see Paragraph 4.6.5) and acquisition strategies. Documentation shall be available to approval authorities for the validation or modification of the FAD.

b. Prepare for the adoption of the International System of Units (SI) as the baseline measurement system per NPD 8010.2, Use of the Metric System of Measurement in NASA Programs, early in the formulation subprocess. If a waiver is required, it shall be approved prior to the Requirements Review.

c. Examine program concepts considering estimated life-cycle cost in tradeoffs of commercialization possibilities, technology alternatives, business opportunities, operational needs, and infrastructure availability.

d. Develop program performance requirements and, as applicable, system and subsystem performance specifications.

e. Develop and continually update assessment of program risks and risk-mitigation actions that are integrated with constituent project(s) risk-management activities.

f. Develop the LCC of the program to include the direct, indirect, recurring, nonrecurring, and other related costs for the design, development, production, operation, maintenance, support, and retirement of the program.

2.1.3 Technology Assessment

2.1.3.1 This activity examines the program's concepts and assesses the technology requirements for feasibility, availability, technology readiness, opportunities for leveraging research, and new technologies. Technology assessment is accomplished early in formulation to assure that technology needs are identified and evaluated and that their infusion is appropriately planned. As a program progresses through its life cycle, additional technology assessments may be undertaken to take advantage of promising technologies that may reduce program risk, gain performance, or overcome problems with selected technologies that are not maturing satisfactorily. The technology assessment activity defines which technologies should be incorporated into the program and which should be considered for a crosscutting technology program. Management of technology falls into the following two general categories:

a. Program managed technologies are those that enhance capabilities, reduce risk, improve safety, or reduce cost of planned missions, or that provide fundamental capabilities without which certain specific objectives cannot be met.

b. Crosscutting managed technologies are those that increase capability or reduce cost or risk to such a degree that they enable completely new mission opportunities. The crosscutting technology programs have formulation, approval, implementation, and evaluation subprocesses separate from the programs, which will eventually utilize those technologies.

2.1.3.2 To accomplish the technology assessment, the program team shall perform the following:

a. Identify technologies required to support the proposed program needs and utilize available tools and resources such as the NASA Technology Portal to identify potential technologies. http://nasatechnology.nasa.gov/portalmain.cfm.

b. Assess system concepts to determine technical viability based on current capabilities, existing Agency crosscutting technology activities, and the potential for leveraging commercial technologies and external partnerships.

c. Identify where technology gaps exist, including those significant enough to question the viability for a concept to be realized. Determine the approach to be used to fill the identified gaps.

d. Where gaps in technology solutions are too large to meet the needs of the program, provide this information to the program's originating Enterprise for consideration of incorporation into the Agency's technology planning process and possible crosscutting technology programs.

e. Identify technologies that have distribution restrictions on the software, hardware, or data.

2.1.4 Technology and Commercialization Planning

This activity plans the technology approaches that satisfy the identified needs of candidate concepts. It also develops options for partnering and commercialization. Further, this activity provides for the development of plans and the establishment of partnerships to transfer technologies, discoveries, and processes with potential for commercialization. To accomplish technology and commercialization planning, the program team shall perform the following:

a. Plan technology to be developed to accomplish specific program and project objectives through identification of technology development strategies that remove gaps identified in the technology assessment specified in paragraph 2.1.3.

b. Explore innovative avenues to expand participation and infuse the latest technological and commercial capabilities into the program.

c. Explore ways the assets (technology, discoveries, innovations, tools, processes, or software), developed as a byproduct of the program execution, can be infused into industry.

d. Identify, verify, and report success stories to the Center Commercialization Office that have resulted from partnerships, transfer, or commercialization of assets.

e. Ensure that the plans for technological or commercial cooperation include a full description of the opportunities for partnering, the potential partners, the need for protection of intellectual property, the likelihood of the partnership coming to fruition, the expected contribution (personnel, facilities, Independent Research and Development (IRAD), and other funding) and the confidence that the partnership will remain in force.

f. Where possible, integrate NASA plans with the technology and commercialization plans of its U.S. customers. Potential U.S. cooperative technology and commercialization opportunities are to be explored and, where advantageous to NASA, agreements enacted.

g. Ensure that the planned technology exchange, contracts and partnership agreements comply with all laws and regulations regarding export control and the transfer of sensitive and proprietary information.

2.1.5 Development and Operations Business Opportunities

In this activity, the Program Manager identifies business opportunity partnerships in the development and operational elements of the program. Business opportunities in the development part of the program will assess the resources and aligned interests of other Government agencies, industry, academia, and international entities, to provide one or more of the program end-item deliverables and reduce LCC. The business opportunities for the operational element will consider communications, tracking, and data processing functions. Development of an operations concept will examine the viability of autonomous control and distributed versus centralized operations, as well as the possibility of commercial operation opportunities. This activity is interdependent with the assessment and planning specified in paragraph 2.1.6 to the extent that an integrated set of outputs is required. Partnering opportunities and relationships identified through these activities will be assessed for feasibility through the analysis specified in paragraph 2.1.2 and the final negotiated agreements. To accomplish this assessment, the program team shall perform the following:

a. Assess development and operational requirements, evaluating alternative approaches to meeting program needs while minimizing Agency resources.

b. Develop an approach for disposition of program assets (orbital and other) after the end of their useful life.

c. Assess teaming and partnering options, including commercial ventures, for the development and operational elements to reduce the project LCC.

d. Develop requirements for communications, tracking, data processing, and mission operations. NASA services shall be used unless a more cost-effective, lifecycle approach can be proposed.

2.1.6 Assess Infrastructure and Plan Upgrades/Development

This activity assesses the capability of the Agencywide infrastructure to satisfy program requirements. Resources in other Government agencies, industry, academia, and international entities will also be considered to minimize program LCC's. To accomplish this assessment, the program team shall perform the following:

a. Identify capability gaps and produce plans and required documentation for infrastructure upgrades or new development, including environmental compliance (see paragraph 4.6.5), and reflect the results in the Program Plan.

b. Perform cost trades to enable meeting requirements through synergy with other programs, thus avoiding costly duplication of support facilities.

c. Perform an appropriate level of analysis to identify the operations and maintenance cost drivers and to assess impacts on the Agency's infrastructure and program logistics support needs.

d. Identify testing requirements (e.g., ground and flight facilities, research aircraft and data needs) and verify infrastructure capability.

2.1.7 Capture Knowledge

The objective of this activity is to enable future programs to benefit from lessons learned during the formulation subprocess.

2.1.7.1 Process-related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process. Activity lessons learned shall be provided to the Lessons Learned Information System (LLIS) maintained at GSFC.

2.1.7.2 Documentation associated with program formulation history which includes the significant events, options studied, trade-offs made, resources expended, time consumed, and any other performance information shall be maintained in order to assist other programs with their execution.

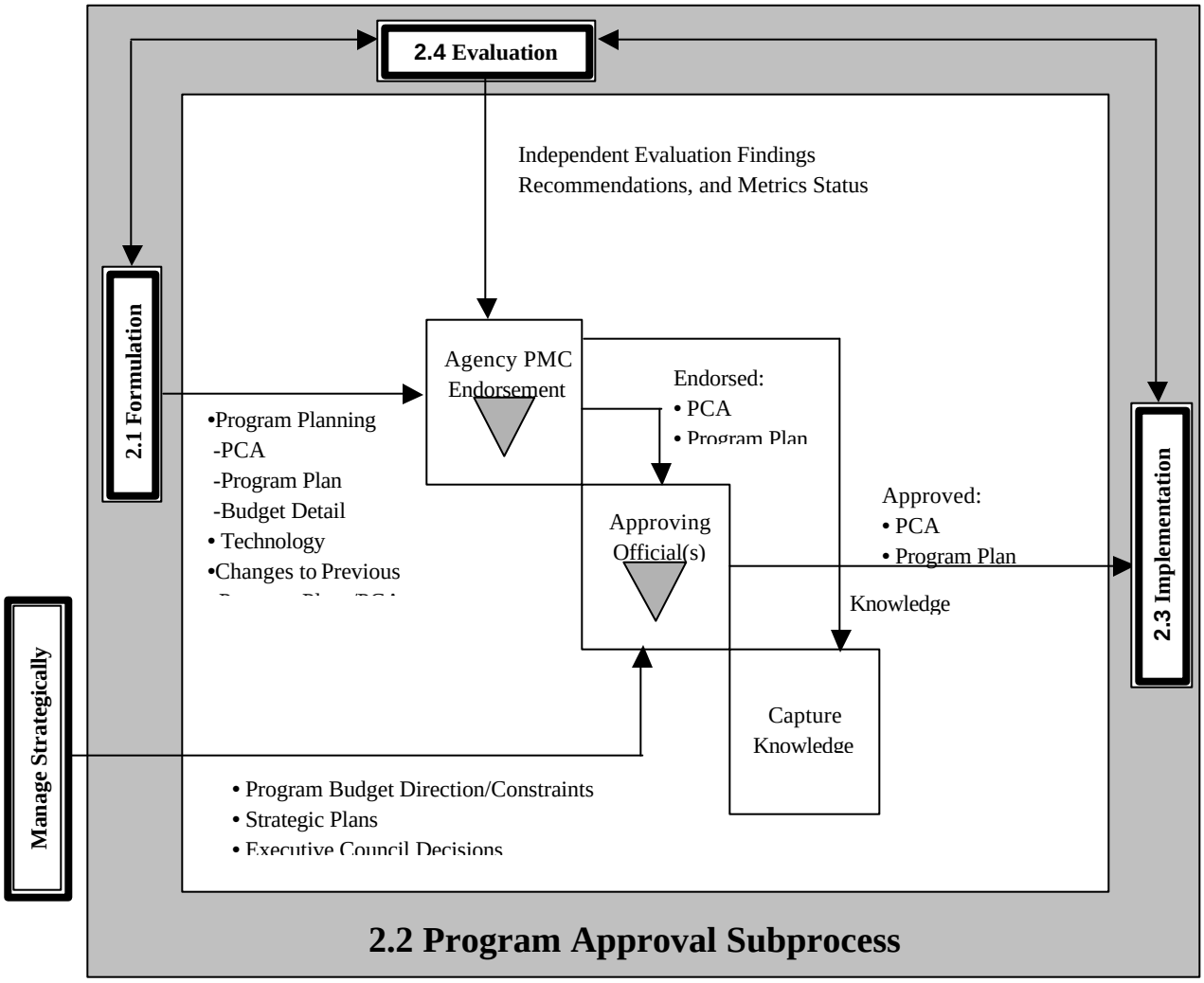


Figure 2-2. Program Approval Subprocess

2.2 Program Approval

2.2.1 The program approval subprocess determines a program's readiness to proceed with implementation. It should result in transition from formulation to implementation. Subsequent approvals may be required as a result of changes to the PCA and Program Plan based on budgetary, technical, or institutional considerations. Each program shall execute the approval subprocess.

2.2.2 Within NASA, the Administrator has sole authority to approve all new programs. NASA will undertake only programs whose objectives are clearly articulated and consistent with the NASA Strategic Plan and Enterprise Strategic Plans. Only those programs for which a firm life-cycle cost, schedule, and content commitment can be made will be approved. The program approval subprocess flow is presented in Figure 2-2. The program budget direction/constraints, NASA and Enterprise

Strategic Plans, and decisions made from recommendations by the Executive Council (EC) are a direct input to program approval, through the approving official. To begin the approval subprocess, the EAA shall provide to the Agency PMC a proposed PCA and Program Plan.

2.2.3 Information from the evaluation subprocess developed through independent review(s) during formulation is provided to the Agency PMC. Based on the Agency PMC recommendation, the Administrator signs the PCA with the EAA, thereby approving the PCA. The EAA, the Program Manager, and other authorities, as documented in the PCA, sign the Program Plan. A signed PCA and Program Plan are provided for the implementation subprocess as the baseline for detailed implementation planning and execution.

2.2.4 The PCA shall be updated if changes are required. The EAA will classify proposed PCA changes as either major or minor. Major changes represent significant impacts to requirements, schedule, resources, risks, or agreements; all other changes are minor. The Deputy Administrator has the authority to approve a revised PCA with minor changes. All major PCA changes shall be forwarded to the Administrator for approval. All changes, major and minor, are logged in the activities log of the affected PCA.

2.3 Program Implementation

2.3.a The program implementation subprocess implements the approved program requirements and plans. All programs shall execute the implementation subprocess. In tailoring the implementation subprocess, all requirements shall be addressed. The approach to addressing the requirements may be tailored to meet the specific needs of the program, including critical characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. The implementation subprocess translates the input products from the formulation and approval subprocesses into the production of output products and services for the designated customers.

2.3.b Each program executes the following implementation activities (see Figure 2-3):

(1) Program Control. (paragraph 2.3.1) This is an activity through which the Program Manager provides direction and exercises control over the program.

(2) Customer Advocacy. (paragraph 2.3.2) This activity maintains contact with customers and advocacy for customer objectives, plans, and requirements implementation.

(3) Requirements Management. (paragraph 2.3.3) This is an activity that converts top-level requirements into implementation requirements and maintains configuration management of requirements documentation

(4) Design, Develop, and Sustain. (paragraph 2.3.4). This activity produces the specific program systems, hardware, and software.

(5) Deliver Products and Services. (paragraph 2.3.5) This activity delivers the program products and services, including science and technology. It includes operations of delivered systems to produce data for customers.

(6) Capture Knowledge. (paragraph 2.3.6) This activity collects and evaluates process performance metrics to identify process corrective actions and/or to communicate the lessons learned in using these processes.

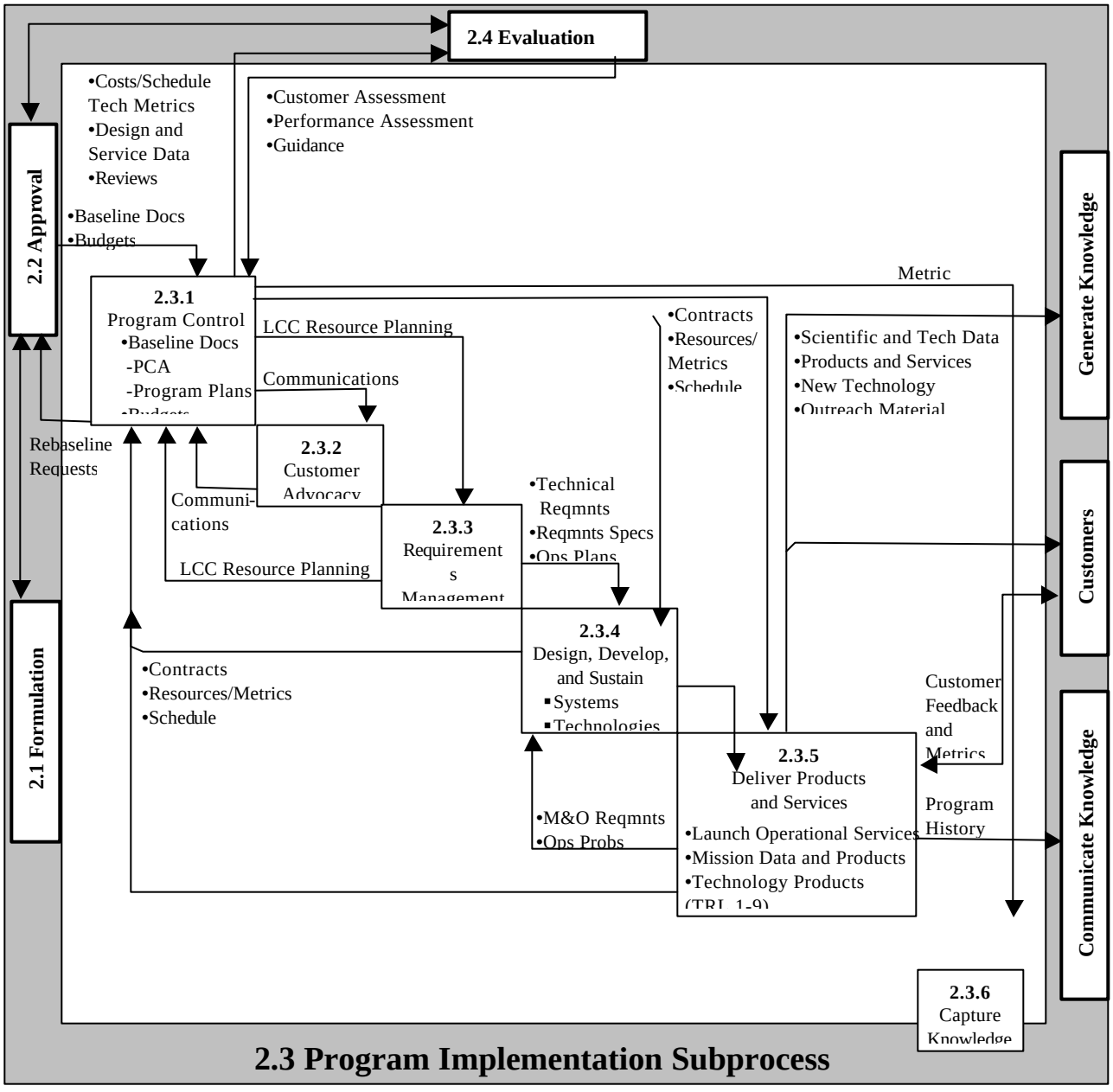


Figure 2-3. Program Implementation Subprocess

2.3.1 Program Control

2.3.1.1 This is an activity through which the Program Manager provides direction and exercises control over the program. The purpose of this activity is to ensure that program implementation is conducted in an effective manner, beginning with and maintaining a thorough understanding of program requirements and the resources required to meet those requirements. The activity maintains PCA's, program plans, budgets, schedules, and top-level performance requirements that are inputs to the implementation subprocess. This activity develops and integrates the overall implementation approach and provides management oversight of all aspects of the program.

2.3.1.2 This activity includes program control and management of all program implementation activities to meet performance requirements within cost, schedule, and quality commitments in compliance with baseline program documentation and the management systems requirements in chapter 4. This activity ensures the collection, tracking, reporting, and management of the program according to performance metrics. The program team shall perform the following:

a. Maintain the program within the scope of the baseline agreements and documents and assess scope changes and impacts caused by customer and evaluation subprocess recommendations, budgetary processes, performance assessments, external agreements performance, and other factors. The Program Plan and PCA shall be updated, as required, to maintain compatibility between the plan and the resources available. Prepare recommendations and request rebaselining through the approval subprocess.

b. Implement integrated planning to maintain program requirements and associated rationale, document the roles of implementers and program interdependencies, and maintain the program management structure.

c. Perform resources management per the requirements in paragraph 4.2 to ensure the appropriate acquisition of and distribution of resources and support the Agency budget process document and manage work authorization including scope, schedule, and budget.

d. Manage acquisition per the requirements in paragraph 4.5 to maintain acquisition plans, execute procurements and agreements in accordance with Federal law and regulations, and ensure monitoring and reporting of activities related to contract and nonprocurement instruments.

e. Manage schedules per the requirements in paragraph 4.4.3 to maintain the baselined schedule consistent with program milestones and the program WBS.

f. Ensure that baselined program documents, including the product baseline, are maintained under configuration management.

g. Assess and report performance per the requirements in paragraph 4.4 to include the assessment of program status against established metrics, the evaluation of variances, and any GPMC assigned actions.

h. Implement risk management per the requirements in paragraph 4.3 to identify risk and its impact and prioritize risks for mitigation or elimination and maintain the Risk Management Plan.

i. Periodically assess the adequacy of resources, including margins, to meet the program requirements and if margins become inadequate, develop and implement a recovery plan.

j. Maintain an effective safety and mission success activity throughout all design, development, delivery, operations and retirement or disposal activities per the requirements in paragraph 4.6.

k. Conduct an integrated continuum of reviews as specified in the Program Plan, based on the guiding principles and major classes of reviews provided in Appendix F. Address, close, and report issues in a timely manner and apprise management of changes to residual risks.

2.3.2 Customer Advocacy

2.3.2.1 The purpose of this activity is to proactively consult and involve customers in the implementation subprocess to ensure customer satisfaction with delivery of quality products and services within budget and schedule commitments. It provides internal implementation process advocacy of customer interests in program decision forums.

2.3.2.2 The Program Manager shall ensure that the customers are an integral part of the program to clarify requirements and assess implementation progress against commitments.

2.3.2.3 The Program Manager shall implement customer advocacy per the Program Plan.

2.3.3 Requirements Management

2.3.3.1 This activity flows down higher level requirements into more specific requirements and allocates them to lower level program elements. A configuration management process is used to ensure compatibility across multiple program elements. To accomplish Requirements Management, the program team shall perform the following:

a. Define program requirements, consistent with the PCA and the Program Plan technical content, cost, schedule, security requirements, and institutional requirements.

b. Perform program systems engineering and analysis to ensure that cost-effective requirements are specified and to refine and validate LCC's.

c. Collect and allocate program requirements into implementable elements.

d. Document, control, and verify program requirements.

e. For programs that deliver systems, develop a specification that includes Government-furnished equipment/products and operations requirements.

2.3.3.2 For some programs, packaging of implementation requirements is effectively a project-defining activity. These packages become the initial requirements for initiating projects or for changing the scope of existing projects. For those programs, requirements management is the major activity responsible for defining the project's content within the program.

2.3.4 Design, Develop, and Sustain

2.3.4.1 This activity develops the specific technology and/or systems and establishes the systems supporting infrastructure for sustaining engineering, logistics, continuing production and operations. All program teams focus on oversight of, and assistance to, the constituent project(s). For programs that deliver systems, the integration of design, development, manufacturing, verification and validation, certification, operations capability development, and overall systems development monitoring and control are major elements of this activity.

2.3.4.2 The program team shall perform the following as applicable:

a. Conduct analyses and reviews of integrated system designs to optimize design for program requirements and direct program activity accordingly.

b. Execute contracts and nonprocurement instruments and conduct appropriate surveillance commensurate with risk.

c. Develop, review, and execute a verification and validation plan that includes software/hardware integration and appropriate independent verification and validation of software.

d. Ensure incorporation of new technology/commercialization per technology and/or commercial development plan(s) and validate the program technology utilization approach.

e. Ensure interface control between various program elements.

f. Establish and maintain logistics support capability to sustain delivered hardware and software systems, consistent with intended mission requirements and plans.

g. Ensure that critical facilities, equipment, and materials are available when needed.

h. For existing operations infrastructures that deliver cross-program products and services, provide design, implementation, and sustaining engineering for technology, commercial, obsolescence, and capacity upgrades.

i. Provide sustaining engineering for efficiency enhancements and for safety and obsolescence plan development and execution.

j. Use technical standards with preference given to non-Government voluntary consensus standards. Maintain a listing of program office required Government and non-Government standards and specifications, and evaluate the impact of relevant changes (http://Standards.msfc.nasa.gov/).

k. Implement the SI (metric measurement system) as planned in program formulation.

l. Identify, document, and control baseline engineering and technical management information.

m. Protect intellectual property and technology in accordance with paragraph 4.7.

n. Assure that a security risk assessment is accomplished.

2.3.5 Deliver Products and Services

This activity ensures delivery of the program and constituent project(s), products, services, and/or technology to the customer. It includes operations of delivered systems and oversight of delivered project systems and production of products for science and technology customers. Routine interaction and outreach with the program/project customer community to pursue customer satisfaction is a critical function. This activity also performs program retirement/closeout planning and execution. To perform these functions, the following shall be accomplished:

a. Ensure that deliverable products and/or services and operations are compliant with all program requirements and customer agreements for technical, cost, schedule, safety, security, and quality performance.

b. Ensure, for those products requiring transfer of custodial responsibility, that acceptance/turnover activities and material are addressed.

c. Refine and prepare to implement plans for disposition of program assets (orbital and other) after the end of their useful life.

d. Collect and analyze metrics and report program status.

2.3.6 Capture Knowledge

The objective of this activity is to enable future programs/projects to benefit from lessons learned during the implementation subprocess.

2.3.6.1 Process related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

2.3.6.2 Documentation associated with program implementation, including engineering and technical management information as well as resources expended, time consumed, and any other performance information, shall be maintained in order to assist other programs/projects with their execution.

2.4 Program Evaluation

2.4.a The evaluation subprocess provides an independent assessment of the continuing ability of the program to meet its technical and programmatic commitments and to provide value-added assistance to the Program Manager. It is applied throughout the life cycle of programs and consists of periodic independent reviews during the formulation and implementation of a program. These, together with the other classes of reviews delineated in Appendix F, shall be appropriately combined to comprise the integrated continuum of reviews required in 2.1.1.3.i. The Agency Independent Program Assessment Office and the Systems Management Office at each Center are key resources to Agency and Center senior managers, PMC's and program/project managers in executing independent assessment of programs and providing recommendations on how to improve.

2.4.b The evaluation subprocess, shown in Figure 2-4, utilizes review teams composed of knowledgeable, independent experts from outside the advocacy chain of the program. Evaluation supports the approval subprocess by providing findings and supporting data necessary to arrive at decisions either to proceed or not to proceed with subsequent portions of program life cycles. Evaluation during formulation assesses whether programs support the Agency goals and strategic planning and that programs can be successfully conducted within allocated resources and applicable constraints. Evaluation during implementation assesses whether programs are being successfully executed according to plans and provides recommendations for enhancing the technical and programmatic performance of programs.

2.4.c All programs shall execute the evaluation subprocess. The approved FAD, PCA and Program Plan shall specify the requirements, timing, objectives and convening authority for independent reviews. The evaluation subprocess should be planned to minimize disruptions to the program and avoid unnecessary duplications. Prior to independent reviews, the current FAD, PCA, Program Plan, and other appropriate program documentation are provided to support evaluation. Independent reviews shall address, as a minimum, technical requirements and achievements, schedules, projected LCC, issues, concerns, safety, security, environmental compliance, risk management plans/status, and other program metrics.

2.4.d Note that requests for audits, additional reviews and assessment of programs may come from the Congress, the NASA Inspector General, the General Accounting Office (GAO), advisory groups

such as the Space Science Advisory Committee, and other similar sources. The NASA Chief Engineer shall coordinate responses to external review requests, work in concert with the EAA and the office responsible for management controls to disposition such requests, and coordinate the scheduling of such activities with the Program Manager and GPMC, when requested.

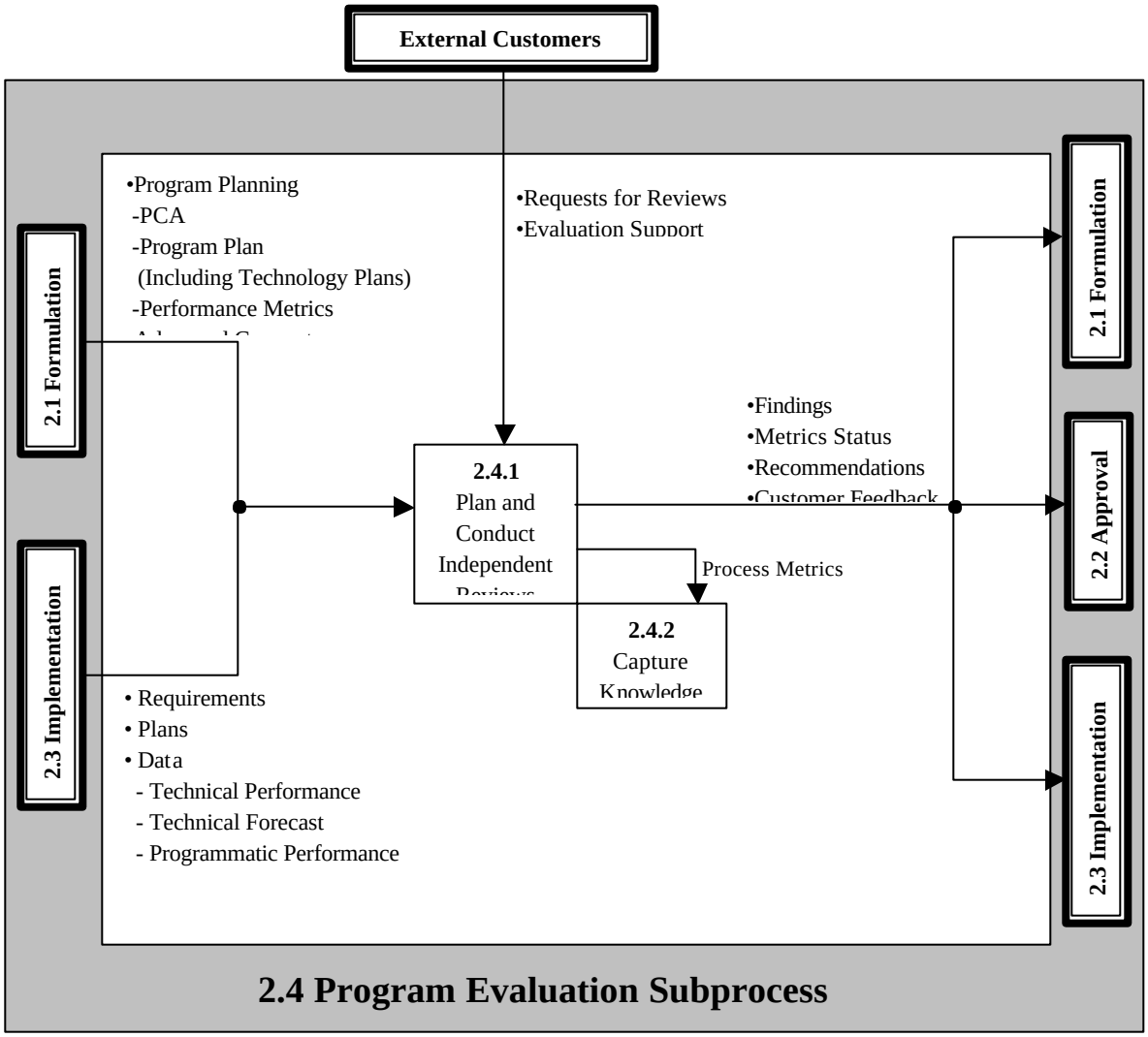


Figure 2-4. Program Evaluation Subprocess

2.4.1 Plan and Conduct Independent Reviews

2.4.1.1 This activity plans and conducts the specific reviews defined in the FAD, PCA and Program Plan. Requirements, implementation plans, data, and customer feedback are all made available for the evaluation subprocess.

2.4.1.2 The purpose and methodology of each review shall be defined prior to initiating the review.

2.4.1.3. During the formulation subprocess, in preparation for requesting approval, a Non-Advocate Review (NAR) shall be conducted to determine the readiness of the program to proceed into implementation. The NAR shall include an ILCCA where applicable. Additional independent reviews (e.g., Independent Assessment) may be required during formulation by the Agency PMC or EAA. Unless otherwise delegated, independent reviews during program formulation shall be reported to the Agency PMC and shall be conducted by the Independent Program Assessment Office (IPAO).

Note that when a project under a program has an estimated NASA LCC greater than $150M, an ILCCA is required during formulation in conjunction with initiating the preliminary design. The results of that ILCCA shall be certified by the Chief Financial Officer (see paragraph 3.4.1.3).

2.4.1.4 Concurrent with the implementation subprocess, evaluation shall consist of periodic (approximately annual) independent reviews, referred to as Independent Implementation Reviews (IIR), which measure program performance and compare that performance with the Program Plans. Unless otherwise delegated, independent program reviews conducted during implementation shall be reported to the Agency PMC and shall be conducted by the IPAO.

2.4.1.5 The GPMC chair, or designee, shall concur that review teams are composed of knowledgeable, independent experts from outside the advocacy chain of the program, and customer representatives, as appropriate.

2.4.1.6 Special-purpose independent reviews (e.g., Termination Review) shall be conducted, as required, at the direction of the GPMC. Requests for special purpose reviews may come to the GPMC from customers, line organizations, or others. Elements such as the anticipated inability of a program to meet its commitments contained in controlling agreements and plans, including a projected cost at completion that exceeds the costs allowed by the PCA; an unanticipated change in Agency strategic planning; or an unanticipated change in the NASA budget shall be considered prior to convening a Termination Review.

2.4.2 Capture Knowledge

The objective of this activity is to enable future programs to benefit from lessons learned during the evaluation subprocess.

2.4.2.1 Process related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

2.4.2.2 Documentation associated with program evaluation as well as resources expended, time consumed, and any other relevant information shall be maintained by the Systems Management Office (SMO) and/or IPAO in order to assist other programs with their execution.

CHAPTER 3. Project Management Process and Functional Requirements

3.0 Introduction

NASA projects are elements of a program and are significant activities that have defined goals, objectives, requirements, LCC's, a beginning, and an end. Projects vary significantly in their complexity, cost, and criticality; however, they are essential to the capabilities NASA delivers to the American public. The Project Manager is responsible for the successful accomplishment of projects from formulation through implementation and customer satisfaction with the products delivered. The Project Manager is accountable to their Program Manager and to the Center Director for assigned projects. Project Managers are key members of the program management team, providing information and assisting the Program Manager in the execution of the integrated program. This chapter further delineates the requirements for the management of projects, described in four subprocesses--formulation, approval, implementation, and evaluation.

3.0.a The Project Manager is responsible for the project safety, cost, schedule, technical performance and other management requirements contained in chapters 3 and 4. The Project Manager should be knowledgeable in all these areas and utilize the experts from line or functional organizations to assist in project formulation and implementation.

3.0.b The Project Manager should develop a cooperative and performance-oriented team. It is imperative that this team be mutually supporting and empower each other to do their functions with full and open communication.

3.0.c The relationship between the Program Manager and Project Manager is critical to the success of both managers. The Project Manager works in concert with the Program Manager but focuses on the day-to-day execution of the project by industrial contractors, universities, NASA personnel, and other agencies, foreign and domestic. The Project Manager ensures that the products and services from the project will meet the customer needs. It is imperative that both project managers and program managers be mutually supporting and empower each to do their function with frequent and open communication.

3.1 Project Formulation

3.1.a The formulation subprocess establishes the success criteria and defines an affordable project concept and plan to meet mission objectives or technology goals specified in the Program Plan. The formulation subprocess explores the full range of implementation options to meet the overall objectives, including flow down of success criteria to the system/subsystem level; establishment of the internal management control functions that will be used throughout the life of the project; assessment of the technology requirements and development of the plans for achieving the technology options, including

options for partnering and commercialization; performance of LCC and performance analyses for concepts deemed to have a high degree of technical and operational feasibility; and identification of margins and reserves associated with management of project risk.

3.1.b The primary input to the project formulation subprocess is the FAD, or equivalent (such as a Program Plan section, EAA letter selecting an Announcement of Opportunity (AO) proposal, or a Program Directive that is used in Space Station and Shuttle programs), authorized by the EAA or designee (see Appendix E.1) which approves formulation resources, the scope of work, period of performance, goals, and objectives. During project formulation, the Project Plan is developed to define and document the project concept, requirements and success criteria. The content of the Project Plan is described in Appendix E.4.

3.1.c All NASA projects, regardless of their size, shall execute the formulation subprocess, addressing all requirements, to provide high confidence that the project is ready to proceed into implementation. The formulation activities are executed consistent with the implementing organization's policies and procedures. The formulation subprocess is an iterative activity rather than a discrete set of linear steps. It begins with customer requirements and strategic planning goals and objectives, all of which are incorporated in the project FAD. It continues with interactive execution of its activities, normally concurrently, until subprocess output products have matured and are acceptable to the Program Manager. The approach to meeting the requirements may be tailored to meet the specific needs of the project, including critical characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk.

3.1.d During implementation, projects may be impacted by external forces, such as budget modifications, schedule, or requirements changes, and internal situations, such as technology challenges or new requirements. The formulation subprocess may need to be revisited to ensure that the planning is consistent with commitments and resource availability. If necessary, agreements (Program and Project Plans) shall be modified, and approved in accordance with the approval subprocess.

3.1.e The formulation subprocess is described in Figure 3-1 which also depicts the principal interfaces with the other three Agency crosscutting processes and the other PAPAC subprocesses. A brief summary of the project activities contained within the formulation subprocess is as follows:

(1) Project Planning (paragraph 3.1.1). This activity develops the detailed definition of the project requirements and establishes project control to manage the formulation subprocess.

(2) Systems Analysis (paragraph 3.1.2). This activity provides the systems analysis and life-cycle costing for concepts and options to meet project objectives.

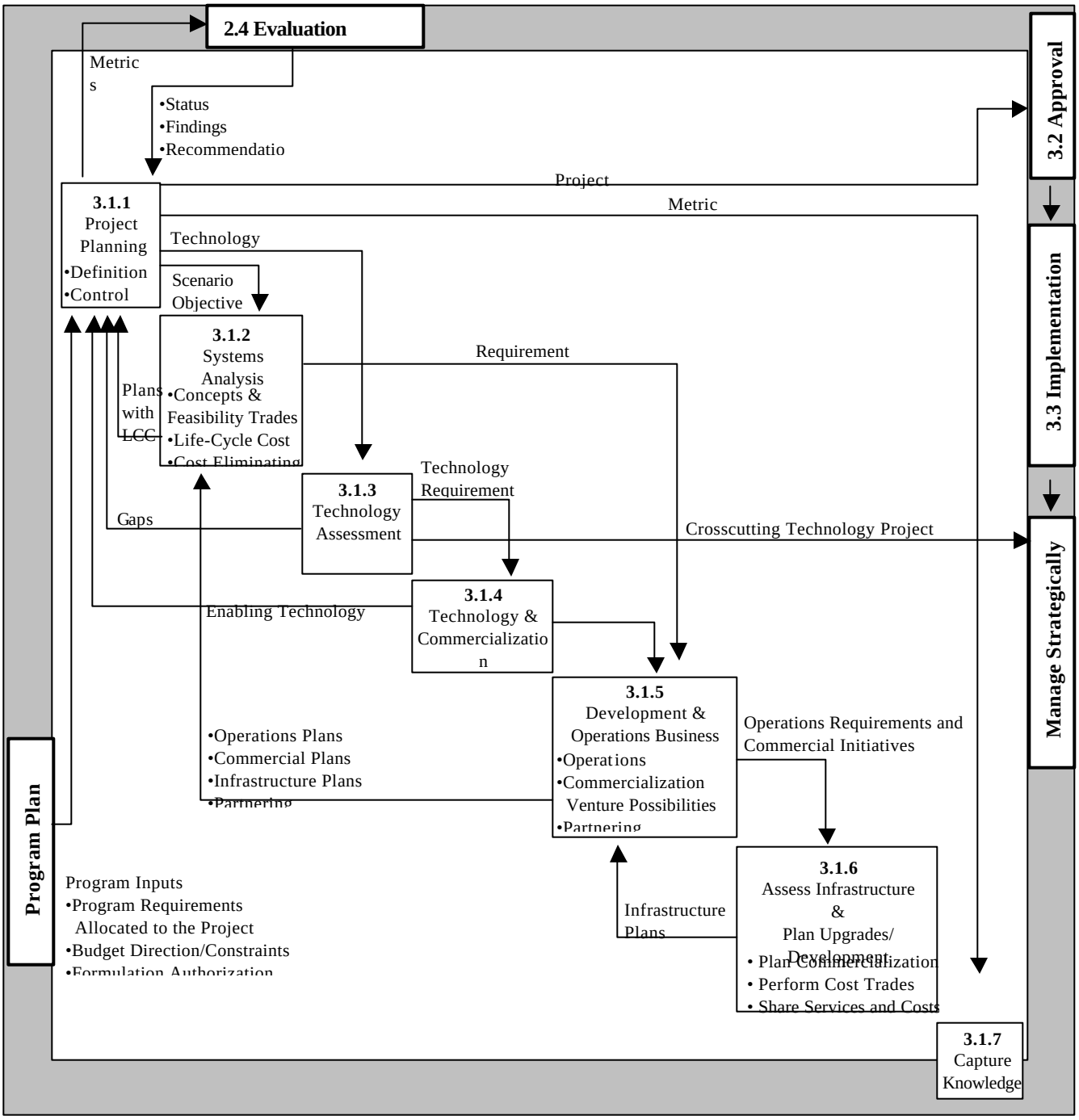
(3) Technology Assessment (paragraph 3.1.3). This activity examines the project concepts and assesses the technology requirements for feasibility, availability, security, technology readiness, opportunities for leveraging research, and new technologies.

(4) Technology and Commercialization Planning (paragraph 3.1.4). This activity develops the technology options and partnering and commercialization options that satisfy the identified needs of candidate concepts.

(5) Development and Operations Business Opportunities (Paragraph 3.1.5). This activity identifies business opportunities for partnerships in the development and operational elements of the project.

(6) Assess Infrastructure and Plan Upgrades/Development (paragraph 2.1.6). This activity minimizes program LCC's through utilization of existing or modified infrastructure of NASA, other national and international agencies, industry, and academia to satisfy program requirements.

(7) Capture Knowledge (paragraph 3.1.7). This activity collects and evaluates process performance and identifies process lessons learned.



3.1 Project Formulation Subprocess

Figure 3-1. Project Formulation Subprocess

3.1.1 Project Planning

3.1.1.1 The Project Manager shall assure that the project team is staffed with personnel with the appropriate skills, abilities, and experience to execute successfully the project. In forming the project

team, particular consideration should be given to skills such as financial and acquisition management, risk management, performance management, environmental management, safety, security, and mission assurance (see section 4.1.2.b).

3.1.1.2 As part of the project control activity, the Project Manager shall establish oversight and reporting systems which integrate the cost, schedule, and technical performance of the project. Preparation of the project's technical management, cost, safety, security, risk management, acquisition, and institutional support approach enables a firm Agency commitment to accomplish the project's goals and objectives on schedule and within budget. The Project Manager supports the annual period of performance cycle through the project control activity by providing assessments of affordability as input to the project's funding requirements. The project obtains its formal external direction and provides formal internal direction through project planning.

3.1.1.3 To accomplish project planning, the project team shall perform the following:

a. As applicable, develop and incorporate concepts, mission development strategies, acquisition strategies, implementation plans, space operations service agreements, launch services agreements, and other internal agreements, and management plans into a preliminary Project Plan (see Appendix E.4.).

b. Identify project LCC elements, schedule, risks, and performance baseline and refine throughout the formulation subprocess (see paragraphs 4.2 and 4.4). Each project with an estimated NASA LCC greater than $150M shall support the NASA CFO in preparing an ILCCA, certified by the CFO and delivered to Congress. This ILCCA shall be conducted in conjunction with a Requirements Review (RR) (See Appendix B).

c. Ensure that project success criteria are defined, as a portion of the top-level project requirements and flow down as appropriate to lower level project elements.

d. Beginning in early project formulation, work with the Office of External Relations and the EAA to identify potential non-NASA partners and necessary agreements for international or interagency cooperation; all activities and documentation must be consistent with policy guidelines and with program or Agency-level agreements with the partners.

e. Maintain effective communication with the program customers regarding the interpretation and accommodation of requirements.

f. Develop and manage acquisition strategy for the conduct of the formulation subprocess and generate a preliminary acquisition strategy for project implementation (see paragraph 4.5).

g. Define project metrics for assessment of project performance (see paragraph 4.4.2.2)

h. Review, approve, and monitor progress of all project formulation products.

i. Define an integrated and comprehensive continuum of reviews tailored to the scope, complexity, visibility, cost, safety, and acceptable risk associated with the project.

j. Establish a configuration management system that provides visibility and control of performance and functional and physical characteristics over the project and product life cycle. Configuration management is applied to requirements, documentation, qualification, protoflight, flight and ground support hardware, and software.

k. Use risk-management planning as a basis for decisions (e.g., to release reserves) to mitigate cost, schedule, technical, environmental, security, or safety risks.

l. Ensure that the project establishes program control and management systems, which provide for WBS development, acquisition management, information technology management, resource management, EVM, facilities, environmental, logistics, and schedule management.

m. Integrate environmental planning processes with other project planning early in the formulation subprocess. Prepare environmental documentation in accordance with the National Environmental Policy Act and other pertinent environmental statutes, regulations, and Executive Orders (see paragraph 4.6.5).

n. Establish logistics support requirements per NPD 7500.1, Program and Project Logistics Policy, to identify and address life-cycle cost drivers for logistics, define logistics requirements that support design, and quantify the equipment and material required.

3.1.2 Systems Analysis

This activity provides the systems analysis and LCC analysis necessary to produce feasible concepts and explore a wide range of implementation options to meet project objectives. It considers risks, technology alternatives, operations, business opportunities, schedule, and infrastructure useful to the project. To accomplish systems analysis, the project team shall accomplish the following:

a. Perform trade studies among candidate project concepts that consider content, safety, affordability, risk, technology, security, environmental impact (see paragraph 4.6.5), and acquisition strategies.

b. Prepare for the adoption of the SI as the baseline measurement system per NPD 8010.2, Use of the Metric System of Measurement in NASA Programs, early in the formulation subprocess. If a waiver is required, it shall be approved prior to the Requirements Review.

c. Examine project concepts considering estimated life-cycle cost in tradeoffs of commercialization possibilities, technology alternatives, business opportunities, operational needs, and infrastructure availability.

d. Develop project performance requirements and, as applicable, preliminary system and subsystem performance specifications.

e. Develop and continually update assessment of project risks and risk mitigation actions and ensure that accepted risks are compliant with program risk strategies.

f. Develop the LCC analysis of the project to include the direct, indirect, recurring, nonrecurring, and other related costs for the design, development, production, operation, maintenance, support, and retirement of the project.

3.1.3 Technology Assessment

3.1.3.1 This activity examines the project's concepts and assesses the technology requirements for feasibility, availability, technology readiness, opportunities for leveraging research, and new technologies. Technology assessment is accomplished early in formulation to assure that technology needs are identified and evaluated, and that infusion is appropriately planned. As a project progresses through its life cycle, additional technology assessments may be necessary to take advantage of the latest and most promising technologies that will reduce program risk, gain performance, or overcome problems with selected technologies that are not maturing satisfactorily. The technology assessment activity defines which technologies should be incorporated into the project and those that should be considered for funding at the program level.

3.1.3.2 To accomplish the technology assessment, the project team shall perform the following:

a. Identify technologies required to support the proposed project utilizing available tools and resources such as the NASA Technology Portal to identify potential technologies, e.g., http://nasatechnology.nasa.gov/index.cfm.

b. Assess systems concepts to determine technical viability based on current capabilities, existing program or Agency crosscutting technology activities, and the potential for leveraging commercial technologies and external partnerships.

c. Identify where technology gaps exist, including those significant enough to question the viability for a concept to be realized, and determine the approach to be used to fill the identified gaps.

d. Where gaps in technology solutions are too large to meet the needs of the program, provide this information to the program's originating Enterprise for consideration of incorporation into the Agency's technology planning process and possible crosscutting technology programs.

e. Evaluate those technologies that can incrementally improve project capabilities, decrease risk, improve safety, or reduce cost.

f. Identify technologies that have distribution restrictions on the software, hardware, or data.

3.1.4 Technology and Commercialization Planning

This activity plans the technology approaches that satisfy the identified needs of candidate concepts. It also develops options for partnering and commercialization. Further, this activity provides for the development of plans and the establishment of partnerships to transfer technologies, discoveries, and processes with potential for commercialization. To accomplish technology and commercialization planning, the project team shall perform the following:

a. Generate technology development plans to remove technology gaps identified in the assessment specified in paragraph 3.1.3.

b. Explore innovative avenues to expand participation and infuse the latest technological and commercial capabilities into the project.

c. Explore how the assets (technology, discoveries, innovations, tools, processes, or software), developed as a byproduct of the project execution, can be infused into industry.

d. Identify, verify, and report success stories to the Center Commercialization Office that have resulted from partnerships, transfer or commercialization of assets.

e. Ensure that the plans for technological or commercial cooperation include a full description of the opportunities for partnering, the potential partners, the need for protection of intellectual property, the likelihood of the partnership coming to fruition, the expected contribution (personnel, facilities, Independent Research and Development (IRAD), and other funding) and the confidence that the partnership will remain in force.

f. Where possible, integrate NASA plans with the technology and commercialization plans of its U.S. customers. Potential U.S. cooperative technology and commercialization opportunities are to be explored and, where advantageous to NASA, agreements enacted.

g. Ensure that the planned technology exchange, contracts, and partnership agreements comply with all laws and regulations regarding export control and the transfer of sensitive and proprietary information.

3.1.5 Development and Operations Business Opportunities

In this activity, the Project Manager identifies business opportunities for partnerships in the development and operational elements of the project. In searching for partnering opportunities, the Project Manager will accommodate agreements and partnerships formed at the program level, and remain consistent with the strategic direction issued by the EAA. Business opportunities in the developmental part of the project will assess the resources and aligned interests of other Government agencies, industry, academia, and international entities, to provide one or more of the project end-item deliverables and reduce LCC. The business opportunities for the operational element will consider communications,

tracking, and data functions. Development of an operations concept will examine the viability of autonomous control and distributed versus centralized operations, and the possibility of commercial operation opportunities. Partnering opportunities and relationships identified through these activities will be assessed for feasibility through the systems analysis specified in paragraph 3.1.2, and the final agreements negotiated. This activity is interdependent with the assessment and planning specified in paragraph 3.1.6, to the extent that an integrated set of outputs is required. To accomplish this assessment, the following shall be performed:

a. Assess development and operational requirements, evaluating alternative approaches to meeting project needs while minimizing Agency resources.

b. Assess teaming and partnering options, including commercial ventures, for the development and operational elements to reduce the project LCC.

c. Develop requirements for communications, tracking, data processing, and mission operations. NASA services shall be used unless a more cost-effective, life-cycle approach can be proposed.

d. Develop an approach for disposition of project assets (orbital and other) after the end of their useful life.

3.1.6 Assess Infrastructure and Plan Upgrades/Development

This activity assesses the capability of the Agencywide infrastructure to satisfy project requirements. Resources in other Government agencies, industry, academia, and international entities will also be considered to minimize program LCC's. Plans are developed for required upgrades and development that may minimize multiprogram or multiproject LCC's. To accomplish this assessment, the following shall be performed:

a. Identify capability gaps and produce plans and required documentation for infrastructure upgrades or new development, including environmental compliance (see paragraph 4.6.5), as required for such things as integration and test facilities, research facilities, data systems, office space, and document in the Project Plan.

b. Perform cost trades to enable meeting requirements through synergy with other programs/projects, thus avoiding costly duplication of support facilities.

c. Perform an appropriate level of analysis to identify the operations and maintenance cost drivers and to assess impacts on the Agency's infrastructure and project logistics support needs.

d. Identify testing requirements (e.g., ground and flight facilities, research aircraft and data needs) and verify infrastructure capability.

3.1.7 Capture Knowledge

The objective of this activity is to enable future projects to benefit from lessons learned during the following formulation subprocess:

a. Process-related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

b. Documentation associated with project formulation, which includes the significant events, options studied, tradeoffs made, resources expended, time consumed, and any other performance information, shall be maintained in order to assist other projects with their execution.

3.2 Project Approval

3.2.a The project approval subprocess determines a project's readiness to proceed with implementation. It may result in transition from formulation to implementation. Subsequent approvals may be required as a result of changes to the Program Plan or Project Plan based on budgetary, technical, or institutional considerations. Each project shall execute the approval subprocess.

3.2.b Only projects whose objectives are clearly documented and consistent with the Program Plan and where success criteria, life-cycle cost, schedule, and technical performance commitments can be made will be approved. Resources and associated margins will be commensurate with the acceptable risk. The project approval subprocess flow is presented in Figure 3-2. The project budget direction/constraints and decisions made from recommendations by the EC are a direct input to the approving official. The Approving Official(s) will be identified in the PCA and Program Plan.

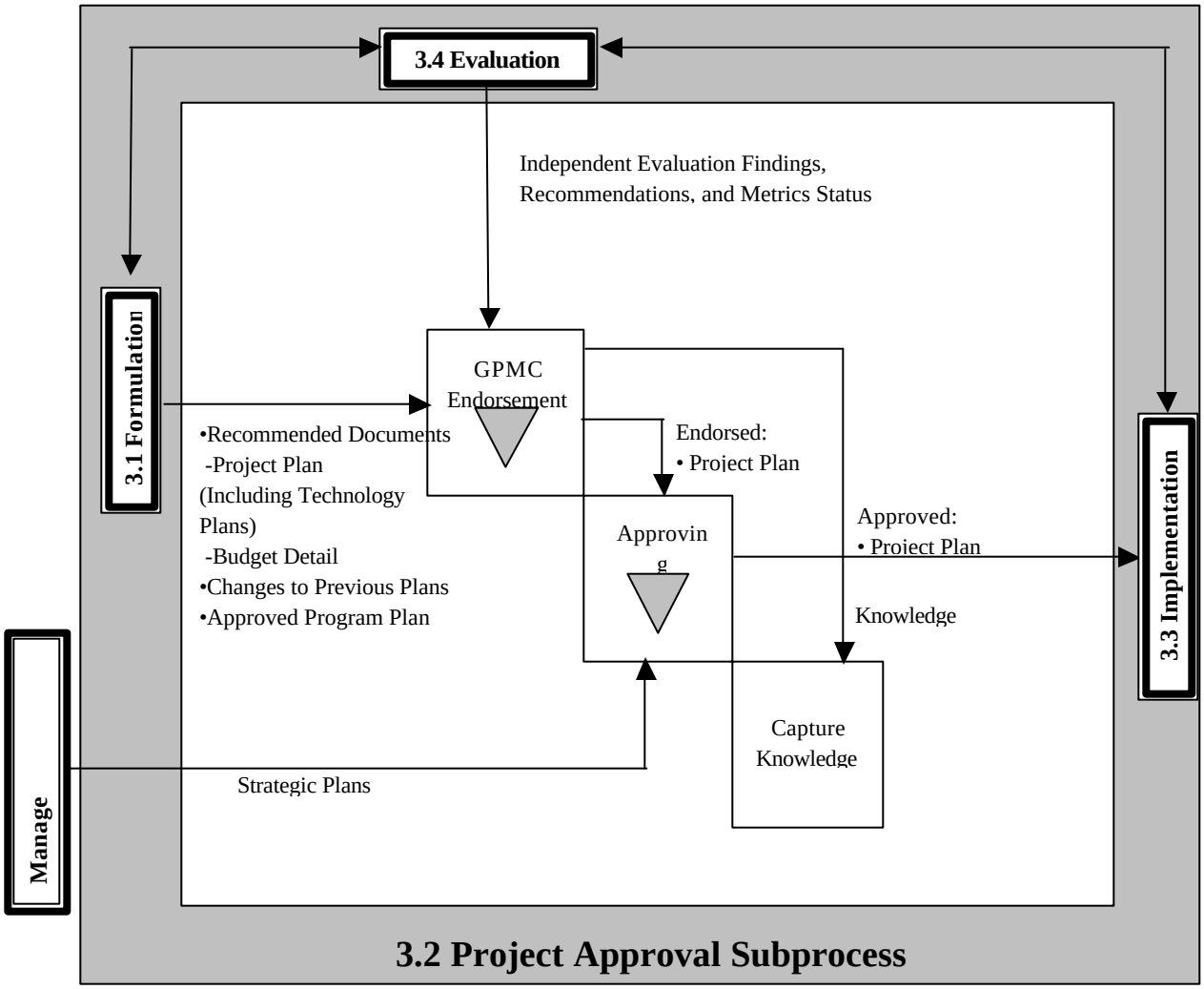


Figure 3-2. Project Approval Subprocess

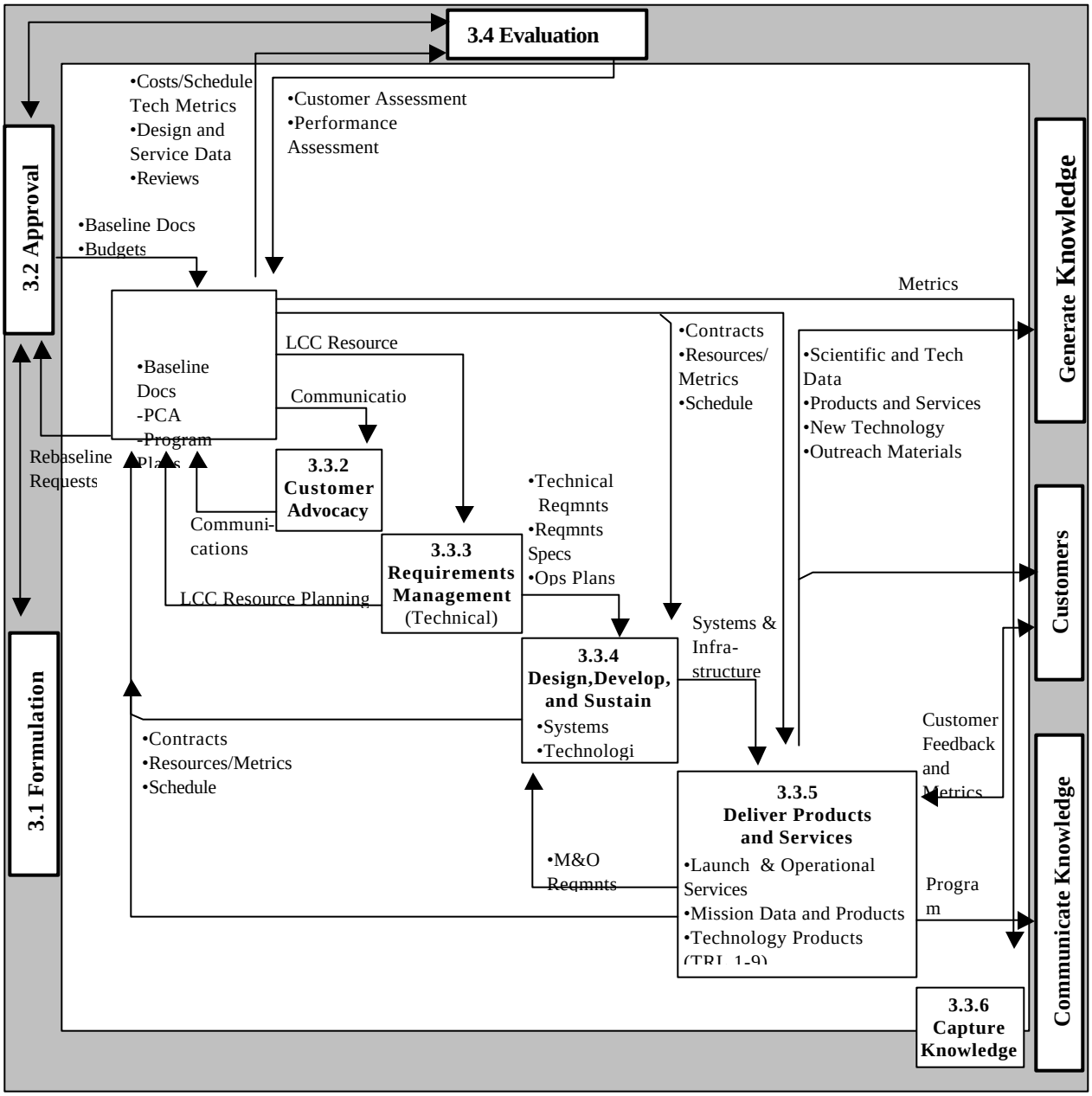
3.2.c In requesting approval for a project, the Project Manager presents project information developed in formulation to the GPMC. This information consists of a Project Plan and supporting information (e.g., institutional resources). The evaluation subprocess provides independent review results to the GPMC in support of the approval activity. Based on the GPMC review and recommendations, the Project Plan is signed by the Program Manager, Project Manager and Center Director. If required by the Program Plan, the Project Manager will obtain any other approvals.

3.2.d The Project Plan shall be updated if changes are required. The process for updating the Project Plan is defined in the Program Plan. Changes in success criteria, resource requirements or availability may necessitate project reformulation and reevaluation for implementation or termination. The Project Manager will classify proposed changes as either major or minor. Major changes represent significant impacts to requirements, schedule, resources, risks, or agreements; all other changes are minor. The

Program Manager has the authority to approve a revised Project Plan with minor changes. The CD and Program Manager shall approve all major changes to the Project Plan. All changes, major and minor, are documented in the change log of the Project Plan.

3.3 Project Implementation

3.3.a The project implementation subprocess implements the approved project requirements and plans. The subprocess shall be executed as depicted in Figure 3-3, in accordance with the controlling documents developed during the formulation and approval subprocesses. In tailoring the implementation subprocess, all requirements shall be addressed. The approach to addressing the requirements may be tailored to meet the specific needs of the program, including critical characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. The implementation subprocess translates the input products from the formulation and approval subprocesses into the production of output products and services for the designated customers.



3.3 Project Implementation Subprocess

Figure 3-3. Project Implementation Subprocess

3.3.b Each project executes the following implementation activities:

(1) Project Control. (See paragraph 3.3.1.) This activity develops, integrates, and provides direction and exercises control over budget, schedules, and acquisition.

(2) Customer Advocacy. (See paragraph 3.3.2.) This activity maintains contact with customers and advocacy for customer objectives, plans, and requirements implementation.

(3) Requirements management. (See paragraph 3.3.3.) This activity is the decomposition of requirements and performance specifications received from project formulation into detailed implementation requirements (functional, performance, physical characteristics or detail design).

(4) Designs, Develop, and Sustain. (See paragraph 3.3.4.) This activity produces the specific project systems, hardware, and software.

(5) Deliver Products and Services. (See paragraph 3.3.5.) This activity delivers the project products and services, including science and technology. It includes operations of delivered systems to produce data for customers.

(6) Capture Knowledge. (See paragraph 3.3.6.) This activity collects and evaluates process performance metrics to identify process corrective actions and/or to communicate the lessons learned in using these processes.

3.3.1 Project Control

3.3.1.1 This is an activity through which the Project Manager provides direction and exercises control over the project. The purpose of this activity is to ensure that project implementation is conducted in an effective manner, beginning with and maintaining a thorough understanding of project requirements and the resources required to meet those requirements. The activity develops and maintains project plans, budgets, schedules, and top-level performance requirements, acquisitions and customer agreements. This activity develops and integrates the overall implementation approach and provides management oversight of all aspects of the project.

3.3.1.2 To accomplish project control, the project team shall perform the following:

a. Periodically assess the adequacy of resources, including margins, to meet the project requirements and if margins become inadequate, develop and implement a recovery plan.

b. Manage acquisition per the requirements in paragraph 4.5 to maintain acquisition plans, execute procurements and agreements in accordance with Federal law and regulations, and ensure monitoring and reporting of activities related to contract and nonprocurement instruments.

c. Perform resources management per the requirements in paragraph 4.2 to ensure the appropriate acquisition and distribution of resources and support the Agency budget process. Document and manage work authorization including scope, schedule, and budget.

d. Maintain an effective safety and mission success activity throughout all design, development, delivery, operations and retirement or disposal activities per the requirements in paragraph 4.6.

e. Manage schedules per the requirements in paragraph 4.4 to maintain the baselined schedule consistent with project milestones and the program WBS.

f. Ensure that the baselined project documents, including the product baseline, are maintained under configuration management.

g. Maintain the project within the scope of the baseline agreements and documents and assess scope changes and impacts caused by customer and evaluation subprocess recommendations, budgetary processes, performance assessments, external agreements performance, and other factors. The Project Plan shall be updated, as required, to maintain compatibility between the plan and the resources available. Prepare recommendations and request rebaselining through the approval subprocess via the Program Manager.

h. Implement risk management per the requirements in paragraph 4.3 to identify risk and its impact and prioritize risks for mitigation or elimination and maintain the Risk Management Plan.

i. Assess and report performance per the requirements in paragraph 4.4 to include the assessment of project status against established metrics, the evaluation of variances, and any GPMC assigned actions.

j. Conduct an integrated continuum of reviews as specified in the Project Plan, based on the guiding principles and major classes of reviews provided in Appendix F. Address, close, and report issues in a timely manner and apprise management of changes to residual risks.

3.3.2 Customer Advocacy

The purpose of this activity is to proactively consult and involve customers in the implementation subprocess to ensure customer satisfaction with delivery of quality products and services within budget and schedule commitments. It provides internal implementation process advocacy of customer interests in project decision forums.

3.3.2.1 The project shall ensure that the customers are an integral part of the project to clarify requirements and assess implementation progress against commitments.

3.3.2.2 The project shall implement customer advocacy per the Project Plan.

3.3.3 Requirements Management

This activity flows down higher level requirements into more specific requirements and allocates them to lower level project elements. To accomplish Requirements Management, the project team shall perform the following:

a. Define project requirements consistent with the Project Plan technical content, cost, schedule, security requirements, and institutional requirements.

b. Perform project systems engineering and analysis to ensure that cost-effective requirements are specified and to refine and validate LCCs.

c. Collect and allocate project requirements into implementable elements.

d. Document, and maintain under configuration control, project requirements, requirements verification, and end-item specifications including Government-furnished equipment and operations.

3.3.4 Design, Develop, and Sustain

3.3.4.1 This activity develops the specific technology and/or systems and establishes the supporting infrastructure for sustaining engineering, logistics, continuing production and operations. For projects that deliver systems, the integration of design, development, manufacturing, verification and validation, certification, operations capability development, and overall systems development monitoring and control are major elements of this activity.

3.3.4.2 The project team shall perform the following, as applicable:

a. Conduct analyses and reviews of integrated system designs to optimize design for project requirements and direct project activity accordingly.

b. Execute contracts and nonprocurement instruments and conduct appropriate surveillance commensurate with risk.

c. Develop, review, and execute a verification and validation plan that includes software/hardware integration and appropriate independent verification and validation of software.

d. Ensure incorporation of new technology/commercialization per technology and/or commercial development plan(s) and validate the project technology utilization approach.

e. Establish and maintain logistics support capability to sustain delivered hardware and software systems, consistent with intended mission requirements and plans.

f. Ensure that critical facilities, equipment, and materials are available when needed.

g. Provide sustaining engineering to accommodate efficiency enhancements, safety enhancements, and obsolescence.

h. Use technical standards with preference given to non-Government voluntary consensus standards. Maintain a listing of project office required Government and non-Government standards and specifications, and evaluate the impact of relevant changes.

i. Implement the International System of Units (metric measurement system) as planned in program formulation.

j. Identify, document and control baseline engineering and technical management information.

k. Protect intellectual property and technology in accordance with paragraph 4.7.

l. Assure that a security risk assessment is accomplished.

3.3.5 Deliver Products and Services

3.3.5.1 This activity ensures delivery of the project products, services, and/or technology to the customer. It includes operations of delivered systems and production of products for science and technology customers. Routine interaction and outreach with the project customer community to pursue customer satisfaction is a critical function. This activity also performs project retirement/closeout planning and execution. To perform these functions, the following shall be delivered as required by the Project Plan:

a. Project flight and ground systems, including spare and ground support equipment.

b. New technology through data, information, products, and services.

c. Acceptance/turnover agreements and data for those products requiring transfer of custodial responsibility.

d. System maintenance and operating procedures and training.

e. As-built documentation.

3.3.5.2 The operations activities shall include the following, as required:

a. Perform operational readiness tests for project end-to-end system readiness and support integrated program testing.

b. Launch, operate, and maintain project flight and ground elements and provide sustaining engineering.

c. Provide customer support services, including user guides, training, and simulation support.

d. Maintain configuration management control of mission and operations plans.

e. Collect, analyze, and report operations performance metrics.

f. Collect, analyze, and report technology and commercialization data and status.

g. Refine and implement plans for disposition of project assets (orbital and other) after the end of their useful life.

3.3.6 Capture Knowledge

The objective of this activity is to enable future programs/projects to benefit from lessons learned during the implementation subprocess.

3.3.6.1 Process related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

3.3.6.2 Documentation associated with project implementation, including engineering and technical management information as well as resources expended, time consumed, and any other performance information, shall be maintained in order to assist other programs/projects with their execution.

3.4 Project Evaluation

3.4.a The evaluation subprocess provides an independent assessment of the continuing ability of the project to meet its technical and programmatic commitments and to provide value-added assistance to the Project Manager. It is applied throughout the life cycle of projects and consists of periodic independent reviews during the formulation and implementation of a project, as defined in either the FAD or the Project Plan. These, together with the other classes of reviews delineated in Appendix F, shall be appropriately combined to comprise the integrated continuum of reviews required in paragraph 3.1.1.3.h. The Agency Independent Program Assessment Office and the Systems Management Office at each Center are key resources to Agency and Center Senior Managers, PMCs and program and project managers in executing independent assessment of projects and providing recommendations.

3.4.b The evaluation subprocess, shown in Figure 3-4, utilizes review teams composed of knowledgeable, independent experts from outside the advocacy chain of the project. Evaluation supports the approval subprocess by providing findings and supporting data necessary to arrive at decisions either to proceed or not to proceed with subsequent portions of the project life cycle. Evaluation during formulation assesses whether projects support Agency and program goals and strategic planning and that projects can be successfully conducted within allocated resources and applicable constraints. Evaluation during implementation assesses whether projects are being

successfully executed according to plans and provides findings for enhancing the technical and programmatic performance of projects.

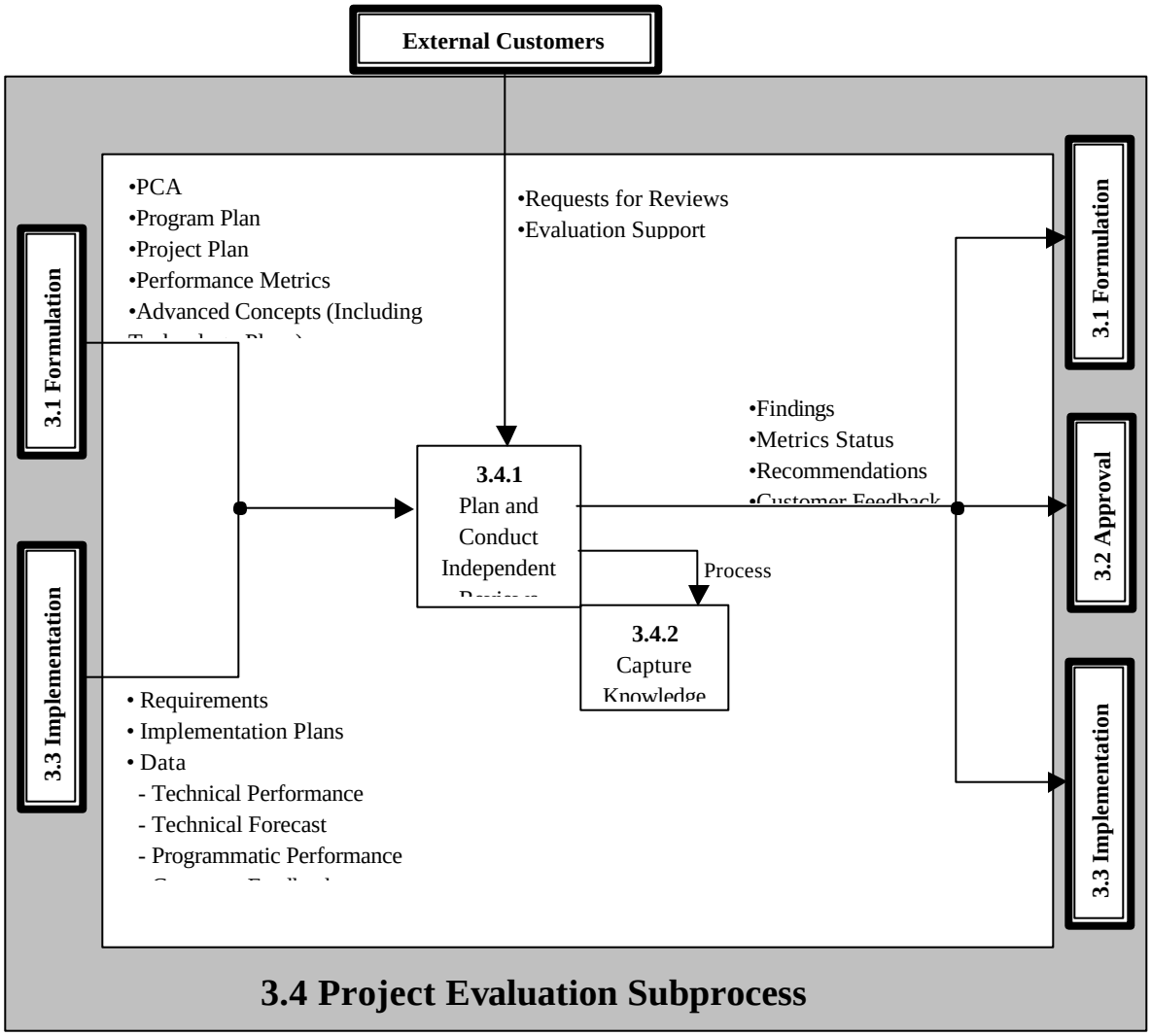


Figure 3-4. Project Evaluation Subprocess

3.4.c All projects shall execute the evaluation subprocess in compliance with applicable requirements of the Program Plan. The project FAD, or equivalent, and Project Plan shall specify the requirements, timing, and objectives for independent reviews. The evaluation subprocess should be planned to minimize disruptions to the project and avoid unnecessary duplications. Prior to independent reviews, the current FAD, Project Plan, and other appropriate program and project documentation are provided to support evaluation. Independent reviews shall address, as a minimum, technical requirements and

achievements, schedules, projected LCC, issues, concerns, safety, security, environmental compliance, risk management plans/status, and other program metrics. The independent review results shall be presented to the GPMC as specified in both the Project Plan and Program Plan.

3.4.d Note that requests for audits, additional reviews and assessment of projects may come from the Congress, the NASA Inspector General, the General Accounting Office (GAO), advisory groups such as the Space Science Advisory Committee, and other similar sources. When requested, the NASA Chief Engineer shall coordinate responses to external review requests, work in concert with the EAA and the office responsible for management controls to disposition such requests, and coordinate the scheduling of such activities with the Project Manager and GPMC.

3.4.1 Plan and Conduct Independent Reviews

3.4.1.1 This activity plans and conducts the specific reviews as defined in the FAD and Project Plan. Requirements, implementation plans, data, and customer feedback are all made available for the evaluation subprocess.

3.4.1.2 The purpose and methodology of each review shall be defined prior to initiating the review.

3.4.1.3 During the formulation subprocess, when a project has an estimated NASA LCC greater than $150M, an ILCCA is required in conjunction with initiating preliminary design, the results of which shall be certified by the Chief Financial Officer (See paragraph 3.1.1.3.b).

3.4.1.4 All projects, in preparation for requesting approval, shall conduct a NAR, or equivalent, to determine the readiness of the project to proceed into implementation. The NAR shall include an ILCCA. Additional independent reviews (e.g., Independent Assessment) may also be required during formulation by the GPMC or EAA.

3.4.1.5 Concurrent with the implementation subprocess, evaluation shall consist of periodic IIR's that measure project performance and compare that performance with the Project Plan.

3.4.1.6 The GPMC chair, or designee, shall concur that review teams are composed of knowledgeable, independent experts from outside the advocacy chain of the project, and customer representatives, as appropriate.

3.4.1.7 Special purpose independent reviews (e.g., Termination Review) shall be conducted, as required, at the direction of the GPMC. Requests for special purpose reviews may come to the GPMC from customers, line organizations, or others. Elements such as the anticipated inability of a project to meet its commitments contained in controlling agreements and plans, including a projected cost at completion that exceeds the costs allowed; an unanticipated change in Agency or program planning; or an unanticipated change in the budgets shall be considered prior to convening a Termination Review.

3.4.2 Capture Knowledge

The objective of this activity is to enable future programs/projects to benefit from lessons learned during the evaluation subprocess.

3.4.2.1 Process-related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

3.4.2.2 Documentation associated with project evaluation, as well as resources expended and time consumed, shall be maintained by the SMO and/or IPAO in order to assist other programs/projects with their execution.

CHAPTER 4. Program/Project Management Requirements

4.0. Introduction

This chapter addresses program/project life-cycle activities, functions, tools, and disciplines that are—
a. generally applicable to all programs and projects, regardless of the acquisition instrument,
b. applicable to all subprocesses described in the PAPAC process,
a. vital to the success of program or project management, and
b. unique requirements driven by statutory, regulatory, or executive direction.

4.0.a Program and project managers are encouraged to contact appropriate functional office staff to ensure that all applicable management requirements have been identified, planned for, and implemented appropriately (also, see Appendix A). Functional offices will provide appropriate expertise, assistance, and counsel to the Program/Project Manager in a timely fashion to facilitate compliance with the applicable requirements.

4.0.b Program and project managers are responsible for addressing all applicable requirements, including management requirements. Applicable controlling legislation, circulars, policy directives and policy guidance are cited at the beginning of each of the subsequent sections. Although the applicable documents may not be specifically used in the text of those sections, they are provided as the authoritative sources of requirements and guidance on the relevant subject. Other references are provided for information.

4.1 Management of Human Capital

4.1.a The success of NASA programs and projects directly depends on the skills and capabilities of the people on, and supporting, program/project teams. People are our greatest asset in ensuring exceptional performance, therefore the development and management of our "human capital" is as critical to the success of the project or program as the management of any other resources at the disposal of the Program/Project Manager.

4.1.b Program/project management success is ultimately dependent on the effective collaboration of the people. The manager must view the program/project team as the most essential attribute for mission success. Behaviors associated with effective teaming include open communication, recognition of superior performance, team development, proper staffing, knowledge management, and personal development and learning.

4.1.c This section addresses the critical relationship of our personnel to program/project success.

4.1.d References

(1) NPD 3000.1, Management of Human Resources.
(2) NPD 3410.2, Employee and Organizational Development.
(3) NPD 3451.1, NASA Awards and Recognition Program.
(4) NASA Professional Development Guide.
(5) Program Project Management Development Program.
(6) Academy of Program and Project Leadership (APPL) Web site: (http:// appl.nasa.gov).

4.1.1 Purpose

The purpose of this section is to provide requirements and guidance on staffing, developing, and recognizing the achievements of the program/project team.

4.1.2 Requirements

It is the responsibility of the Program/Project Manager to assure that the program/project team is staffed with personnel with the appropriate skills, abilities, and experience to successfully execute the program/project. The program/project team is composed of civil service personnel, contractors, partners, and customers.

a. It is the responsibility of the Program/Project Manager to be familiar with the characteristics of superior project teams found at http://appl.nasa.gov.

b. The Program/Project Manager shall develop staffing requirements consistent with the needs over the life cycle of the program or project. Appropriate staffing of program/project teams shall include consideration of managerial and administrative skills, technical and scientific skills, interpersonal skills, and experience. Tools to assist the Program/Project Manager in staffing the team may be found on the APPL Web site.

c. In their supervisory capacity, program/project managers shall provide for the individual development of those team members that report directly to them. In addition, project managers should collaborate with line managers on the individual development needs of other members of the team.

d. The Program/Project Manager shall perform a "gap" analysis to identify specific team skills and deficiencies and provide integrated team training to eliminate these gaps.

e. Program/project managers and program/project personnel shall participate in a minimum of 40 hours annually of project management or skills development training and are additionally encouraged to participate in at least 40 hours of additional development activities.

f. The Program/Project Manager shall recognize the achievements of the program/project team. The execution of this responsibility should include sharing of best practices, lessons learned, and encouraging

a continual learning environment. The Program/Project Manager is also responsible for the use of the NASA Awards and Recognition Processes to acknowledge successful, high-performing individuals and teams.

4.1.3 Available Development Resources

NASA maintains the APPL to develop, maintain and support program and project professionals. The Academy emphasizes project management competencies achieved through on-the-job work experiences that are supplemented by development programs that include formal training, development assignments, university programs, team consultation services, and e-learning and automated tools. A full description of services and support can be found at http://appl.nasa.gov. The following services are available to support both individual professional growth, as well as project team capability. NASA encourages managers to take advantage of these opportunities to enhance the likelihood of the following mission success:

a. Project Management Development Process (PMDP) – This model serves as the NASA-wide standard for professional competency for practitioners of programs and projects. The model emphasizes the importance of on-the-job experiences that are supplemented by other learning strategies. PMDP offers project professionals certificates of achievement at four levels of proficiency.

b. Accredited Project Management Curriculum – A large array of training programs are available to facilitate capability. These courses are based on NASA requirements as identified in the PMDP model. A full description of offerings, schedules, and agendas are included in the Academy Web site listed above.

c. E-Learning and PM Tools – The Academy Web site offers a variety of materials, tools, references, and learning aids that go directly to the individual and are available at any time. Tools are available to assess project team effectiveness.

d. Performance Support for Project Teams – Projects can receive tailored expert consultation that goes directly to the team when the need is greatest. Consultation is designed to meet project requirements. Project planning and scheduling, cost controls, risk assessment, and management and team building are some of the services that have been provided.

e. Knowledge Management – APPL supports knowledge sharing forums and activities targeted at capturing best practices, lessons learned, and encouraging practitioner exchange and networking. These activities span both internal NASA communities and external partners and leading organizations.

4.2 Resources Management

4.2.a This section addresses the requirements for management of the resources supporting program/project management. Within this context, financial resources management, life-cycle costing, and information technology resource requirements will be discussed.

4.2.b References

(1) NPD 1440.6, NASA Records Management.
(2) NPG 1441.1, NASA Records Retention Schedules.
(3) NPD 2800.1, Managing Information Technology.
(4) NPG 2800.1, Managing Information Technology.
(5) NPD 7000.3, Allocation and Control of Agency Resources.
(6) NPD 8070.6, Technical Standards.
(7) NPD 9050.3, Administrative Control of Appropriations and Funds.
(8) NPD 9501.1, NASA Contractor Financial Management Reporting System.
(9) NPG 9501.2, NASA Contractor Financial Management Reporting.
(10) NPD 9501.3, Earned Value Performance Management.
(11) 40 U.S.C. 1401 *et seq.,* the Clinger-Cohen Act of 1996 (Section 808 of Pub. L. 104-208; renaming, in pertinent part, the Information Technology Management Reform Act, Division E of Pub. L. 104-106).
(12) 44 U.S.C. 3501 *et seq.,* The Paperwork Reduction Act of 1995 (Pub. L. 104-13 of May 22, 1995), as amended.
(13) NASA Financial Management Manual, Volumes 9000, 9100, and 9300.
(14) OMB Circular A-94, Guidelines and Discount Rates for Cost-Benefit Analysis of Federal Programs.
(15) OMB Circular A-11, Preparation and Submission of Budget Estimates.

4.2.1 Financial Management

4.2.1.1 Purpose

Financial resources management ensures that budgets are developed and administered according to program/project needs; funds are controlled within funding constraints and governing laws and regulations; and contractor financial reporting meets program/project needs and governing NASA procedures and instructions.

4.2.1.2 Requirements

a. Budget Development and Execution. Program and project managers support the Agency in submitting the NASA budget and in executing NASA's programs approved through the congressional authorization and appropriations process. Specific guidance on Integrated Financial Management

System (IFMS) implementation and the revised budget structure and process is contained in a variety of IFMS handbooks, revisions to the Financial Management Manual, and the Chief Financial Officer's (CFO) annual Budget Guidelines. The following represent the simplified, anticipated steps of the budget development and execution process:

(1) Guideline Development

(a) The Administrator and the EC provide strategic guidance for Enterprises, Centers, and Functional Offices.

(b) Detailed guidance is developed by Enterprises and Functional Offices, working with the Program Managers and CDs, and provided to the CFO. The CFO issues a single set of budget guidelines annually.

(2) Budget Submissions

(a) Initial submissions are prepared by the projects, programs, and Centers and forwarded to both the program managers and the Institutional Program Office (IPO). Feedback is provided from both the program managers and the IPOs. CDs, program managers, and project managers then revise their full-cost submissions. Final submissions are made to the appropriate Enterprise Associate Administrator (EAA). The EAA allocates budgets across programs and across Centers. Functional Offices provide their assessments to the EAA's.

(b) The Enterprise and Functional Offices are responsible for submitting and advocating their requirements to the CFO, the EC, the Administrator, the Office of Management and Budget, and the Congress.

(c) Implementation of final decisions (internal and Administration) flows back down to the performing Centers through the same path that submissions follow.

(3) Budget Execution

(a) Congressional authorization and appropriations are implemented in accordance with Agency direction on operating and phasing plans. Program/project managers support requirements for both initial and updated plans.

(b) Program and project status reporting shall be accomplished in accordance with directions from the PMC, the EAA's and Centers.

b. Contractor Financial Reporting. Contractor program/project cost reporting shall be applied to contracts according to NASA Contractor Financial Reporting Systems, as supplemented by reference 4.2.e and relevant Center directions.

(1) Contractor cost reporting and performance measurement shall be of sufficient depth to enable program/project management to accomplish the following:

(a) Review the cost and workforce expended on the project in relation to the schedule and technical progress.

(b) Determine the critical elements of risk to the program/project.

(c) Report progress relative to the Program and/or Project Plan.

(d) Support the EAA in reporting compliance with the PCA to the Agency PMC, if required.

(2) Contractor program/project performance data provided to NASA will be summarized directly from the same systems used for internal contractor management.

(3) For performance-based contracts, reporting shall be consistent with resource and performance metrics.

4.2.2 Life-Cycle Cost (LCC) Management and Accounting

4.2.2.1 Purpose

The purpose of LCC management and accounting is to ensure that programs and projects are managed on the basis of LCC, that costs are fully accounted for, and that the LCC is minimized.

4.2.2.2 Requirements

a. The LCC shall be developed to establish a program/project commitment, assessed at major reviews, and updated for each budget submission.

b. The LCC shall be determined using currently available full cost initiative guidance.

c. All cost estimates shall be summarized according to the current WBS and time phased by Government Fiscal Year (FY).

d. The LCC effects shall be projected for all major changes and submitted as a part of any formal change control request.

e. Program/project baselines are to incorporate program management flexibility, including financial reserves, schedule margins, and technical performance margins to enable the management of risks. Financial reserves shall be established and maintained commensurate with programmatic, technical, cost, and schedule risks. These reserves include the following:

(1) Allowance for Program Adjustment (APA). These reserves are available for approved changes in program or project objectives or scope, the resolution of unforeseen major problems, project stretch-outs from Agency funding shortfalls, and similar fiscal difficulties.

(2) Contingency. Sufficient reserves are allocated to and managed by the Program or Project Manager for the resolution of problems normally encountered while ensuring compliance to the specified project scope.

4.2.3 Information Technology Management

4.2.3.1 Purpose

This section establishes the requirements for managing, implementing, and reporting of Information Technology (IT) in Agency programs and projects.

4.2.3.2 Requirements

a. Programs and projects shall use existing NASA IT capabilities and resources to satisfy their IT requirements to the maximum extent possible. In addition to program/project-specific IT capabilities, the Agency has a robust IT infrastructure which includes wide area communications resources, NASA supercomputing resources, NASA mainframe and midrange computing resources, and desktop and intra-Center communications, Independent Verification and Validation (IV&V), and software-independent assessments services by the NASA Software IV&V Facility located in Fairmont, West Virginia, and software engineering process improvement resources from the NASA Software Engineering Laboratory at the Goddard Space Flight Center.

b. Program/project IT investments shall be separately planned for, evaluated in terms of its return on investment, budgeted, and managed. Planning shall cover the life cycle of the program and be sufficient to provide for data recovery, contingency facilities, and reconstitution of critical IT resources. IT systems, products, and services shall be assessed throughout their useful life to evaluate their effectiveness and efficiency in supporting program/project objectives. Assessments shall include metrics to evaluate the cost and performance of IT investments.

c. Program/project investments in IT shall meet Agency technical architecture and interoperability standards.

d. IT requirements shall be integrated into the planning and technical management effort throughout the execution of the program/project life cycle.

4.3 Risk Management

4.3.a This section will focus on the requirements for establishing effective risk management.

4.3.b References

(1) Software Engineering Institute at Carnegie Mellon University, Continuous Risk Management Guidebook, 1996, NTIS#: AD-A319533KKG, DTIC#: AD-A319 533\6\XAB, and NASA Continuous Risk Management Course, http://smo.gsfc.nasa.gov
(2) NPG 8715.3, NASA Safety Manual.
(3) NPG 8000.4, Risk Management Procedures and Guidelines.
(4) NPG 2810.1, Security of Information Technology.

4.3.1 Purpose

As depicted in Figure 4-1, risk management is a continuous process that identifies risks; analyzes their impact and prioritizes them; develops and carries out plans for risk mitigation or acceptance; tracks risks and the implementation of mitigation plans; supports informed, timely, and effective decisions to control risks and mitigation plans; and assures that risk information is communicated and documented. Risk management is driven by established success criteria and is performed by the entire team. Risk management begins early in the formulation phase with an initial risk identification and development of a Risk Management Plan and continues throughout the product's life cycle. The risk-based acquisition management initiative is a part of the continuous risk management process (see paragraph 4.5.5).

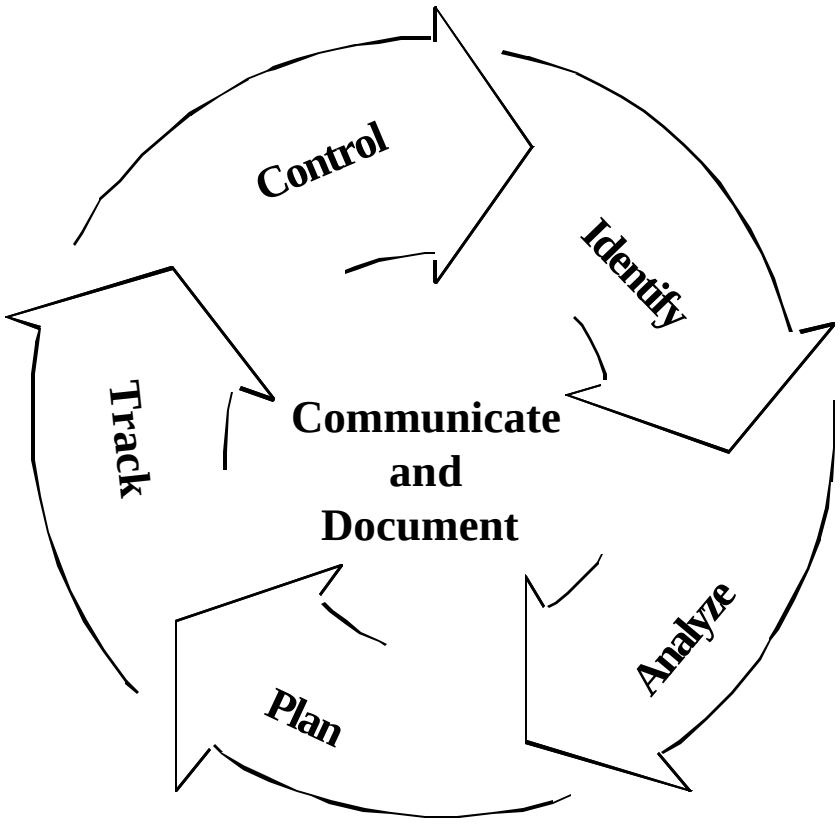


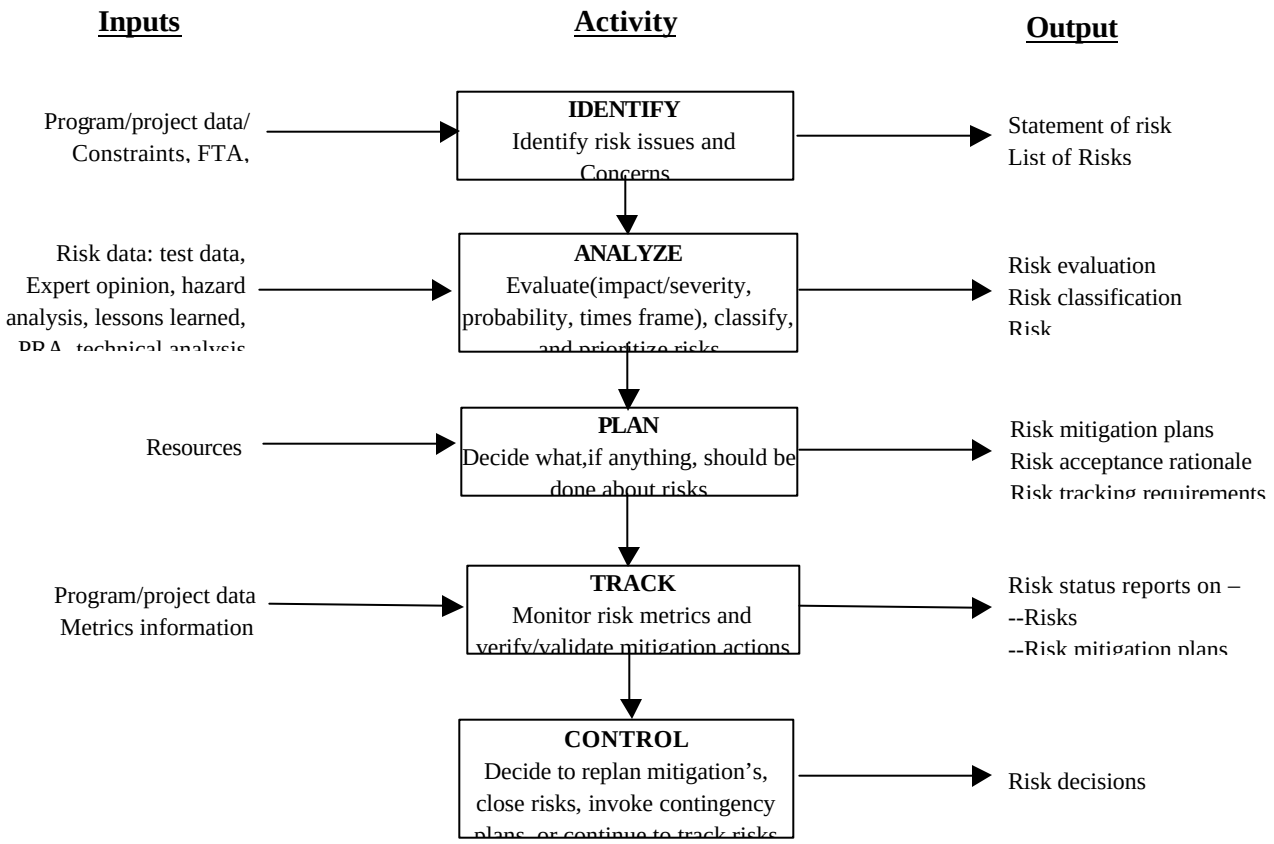
Figure 4-1. Continuous Risk Management

4.3.2 Requirements

The following is intended to outline the minimum activities necessary for a risk management process:

a. Risk Management Planning. Risk management planning shall begin early in formulation, shall involve the program/project team to assess all identifiable risks up front**,** shall be included in the PCA/Program/Project Plans (see appendices E.2, E.3 and E.4), and shall be continually reviewed for new risks and disposition and tracking of all identified risks throughout the implementation phase.

b. Risk Management Process Description. Each program/project shall follow a continuous risk management process as shown in Figure 4-2; this process will be iterated throughout the life cycle. The methods, such as Failure Modes and Effects Analysis (FMEA), Fault Tree Analysis (FTA), Probabilistic Risk Assessment (PRA), or others may be tailored for each program/project, but the activities described in paragraph 4.3.2c below shall be addressed throughout the life cycle. This process begins with risk identification and an assessment of program/project constraints, which will define the acceptable risk. Examples include, but are not limited to mission success criteria; development schedule; budget limits; launch window and vehicle availability; international partner participation; critical single-source suppliers; security or environmental concerns; human space flight safety issues; "fail ops/fail safe" requirements; facilities and infrastructure limitations; technology readiness; surveillance requirements; and amount and type of testing. If an IA has been performed, the program or project shall use the risks identified during the assessment as input. The risk management process continues with risk analysis, planning, tracking, and control. All risks shall be dispositioned before the delivery to operations or the equivalent for a technology program.



NOTE: Communication and documentation occurs throughout all of the activities.

Figure 4-2. The Risk Management Process

c. Risk Management Activities.

(1) Identify. State the risk in terms of condition and consequence(s); capture the context of the risk; e.g., what, when, where, how, and why. Tools such as FMEA and FTA can help to identify risks.

(2) Analyze. Evaluate risk probability, impact/severity, and timeframe (when action needs to be taken); classify/group with similar/related risks; and prioritize. Tools such as Probabilistic Risk Assessment (PRA) can help to analyze risk.

(3) Plan. Assign responsibility, determine approach (research, accept, mitigate, or monitor); if risk will be mitigated, define mitigation level (e.g., action item list or more detailed task plan) and goal and include budget estimates.

(4) Track. Acquire/update, compile, analyze, and organize risk data, report results, and verify and validate mitigation actions.

(5) Control. Analyze results, decide how to proceed (replan, close the risk, invoke contingency plans, continue tracking); execute the control decisions.

(6) Communicate and document. Essential risk status is to be communicated on a regular basis to the entire team, as well as to the GPMC. A system for documentation and tracking of risk decisions will be implemented.

d. Primary Risks. For each primary risk (those having both high probability and high impact/severity; e.g., a Risk Assessment Code of 1 or 2, as defined in Reference 4.3.b(2), the program/project shall develop and maintain the following in the risk sections of the Program/Project Plan and, as appropriate, in the PCA.

(1) Description of the risk, including primary causes and contributors, actions embedded in the program/project to date to reduce or control it, and information collected for tracking purposes.

(2) Primary consequences, should the undesired event occur.

(3) Estimate of the probability (qualitative or quantitative) of occurrence together with the uncertainty of the estimate. The probability of occurrence should take into account the effectiveness of any implemented risk mitigation measures.

(4) Potential additional mitigation measures, including a cost comparison, which addresses the probability of occurrence multiplied by the cost of occurrence versus the cost of risk mitigation.

(5) Characterization of the risk as "acceptable" or "unacceptable" with supporting rationale.

e. Acceptable Risk. Acceptable risk is the risk that is understood and agreed to by the program/project, GPMC, Enterprise, and other customer(s) sufficient to achieve the defined success criteria within the approved level of resources. Characterization of a primary risk as "acceptable" shall be supported by the rationale, with the concurrence of the GPMC, that all reasonable mitigation options (within cost, schedule, and technical constraints) have been instituted.

4.4 Performance Management

4.4.a This section addresses the needs of each program and project to establish effective mechanisms for tracking and maintaining successful performance. Topics within this section include EVM, performance assessment, schedule management, WBS, and process metrics.

4.4.b References

(1) NPG 5101.33, Procurement Advocacy Program.
(2) NPD 9501.3, Earned Value Performance Management.
(3) NPG 9501.1, Earned Value Management Implementation on NASA Contracts.

(4) OMB Circular A-11, Preparation and Submission of Budget Estimates.
(5) MIL-STD-881, Work Breakdown Structures for Defense Material Items.
(6) MIL-HDBK-245, Preparation of Statement of Work.
(7) The Government Performance and Results Act of 1993 (Pub. L. 103-62 of August 3, 1993).

4.4.1 Earned Value Management (EVM)

4.4.1.1 Purpose

EVM is to enable effective execution, management, and control and the integrated evaluation of cost, schedule, and technical performance against the baseline. EVM is the primary management tool to satisfy the performance-based management system requirement of OMB Circular A-11, Part 3.

4.4.1.2 The program/project manager shall perform the following:

a. Ensure that EVM provisions and requirements of References 4.4.b(2) and 4.4.b(3) are included in Requests for Proposals (RFP) and contracts.

b. Ensure that an effective surveillance program is in place to provide assurance that EVM data are valid and that the contractor's integrated management system remains in compliance with the EVM criteria.

4.4.2 Performance Assessment

4.4.2.1 Purpose

Performance assessment confirms satisfactory program/project performance and ensures timely identification of all problems throughout the life cycle.

4.4.2.2 Requirements

a. Each program and project shall establish a set of metrics, which are used to assess and report program and project performance against commitments throughout the life of the program or project. Metrics shall be identified in the PCA, Program Plan, and Project Plan.

b. Each program/project shall periodically generate Estimates at Completion (EAC). The program/project shall perform cost and schedule variance analyses based upon preestablished thresholds and prepare corrective action plans where necessary.

c. Reconciliation of the reported accrued cost to the reported work accomplished should be extended beyond acquisition activities to the maximum extent practical, e.g., civil service and in-house contractor project support.

d. For programs or projects required to provide Project Status Reports (PSR), as defined in General Accounting Office Report B-237602, "Project Status Reports," the appropriate EAA shall submit the report to the CFO. The CFO shall validate and, through the Office of Legislative Affairs, provide the completed PSRs to the appropriate congressional committees.

e. Program and project managers are required to support NASA GPRA compliance. The GPRA requires annual plans, setting performance goals, and reporting on actual performance against these goals. Performance goals and indicators, as well as output and outcome measures, are to be utilized in making and justifying key decisions on programs.

4.4.3 Schedule Management

4.4.3.1 Purpose

Schedule management ensures the establishment, management, and control of baseline master schedule and derivative schedules which provide the framework for time phasing and coordinating all project efforts into a master plan to ensure that objectives are accomplished within project or program commitments. Project or program performance against the baseline schedule represents a key element in the management of risk.

4.4.3.2 Requirements.

a. Each program and project shall develop, maintain, and execute integrated master schedules as follows:

(1) Provide a controlled schedule baseline, including all elements of the program or project WBS, and provide regular status reporting against the baseline.

(2) Provide hierarchical traceability to both the detailed (lower level) schedules and the milestones which are controlled by the approving officials (e.g., EAA, CD, Program Manager, Project Manager).

(3) Identify the program/project "critical path" for management and control.

(4) Contain all critical milestones for internal and external activities.

(5) Provide traceability based on a network logic format that relates all tasks and milestone dependencies and interdependencies from program/project start to completion.

b. Ensure that an automated program/project management (network/scheduling/critical path analysis) system that provides electronic interface and transmission capabilities is utilized to the fullest extent possible by the contractor and the program/project office.

4.4.4 Work-Breakdown Structure (WBS)

4.4.4.1 Purpose

The WBS serves as the structure for program/project technical planning, scheduling, cost estimating and budgeting, contract scope definition, documentation, product development, and status reporting and assessment (including integrated cost/schedule performance measurement).

4.4.4.2 Requirements.

a. A preliminary WBS shall be developed during the formulation phase. A final WBS shall be generated following contractor selection or approval to implement. The WBS is a product-oriented hierarchical division of the hardware, software, services, and data required to produce the program/project's end product(s), structured according to the way the work will be performed, and reflective of the way in which program/project costs, schedule, technical and risk data are accumulated, summarized, and reported.

b. The program/project shall develop a companion WBS dictionary that narratively describes the overall structure and content of each individual element of the WBS.

4.4.5 Program and Project Management Process Metrics

4.4.5.1 Purpose

The process metrics for PAPAC are developed by the Chief Engineer and supported by the Enterprises. They include a suitable mix of efficiency, output, levels of customer satisfaction, and outcome measures.

4.4.5.2 Requirements

Program and project managers shall support requests from the Enterprises associated with reporting these metrics.

4.5 Acquisition Management

References

a. 48 CFR Chapter 1, Federal Acquisition Regulation (FAR).
b. 48 CFR Chapter 18, NASA Federal Acquisition Regulation (FAR) Supplement (NFS).
c. OMB Circular A-109, Major Systems Acquisition.
d. OMB Circular A-11, Part 3, Supplement: Capital Programming Guide.
e. NPD 2190.1, NASA Export Control Program.
f. NPG 2190.x, NASA Export Control Program.

g. NPG 5800.1, Grant and Cooperative Agreement Handbook.
h. NPD 5101.32, Procurement.
i. NPG 5101.33, Procurement Advocacy Programs.
j. NPD 7500.1, Program and Project Logistics Policy.
k. NPD 9501.3, Earned Value Performance Management.
l. Office of Procurement Home Page: http://www.hq.nasa.gov/office/procurement.
m. 42 U.S.C. 2451, et seq., the National Aeronautics and Space Act of 1958, as amended.

4.5.1 Acquisition

4.5.1.1 Purpose

Historically, NASA spends approximately 90 percent of its budget on acquisition, including contracts, grants, and cooperative agreements. Acquisition delivers the required product or service to a program or project when NASA does not provide it in-house. The component activities of acquisition are defining requirements, strategizing implementation, executing contracts and nonprocurement instruments, and monitoring performance. To expedite the acquisition process, the Program/Project Manager involves the contracting activity early in program/project planning activities.

4.5.1.2 Requirements

Program/project teams shall conduct acquisition activities in accordance with the provisions in References 4.5a. through 4.5l. Numerous laws and Government wide regulations pertain to the acquisition process. All members of the program and project offices should be broadly aware of key acquisition concerns; e.g., competition, performance-based contracting, and conflicts of interest. In addition, the procurement member provides definitive advice on conducting acquisitions. In the case of agreements with foreign entities, the Office of External Relations will be consulted.

4.5.2 Defining Requirements/Strategizing Implementation

4.5.2.1 Purpose

Defining requirements and strategizing implementation activities identify the needs of the program or project, determine how best to satisfy those needs, and develop an implementation strategy.

4.5.2.2 Requirements

a. The acquisition team shall generate a requirement set for each acquisition, including, as applicable, statement of work, specifications, documentation deliverables, and applicable documents. Appropriate team members should be included in identifying the requirements set.

b. Industry comments on the requirements set shall be obtained by use of Draft Request for Proposals (DRFP) as required by NFS 1815.405-70. Where DRFP's are not required, a less formal method for obtaining industry comment should be considered.

c. The program/project team shall develop an acquisition strategy that addresses acquisition requirements, necessary elements and issues (see NFS Part 1807).

4.5.3 Executing Contracts and Nonprocurement Instruments

4.5.3.1 Purpose

This activity selects the most appropriate instrument, contract or otherwise, to satisfy the goals of the project or program.

4.5.3.2 Requirements

a. The program/project team shall execute all contracts and nonprocurement instruments per the acquisition strategy.

b. A contract is a binding, enforceable agreement, which obligates the performance of one party to provide supplies or services, usually in consideration for monetary payment. A contract is used when a definitive need must be fulfilled.

c. There are a number of agreements that are nonprocurement instruments that may be appropriate for a given project to consider. Grants and cooperative agreements are financial assistance instruments whose primary purpose is to transfer something of value (e.g., money, resources, or data) to another (generally educational institutions, but also nonprofit entities, commercial firms, or other organizations) to carry out a public purpose of support or education; e.g., further general research or educate the public. Interagency funds transfers are used when NASA needs to use another Federal agency's resources to accomplish a requirement. Grants, cooperative agreements, and interagency funds transfers are executed by the procuring activities.

d. There are still other agreements that may be appropriate for a given requirement that would fall under procurement laws and regulations or the Space Act agreements, which include reimbursable, nonreimbursable, cooperative, and funded agreements. NASA has traditionally categorized agreements by whether or not NASA is to receive payment for its efforts. Therefore, the agreement may provide for payment of NASA's costs by the other party (a reimbursable agreement), or may require NASA and the other party to the agreement to bear the cost of the undertaking (a nonreimbursable or cooperative agreement). In some cases, NASA may enter into agreements to provide funding to a party (a funded agreement). Procurement laws and regulations are inapplicable to these agreements. The General Counsel provides guidance on the applicability of the Space Act agreements and on applicable laws and regulations.

4.5.4 Monitoring Performance

4.5.4.1 Purpose

Monitoring performance assures contractor compliance with contract terms and receipt of value commensurate with funds expended. The Program/Project Manager and Contracting Officer are responsible for determining and implementing the level and type of performance monitoring required after considering the risk associated with the work and the contractor. A critical aspect of this monitoring is change control. Performance monitoring assistance may be obtained as necessary from other offices (e.g., safety, export control, and the Defense Contract Management Agency).

4.5.4.2 Requirements

a. For contracted activities, change orders shall be definitized in a timely manner and to the maximum extent possible before issuance (see NFS 1843.70).

b. The program/project office and the Contracting Officer shall report the Government's assessment of performance to the contractor.

c. Records of contractor performance shall be maintained in accordance with Agency and Center policy to support future source selection activities.

4.5.5 Risk-Based Acquisition Management

4.5.5.1 Purpose

The primary goal of NASA is to achieve mission success without compromising safety. While risk management is not a new acquisition concept, NASA has initiated a Risk-Based Acquisition Management (RBAM) Initiative to refocus on risk as a core acquisition concern. The initiative conveys this focus on safety and mission success to NASA contractors. It is a part of the continuous risk management process (see paragraph 4.3).

4.5.5.2 Requirements

a. Acquisition Planning. The initial focus of the RBAM initiative is in acquisition planning (see NFS 1807.104). The acquisition planning team shall obtain input from Center personnel responsible for safety and mission assurance, health, environmental protection, information technology, export control, and security. The goal of this involvement is to ensure that the acquisition is structured to address appropriately the concerns of these disciplines as they relate to the requirement.

b. Solicitation Process. Any exchanges with industry prior to receipt of offers should include requests for any perceived safety, occupational health, security (including information technology), environmental, export control, and/or other programmatic risk issues associated with performance of the work.

Similarly, when technical proposals are required as part of requests for proposals for supplies or services, offerors are instructed to identify and discuss risk factors and their approach for managing those risk factors (see NFS 1815.201 and NFS 1815.203-72). Where the solicitation requires submission of a Safety and Health Plan (see NFS 1823.7001(c)), safety and health shall be a consideration in the evaluation process (also see NFS 1815.305).

c. Surveillance Plans. Quality assurance surveillance plans are required and prepared with the statement of work for all performance-based contracts and, as necessary, for other contracts. Those plans reflect NASA's surveillance approach relative to the perceived programmatic risk. The plans are general at the outset, but after contract award, contracting officers shall ensure that the plans are revised to reflect the risks associated with the successful proposal (see NFS 1846.401). When previously used software that has been significantly changed or new software is developed and is a critical part of a mission success, it should be designated as an area of risk.

4.6 Safety and Mission Success, and Environmental Management

Program and project managers are responsible for the safety, mission success and environmental consequences of actions taken in the formulation, approval, implementation and evaluation of programs and projects. Safety will be the guiding core value used in decisions whenever a risk to the public, astronauts, pilots, employees, or high value assets is at issue. This section identifies requirements and activities that constitute prudent safety, mission success and environmental activities to be conducted as a part of the PAPAC process. The section was written to be directly applicable to programs/projects when executed in-house or where NASA is the integrator. When a prime contractor is assigned the total system integration responsibilities, many of the activities may be delegated to the prime contractor. However, the NASA Program/Project Manager must have enough visibility into these activities to fulfill his/her responsibility for the safety, the success and the environmental impact of the program/project.

4.6.1 Safety and Mission Success

4.6.1.1 References

a. NPD 1800.2, NASA Occupational Health Program.
b. NPD 2820.1, NASA Software Policies.
c. NPD 7100.8, Protection of Human Research Subjects.
d. NPD 8621.1, NASA Mishap Reporting and Investigation Policy.
e. NPD 8700.1, NASA Policy for Safety and Mission Success.
f. NPD 8709.x, Safety and Mission Assurance (SMA) Requirements for NASA Spacecraft, Instrument, and Expendable Launch Vehicle (ELV) Missions.
g. NPD 8710.2, NASA Safety and Health Program Policy.
h. NPG 8715.3, NASA Safety Manual.
i. NASA-STD 8719.13, NASA Software Safety.
j. NPD 8720.1, NASA Reliability and Maintainability (R&M) Program Policy.

k. NPD 8730.2, NASA Parts Policy.
l. NPD 8730.3, NASA Quality Management System Policy (ISO 9000).
m. NPD 8730.4, Software Independent Verification and Validation (IV&V) Policy.
n. NPG 8735.2, Management of Government Safety and Mission Assurance Surveillance Functions for NASA Contracts.
o. NPD 8900.1, Medical Operations Responsibilities for Human Space Flight Programs.
p. ANSI/ISO/ASQ-Q9001-2000 as applicable.
q. Presidential Directive/National Security Council Memorandum No. 25 (PD/NSC-25), Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space.

4.6.1.2 Purpose

The program/project safety and mission success activity provides for the early identification, analysis, reduction, and/or elimination of hazards, which might cause the following:

a. Loss of life or injury/illness to personnel.
b. Damage to or loss of equipment or property (including software).
c. Unexpected or collateral damage as a result of tests.
d. Failure of mission.
e. Loss of system availability.
f. Damage to the environment.

4.6.1.3 Requirements

The Program/Project Manager shall establish a safety and mission success activity as a part of the risk management process, early in the project or program formulation process. This activity shall continue throughout the life of the program/project. The Program/Project Manager, with the assistance of the safety and mission assurance organization or other relevant organization, shall develop a subelement of the Program/Project Plan to address the process for achieving safety and mission success. The safety and mission success activity shall accomplish the following:

a. Incorporate health and safety principles in all planning.

b. Perform formal assessment and documentation of each hazard. The hazards shall be controlled in accordance with the reduction protocol (see Reference 4.6.1.1h.).

c. Perform a safety assessment of readiness for flight or operations, explicitly noting any exceptions arising from safety issues and concerns.

d. Utilize a quality management system governed by the ISO 9000 standard (see Reference 4.6.1.1l.) and appropriate supplier assessment and surveillance.

e. Provide a reliability, maintainability, and parts assurance program appropriate to the needs of the program/project (see References 4.6.1.1j. and 4.6.1.1k.).

f. Provide for a software development approach that complies with NASA Software Policy (see Reference 4.6.1.1b.).

4.6.2 Nuclear Launch Safety

4.6.2.1 References

a. Presidential Directive/National Security Council Memorandum No. 25. (PD/NSC-25), Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space.
b. NPG 8715.3, NASA Safety Manual.

4.6.2.2 Purpose

To ensure an internal NASA process is in place for effective intra-Agency and interagency coordination in obtaining approval to launch radioactive materials.

4.6.2.3 Requirements

a. Each program/project shall ensure that system designs that use radioactive materials reduce public exposure to radiation and radioactive materials to levels that are as low as reasonably achievable.

b. Each program/project proposing to launch radioactive materials shall fully adhere to the NASA and Executive branch interagency coordination processes for nuclear launch safety approval in accordance with References 4.6.2.1a. and 4.6.2.1b.

c. The NASA Office of Safety and Mission Assurance shall assist the program/project office in obtaining nuclear launch safety approval in accordance with References 4.6.2.1a. and 4.6.2.1b.

4.6.3 Lessons Learned

4.6.3.1 References

NASA Lessons Learned Information System (LLIS), http://llis.gsfc.nasa.gov.

4.6.3.2 Purpose

a. An important element of the design and development heritage of NASA is the application of knowledge previously gained (also known as lessons learned). Without the use of lessons learned, the science and engineering of NASA would not approach the degree of success the Agency has

established. NASA learns from both its successes and failures in a constant quest to improve both the process and the product. As a philosophy, program and project managers derive those lessons from many sources and use the lessons in the life-cycle development of its products.

b. Many sources exist for the lessons that NASA learns and provides to its engineers. Each of these sources has its own characteristics and role to play in the overall process of knowing how to develop and support aeronautical and space systems. The following are general sources for lessons learned: program, policy directives, technical standards, memoranda, operation sheets, test methods, parts alerts, FAR/NFAR, training, mentoring, best practices, cautions and warnings, story telling, the NASA LLIS, other collections of lessons developed by each program, expert opinion, programmatic review by third party, and mishap reports and corrective action plans. There are others.

4.6.3.3 Requirements

a. Each program/project manager shall contribute to the body of knowledge all significant lessons learned as part of the capture knowledge activity. For those lessons that apply to the PAPAC process, those lessons will be provided to the Chief Engineer; for others, the lessons will be compiled in a repository that provides a systematic way for cataloging and retrieving the information by subsequent search. At the end of formulation and implementation and as deemed appropriate, the Program/Project Manager shall report the extent to which he or she contributed lessons learned.

b. Each program/project manager shall seek and apply significant lessons learned from past experiences at the beginning and during the conduct of each subprocess using the applicable sources for lessons learned. At each major milestone, the Program/Project manager shall report the extent to which he or she applied the lessons learned.

4.6.4 Program/Project Emergency Planning/Response

4.6.4.1 References

a. NPD 8710.1, Emergency Preparedness Program.
b. NPG 8715.3, NASA Safety Manual.
c. Presidential Directive/National Security Council Memorandum No. 25. (PD/NSC-25), Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space.

4.6.4.2 Purpose

This activity integrates emergency mitigation, planning, response, and recovery requirements into the program/project planning and management activities.

4.6.4.3 Requirements

a. Each program/project shall develop emergency response, mitigation, and recovery plans in accordance with Reference 4.6.4.1a. These plans will be coordinated with the local Emergency Preparedness Office.

b. Each program/project shall complete preparations and ensure that response capabilities (to include restoration of program-unique resources and capabilities) are available when needed.

c. Each program/project shall ensure that contingency plans are in place to properly secure a mishap site, impound evidence, and provide necessary notification within the program and to designated Agency notification contacts.

d. Radiological contingency plans, commensurate with the potential health risk to the public, shall be developed for missions carrying radioactive materials in accordance with References 4.6.4.1a. and 4.6.4.1b.

4.6.5 Environmental Management

4.6.5.1 References

a. NPD 1820.1, NASA Environmental Health Program.
b. NPD 8020.7, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft.
c. NPG 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions.
d. NPD 8500.1, NASA Environmental Management.
e. NPG 8570.1, Energy Efficiency and Water Conservation Technologies and Practices.
f. NPG 8580.1, Implementing the National Environmental Policy Act and Executive Order 12114.
g. NPG 8820.3, Pollution Prevention.
h. NPG 8830.1, Affirmative Procurement Plan for Environmentally Preferable Products.
i. NPG 8850.1, Environmental Investigation and Remediation - Potentially Responsible Party Identification and Analysis.
j. OMB Circular A-11, Preparation and Submission of Budget Estimates.
k. Executive Order 12088, Federal Compliance with Pollution Control Standards.
l. 14 CFR Part 1216, Environmental Quality.
m. NPG 8553.1, NASA Environmental Management System (EMS).

4.6.5.2 Purpose

Program and project managers will consider the environmental risks and liabilities associated with programs and projects. Managers will focus on minimizing future problems through pollution prevention, operating in compliance with environmental requirements, and preserving our rich natural and cultural heritage for future generations. Compliance with the procedural and substantive requirements of environmental laws and Executive Orders assists NASA in fulfilling its Federal stewardship responsibilities while carrying out its primary mission.

4.6.5.3 Requirements

The program or project manager is responsible for compliance with environmental requirements. The support of Center environmental functional offices shall be obtained early in the program/project.

a. The National Environmental Policy Act (NEPA), NASA policies and procedures, and Executive Order 12114 require NASA program/project managers to consider environmental impacts in the planning of Agency programs and projects that may have an impact on the quality of the human environment, consider alternatives to their proposed actions, and ensure compliance with other relevant environmental statutes, regulations, and Executive Orders. The program or project manager shall complete the NEPA process before taking any action that would either (1) have an adverse environmental impact; or (2) limit the choice of reasonable alternatives. It is recommended that the program or project manager complete the NEPA process before the final design is approved in order to avoid substantial cost and schedule impacts.

b. Program/project managers shall consider pollution prevention in program and project decisions concerning process, design, chemical usage and facilities. Managers should reduce or eliminate the use of hazardous materials from operations or processes that produce hazardous/solid waste and other emissions. Managers should use environmentally preferable products, and factor into their program/projects LCC for ultimate cessation of operations and disposal.

c. Program/project managers shall obtain all required permits, waivers, documents, or authorizations through the Center environmental offices to ensure that operations meet all Federal, state, or local environmental regulations. Obtaining these documents and materials are time consuming, and appropriate planning for such is needed.

d. Program/project managers shall comply with the energy efficiency and water conservation requirements established by the National Energy Conservation Policy Act and Executive Order 13123, design new facilities to meet required energy efficiency standards, and incorporate the use of solar and other renewable energy sources where cost effective.

e. Program/project managers shall comply with the applicable provisions of directives implementing NASA's planetary protection policy (see References 4.6.5.1b. and 4.6.5.1c.).

4.7 Security, Export Control, and Foreign Involvement in Programs and Projects

4.7.a Program and project managers are responsible for requirements associated with the (1) security of people and NASA assets; (2) security of information technology; and (3) proper export of controlled hardware, technology and data (including software), and involvement of partners, contractors, and citizens of foreign countries.

4.7.b This section provides basic information to assist program and project managers in complying with the requirements for the protection of NASA resources, and with NASA policy and U.S. export laws and regulations when programs and projects are international in scope or involve partners, contractors, or citizens of foreign countries.

4.7.c References

(1) NPD 1050.1, Authority to Enter Into Space Act Agreements.
(2) NPD 1360.2, Initiation and Development of International Cooperation in Space and Aeronautics Programs.
(3) NPG 1371.2, Procedures and Guidelines for Processing Requests for Access to NASA by Foreign Nationals or Representatives.
(4) NPD 1371.5, Coordination and Authorization of Access by Foreign Nationals and Foreign Representatives to NASA.
(5) NPG 1382.17, Privacy Act – Internal NASA Direction in Furtherance of NASA Regulation.
(6) NPD 1600.2, NASA Security Policy.
(7) NPG 1600.6, Communications Security Procedures and Guidelines.
(8) NPG 1620.1, Security Procedures and Guidelines.
(9) NPD 2190.1, NASA Export Control Program
(10) NPD 2810.1, Security of Information Technology.
(11) NPG 2810.1, Security of Information Technology.
(12) NFS 1825.7002, Foreign Contracts.
(13) 14 CFR Part 1203, Information Security Program.
(14) 15 CFR Parts 730-774, Export Administration Regulation.
(15) 22 CFR Parts 120-130, International Traffic in Arms Regulations.
(16) National Defense Authorization Act for FY 2001, Division A, Title X, Subtitle G, Government Information Security Reform, Public Law 106-398.
(17) OMB Circular A-130, Appendix III, Management of Federal Information Resources.
(18) 40 U.S.C. 1441 *et seq.,* the Computer Security Act of 1987 (Pub. Law 100-235 of January 8, 1988), as amended.
(19) NSTISSP No.12, National Security Telecommunications and Information Systems Security Policy No.12, National Information Assurance (IA) Policy for U.S. Space Systems.

4.7.1 Personnel and Physical Security

4.7.1.1 Purpose

Program and project managers utilize security programs and mission-oriented protective services at performing Centers that provide for the safety of personnel and the protection of national security classified information, sensitive or valuable unclassified information, material, facilities, and other property under program and project control.

4.7.1.2 Requirements

a. Personnel Security. Program and project managers shall work with Chiefs of Center Security to identify and control threats to personnel, monitor the level of security-cleared personnel, and employ access control devices and other safeguards.

b. Physical Security. Program and project managers shall employ the recommendations of Chiefs of Center Security that address physical security and loss-prevention measures within program and project facilities.

4.7.2 Information Technology Security

4.7.2.1 Purpose

Information technology security concerns safeguarding the integrity, availability, and confidentiality of resources such as, data, information, applications and systems. Information technology security policies and procedures are integrated into all NASA programs and projects throughout their life cycle. Information technology security applies to embedded and nonembedded information technology.

4.7.2.2 Requirements

a. Program and project managers are responsible for the protection of the information generated within their program and shall take appropriate action(s) to protect it depending on its sensitivity. This may include classified or sensitive information, export-controlled information, command, control and communications, industry proprietary data, systems, applications, and information that support NASA's daily business activities (e.g., e-mail management reporting).

b. Program and project technical requirements shall include information technology security requirements.in accordance with Reference 4.7.c(11).

c. Program and project plans shall incorporate a life-cycle risk management approach, addressing the following information technology security requirements:

(1) Conduct risk assessment, determine and implement risk-mitigating technologies or procedures, and manage residual accepted risk in accordance with References 4.7.c(8) and 4.7.c(11).

(2) Coordinate specific security measures with those of Center and NASA-wide infrastructure in accordance with References 4.7.c(8) and 4.7.c(11).

(3) Address specific requirements for security of systems (including Web sites) containing or processing export controlled, proprietary, classified or other sensitive information in accordance with Reference 4.7.c(11).

(4) Provide for appropriate security of command, control, and communications channels in accordance with Reference 4.7.c(11).

(5) Requirements for and affording of access by citizens of foreign countries involved in programs and projects.

4.7.3 Export Control and Foreign Involvement in Programs and Projects

4.7.3.1 Purpose

Program and project managers have a responsibility to comply with export control requirements in order to protect U.S. technologies and NASA's export privileges. Exporting of U.S. technologies is controlled by statutory regulations and is a privilege that can be revoked, precluding NASA's ability to conduct international programs and projects. Export control applies in all instances where partners, contractors, or citizens of foreign countries are involved, and in certain instances in which U.S. citizens represent entities, individuals or interests of foreign countries, and it applies whether the activity is occurring in the United States or abroad. Export control regulations can pose a significant challenge to the Program and Project Managers' ability to meet cost and schedule objectives. Center export control administrators are available to assist program and project managers in carrying out export control responsibilities.

4.7.3.2 Requirements

International agreements are generally the basis for all NASA foreign cooperative activity.

a. All NASA international agreements contain a clause on transfers of controlled hardware, technology, and data (including software) both from NASA to foreign partners and from foreign partners to NASA. Program and project managers shall comply with the clause when transfers are made from NASA to a partner or a contractor of a foreign country.

b. Program and project managers shall transfer only those technical data (including software) and hardware necessary to fulfill NASA responsibilities under international agreements. If foreign contracts are anticipated, program and project managers shall assure that there is appropriate Headquarters review when required and that such contracts are prepared with appropriate export control provisions. Applicable contracts with U.S. industry that support an international program or project shall also include appropriate provisions related to export control requirements.

c. Export control requirements and milestones shall be included in program and project plans.

d. When foreign nationals are involved, program and project managers shall plan for internal technology transfer controls.

e. Program and project managers shall identify export license requirements and are responsible for obtaining any required export licenses prior to exporting.

f. As applicable, program and project managers shall instruct contractors and partners of NASA obligations under international agreements and of their responsibility for obtaining proper authority for any contractor and partner exports.

g. Program and project managers shall advise foreign partners of the sensitive nature of export controlled hardware and data (including software) prior to transfer.

h. Program and project managers shall require the timely preparation and coordination of requests for foreign travel by program and project personnel and obtain the concurrence of the NASA Headquarters Office of External Relations.

APPENDIX A. References Available Via NODIS

NASA maintains an online library for official documents called NASA Online Directives Information System (NODIS) Library that provides access to a wide range of requirements applicable to NASA programs and projects. This library is updated as new requirements are approved.

The NODIS library will provide access to NASA's Strategic Plan, NPD 1000.1, NASA Strategic Management Handbook, NPG 1000.2, and Agency and Center Directives. Access is also provided to Federal Regulations, Executive Orders, Technical Standards, the NASA Procurement Library, OMB Circulars, and Financial Management Manuals. Figure A-1.1 provides a list of functional areas relevant to program and project managers, with hyperlinks to either specific directives or lists of directives in the NODIS Library. NODIS also has an advanced search engine to help locate relevant directives.

1. Aircraft Management NPD NPG	9. Legal and Technical NPD's NPG's
2. Equal Opportunity NPD's NPG's	10. Occupational Health NPD's NPG's
3. Facilities Engineering (CoF & Facilities Maintenance) NPD's NPG's	11. Procurement NPD's NPG's
4. Environmental & Energy Programs NPD's NPG'	12. Public Affairs NPD's
5. Financial Management NPD's NPG's	13. Safety & Mission Assurance NPD's NPG's STD's
6 Human Resources & Education NPD's NPG's	14. Security NPD's NPG's
7. Industrial Relations NPG's	15. Small & Disadvantaged; Business Utilization NPD's
8. Information Technology NPD's	16. Logistics Management NPD's NPG's

Figure A-1.1. Functional Areas

Program and project managers should contact Center-level functional managers who are knowledgeable about management system requirements to ensure they meet applicable laws, regulations, and Agency policies.

APPENDIX B. Definitions

Acceptable Risk. The risk that is understood and agreed to by the program/project, GPMC, Enterprise, and other customer(s) sufficient to achieve the defined success criteria within the approved level of resources.

Acquisition. The acquiring, by contract, of supplies or services (including construction) through purchase or lease, whether the supplies or services are already in existence or must be created, developed, demonstrated, or evaluated. Acquisition begins at the point when Agency needs are established and includes the description of requirements to satisfy Agency needs, solicitation, and selection of sources, award of contracts, contract financing, performance, administration, technical, and management functions directly related to the process of fulfilling Agency needs by contract.

Acquisition Team. All participants in Government acquisition, including not only representatives of the technical, supply, and procurement communities, but also the customers they serve and the contractors who provide the products and services.

Activity. Any of those major program and project management components that are executed in order to complete a subprocess within the PAPAC process. Note: in Chapters 2 and 3 of this document, an activity is carried as a three-digit item (e.g., x.y.z.).

Advocacy Chain. Any person that has a vested interest in the outcome of a particular program or project.

Agency Program Management Council (Agency PMC). The senior management group, chaired by the Deputy Administrator or the Administrator's designee, responsible for reviewing program formulation performance, recommending approval of proposed programs, and overseeing implementation of designated programs and projects according to Agency commitments, priorities, and policies.

Allowance for Program Adjustment (APA). Fiscal resources available for approved changes in program objectives or scope that are documented in the PCA, the resolution of unforeseen major problems, program/project stretch outs from Agency funding shortfalls, and similar fiscal events.

Approval. The PAPAC subprocess used to initially decide on a program/project's readiness to proceed from formulation into implementation and subsequently used to approve changes to the program/project baseline.

Baseline. The technical performance and content, technology application, schedule milestones, and budget (including contingency and APA) which are documented in the approved Program and Project Plans.

Commercialization. The use of NASA technology by a U.S. firm for commercial applications.

Component Facilities. Complexes that are geographically separated from the NASA Center or institution to which it is assigned.

Configuration Management. A management discipline applied over the product's life cycle to provide visibility and to control performance and functional and physical characteristics.

Contingency. Reserves, including funding, schedule, performance, manpower, and services, allocated to and managed by the Program/Project Manager for the resolution of problems normally encountered to mitigate risks while ensuring compliance to the specified program/project scope.

Contract. A mutually binding legal relationship obligating the seller to furnish the supplies or services (including construction) and the buyer to pay for them. In addition to bilateral instruments, contracts include, but are not limited to, awards and notices of awards; job orders or task letters initiated under basic ordering agreements; letter contracts; orders, such as purchase orders, under which the contract becomes effective by written acceptance or performance; and bilateral contract modifications.

Crosscutting Technology. That which is generally applicable to multimissions and focuses on the earlier stages of the life cycle.

Customer. Any individual, organization, or other entity to which a program or project provides a product(s) and/or service(s).

Earned Value Management (EVM). A tool for measuring and assessing program/project performance through the integration of technical, cost, and schedule parameters during the execution of the program or project.

Environmental Impact. The direct, indirect, or cumulative beneficial or adverse effect of an action on the environment.

Environmental Management. The activity of ensuring that program and project actions and decisions which potentially impact or damage the environment are assessed/evaluated during the formulation/planning phase and reevaluated throughout implementation and performed according to all NASA policy and Federal, state, and local environmental laws and regulations.

Estimate at Completion. The sum of program/project actual costs to date, estimated costs to complete (ETC), and reserves. Contractor financial information is included in the program/project Estimate at Completion.

Evaluation. The PAPAC subprocess used to provide independent assessments of the continuing ability of the program/project to meet its technical and programmatic commitments. Evaluation also provides value-added assistance to the program/project managers.

Formulation. The PAPAC subprocess used to define the program/project concept and plan to meet customer requirements.

Formulation Authorization Document (FAD). The document issued by the EAA to authorize the level of formulation of a program whose goals will fulfill part of the Enterprise Strategic Plan. In addition, a FAD or equivalent is used to authorize the level of formulation of a project.

Governing Program Management Council (GPMC). The highest level PMC that has the responsibility to regularly review a program or project.

Implementation. The PAPAC subprocess used to deliver the products and capabilities specified in the approved Program/Project Plan.

Independent Implementation Review (IIR). An assessment conducted by experts outside the advocacy chain, of the status of the commitments (performance, cost, and schedule) in a PCA, Program Plan, and/or Project Plan at approximately annual intervals during implementation.

Independent Assessment (IA). An assessment conducted during formulation by experts outside the advocacy chain, of the design process used to develop an advanced concept and a validation of the selected concept's ability to efficiently meet the success criteria.

Independent Life-Cycle Cost Analysis (ILCCA). An LCC analysis generated by a designated team outside of the advocacy chain of the program/project being reviewed. Accompanying documentation includes the program/project requirements and technical risk assumptions underlying the analysis.

Independent Program Assessment Office (IPAO). The organization responsible for scheduling, organizing, and conducting the NAR, IIR, and IA's for programs/projects reporting to the Agency PMC.

Independent Verification and Validation (IV&V). A process whereby the products and processes of the software development life-cycle phases are reviewed, verified, and validated by an organization that is neither the developer nor the purchaser of the software, which is defined by two parameters – technical independence and managerial independence. Technical independence engages personnel who are not involved in the development activities. Managerial independence requires responsibility for the IV&V effort to be vested in an organization separate from the organization responsible for development.

Information Technology. Hardware and software operated by a Federal agency or by a contractor of a Federal agency or other organization that processes information on behalf of the Federal Government to

accomplish a Federal function, regardless of the technology involved, whether by computers, telecommunications systems, automatic data processing equipment, or other.

Infrastructure. The human resources, facilities, equipment, information resources, and administrative and program support services that are available to support programs and projects. Utilization of the capability afforded by the infrastructure includes consideration of the maintenance and other liabilities it presents.

In-House Project. One that is conducted onsite or in the immediate vicinity of a NASA Center in which most major technical, business, and management tasks are performed primarily by the Center's civil service workforce.

Lesson Learned. The significant knowledge or understanding gained through past or current programs and projects that is documented and collected to benefit current and future programs and projects.

Life-Cycle Cost (LCC). The total of the direct, indirect, recurring, nonrecurring, and other related expenses incurred, or estimated to be incurred, in the design, development, verification, production, operation, maintenance, support, and retirement of a system over its planned life.

Logistics. The management, engineering activities, and analysis associated with design requirements definition, material procurement and distribution, maintenance, supply replacement, transportation, and disposal which are identified by flight and ground systems supportability objectives.

Margin. The allowances carried in budget, projected schedules, and technical performance parameters (e.g., weight, power, or memory) to account for uncertainties and risks. Margins are baselined in the formulation subprocess, based on assessments of risks, and are consumed as the program/project proceeds through the life cycle.

Metric. A measurement taken over a period of time that communicates vital information about a process or activity. A metric should drive appropriate action.

Mission. A major activity required to accomplish an Agency goal or to effectively pursue a scientific, technological, or engineering opportunity directly related to an Agency goal. Mission needs are independent of any particular system or technological solution.

Mission Assurance. Those independent activities performed outside of the program or project that are necessary to provide increased confidence in achieving mission success. The mission assurance activities will typically include independent assessments, Non-Advocate Reviews (NAR's), process verification, program or project reviews and audits, quality assurance, software verification, and other activities that validate approaches and/or highlight potential problem areas.

Mission Success. Those activities performed in line and under the control of the program or project that are necessary to provide assurance that the program or project will achieve its objectives. The mission

success activities will typically include risk assessments, system safety engineering, reliability analysis, quality assurance, electronic and mechanical parts control, software validation, failure reporting/resolution, and other activities that are normally part of a program or project work structure.

Non-Advocate Review (NAR). The analysis of a proposed program or project by a (nonadvocate) team composed of management, technical, and budget experts (personnel) from outside the advocacy chain of the proposed program or project. It provides Agency management with an independent assessment of the readiness of the program/project to proceed into implementation.

Occupational Health. The promotion and maintenance of physical and mental health in the work environment.

Performance-Based Contracting. Structuring all aspects of an acquisition around the purpose of the work to be performed as opposed to either the manner by which the work is to be performed or broad and imprecise statements of work.

Performance Measurement Baseline. The time-phased budget plan against which contract execution is measured. It is formed by the budgets assigned to scheduled control accounts and the applicable indirect budgets. For future effort, not planned to the control account level, it also includes budgets assigned to higher level contractor work breakdown structure elements and undistributed budgets. It equals the total allocated budget less management reserves.

Primary Risks. Those undesirable events having both high probability and high impact/severity.

Program. A major activity within an Enterprise having defined goals, objectives, requirements, and funding levels, and consisting of one or more projects.

Program Commitment Agreement (PCA). The contract between the Administrator and the cognizant EAA for implementation of a program.

Program Management Council (PMC). One of the hierarchy of forums, composed of senior management, that assesses program and project planning and implementation and provides oversight and direction as appropriate. These are established at the Agency, Enterprise, Center and lower levels.

Program Operating Plan (POP). A document produced by a Center in response to Headquarters-directed budget guidelines, including requested budgets by program or project.

Program Plan. The document that establishes the baseline for implementation, signed by the EAA, CD, and Program Manager.

Program (Project) Team. All participants in program (project) formulation and implementation. This includes all direct reports and others that support meeting program (project) responsibilities.

Project. An activity, designated by a program, characterized as having defined goals, objectives, requirements, a Life-Cycle Cost (LCC), a beginning, and an end.

Project Plan. The document that establishes the baseline for implementation, signed by the Program Manager, CD, and Project Manager.

Quality Assurance. A planned and systematic set of actions necessary to provide confidence that the products or services conform to documented requirements.

Requirements Review (RR). An assessment, during the formulation subprocess, of the completeness, consistency, and achievability of the project objectives and requirements, including those specified in the FAD. The RR covers, as applicable, mission, project, science, operational, flight system and ground system requirements, including cost and schedule. The RR is conducted prior to the initiation of preliminary design.

Reserves. The APA and contingency resources.

Resources Management. A function that is composed of planning and monitoring implementation of cost, workforce, and facility requirements; correlating these requirements to technical and schedule performance; and comparing these parameters to baselines established for the program and projects. This function establishes, monitors, and updates budget development and execution and contractor financial reporting.

Risk. The combination of (1) the probability (qualitative or quantitative) that a program or project will experience an undesired event such as cost overrun, schedule slippage, safety mishap, compromise of security, or failure to achieve a needed technological breakthrough; and (2) the consequences, impact, or severity of the undesired event were it to occur.

Risk Management. An organized, systematic decision making process that efficiently identifies, analyzes, plans, tracks, controls, communicates, and documents risk to increase the likelihood of achieving program/project goals.

Safety. Freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

Schedule Management. The establishment, monitoring, and maintenance of the baseline master schedule and derivative detailed schedules. It is composed of the establishment and operation of the system and includes (1) definition of format, content, symbology, and control processes, and (2) selection of key progress milestones and indices for measuring program and project performance and indicating problems.

Security. Protection of people, property, and information assets owned by NASA which covers physical assets, personnel, IT, communications, and operations.

Stakeholder. An individual or organization having an interest (or stake) in the outcome or deliverable of a program or project.

Success Criteria: That portion of the top-level requirements that define what will be achieved to successfully satisfy the Strategic Plan objectives addressed by the program, project, or technology demonstration.

Surveillance. The continual monitoring and verification of status of an entity and analysis of records to ensure that specified requirements are being met. Surveillance can be performed in an insight, oversight, or a combined mode, using a risk-based decision process.

System. The combination of elements that function together to produce the capability required to meet a need. The elements include all hardware, software, equipment, facilities, personnel, processes, and procedures needed for this purpose.

Systems Management Office. The Center organization responsible for independent review and assessment of programs/projects during formulation and implementation, whose findings are reported to the Center GPMC.

Tailoring. The documentation and approval of the adaptation of the PAPAC process and approach to complying with requirements underlying the specific program or projects. The results of this activity are documented in the FAD, PCA, Program Plan, and/or Project Plan.

Termination Review. An analysis by the GPMC or by an independent assessment board, i.e., IPAO or SMO, for the purpose of securing a recommendation as to whether to continue or terminate a program or project. Exceeding the parameters or levels specified in controlling documents will result in PMC or GPMC consideration of a termination review.

Validation. Proof that the product accomplishes the intended purpose. May be determined by a combination of test, analysis, and demonstration.

Verification. Proof of compliance with specifications. May be determined by a combination of test, analysis, demonstration, and inspection.

Work Breakdown Structure (WBS). A product-oriented hierarchical division of the hardware, software, services, and data required to produce the program/project's end product(s), structured according to the way the work will be performed, and reflective of the way in which program/project costs, schedule, technical and risk data are to be accumulated, summarized, and reported.

APPENDIX C. Acronyms

AA	Associate Administrator
AO	Announcement of Opportunity
APA	Allowance for Program Adjustment
APPL	Academy of Program and Project Leadership
BPR	Office of Biological & Physical Research
CD	Center Director
CoF	Construction of Facilities
CDR	Critical Design Review
CFO	Chief Financial Officer
CMR	Critical Milestone Review
DRFP	Draft Request for Proposal
EA	Environmental Assessment
EAA	Enterprise Associate Administrator
EC	Executive Council
EPR	Engineering Peer Review
EVM	Earned Value Management
FAD	Formulation Authorization Document
FAR	Federal Acquisition Regulation
FMEA	Failure Modes and Effects Analysis
FTA	Fault Tree Analysis
FTE	Full-Time Equivalent
FY	Fiscal Year
GAO	General Accounting Office
GPMC	Governing Program Management Council
GPRA	Government Performance and Results Act
IA	Independent Assessment

IIR	Independent Implementation Review
IDP	Individual Development Plans
IFMS	Integrated Financial Management System
ILCCA	Independent Life-Cycle Cost Analysis
IOS	International Organization for Standardization
IPAO	Independent Program Assessment Office
IPO	Institutional Program Office
IT	Information Technology
IV&V	Independent Verification & Validation
LaRC	Langley Research Center
LCC	Life-Cycle Cost
LLIS	Lessons Learned Information System
MO&DA	Mission Operations and Data Analysis
NAR	Non-Advocate Review
NEPA	National Environmental Policy Act
NFS	NASA Federal Acquisition Regulation (FAR) Supplement
NOA	New Obligation Authority
NODIS	NASA On-Line Directives Information System
NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NRA	NASA Research Announcement
OMB	Office of Management and Budget
PAPAC	Provide Aerospace Products and Capabilities
PCA	Program Commitment Agreement
PDR	Preliminary Design Review
PI	Principal Investigator
PIR	Product Integrity Review
PMC	Program Management Council
PMDP	Program/Project Management Development Process

POP	Program Operating Plan
PRA	Probabilistic Risk Assessment
PSR	Project Status Report
R&A	Research and Analysis
RDT&E	Research, Development, Test, and Evaluation
RFP	Request for Proposal
RR	Requirements Review
SBIR	Small Business Innovation Research
SI	International System of Units measurement system (Systeme Internationale)
WBS	Work-Breakdown Structure

APPENDIX D. Responsibilities for Program and Project Management

For reference purposes, this appendix summarizes principal responsibilities of key management individuals other than the Program and Project Manager. The Strategic Management Handbook defines the responsibilities of key NASA officials involved in the program/project management process.

D.1 Headquarters Responsibilities

a. The Administrator is responsible for the following:

(1) Agency-level strategic planning.

(2) Overall Agency budget allocation across Enterprises.

(3) Approval of all programs for implementation.

(4) Approval of all program assignments to Centers.

b. The Deputy Administrator as Chair of the PMC is responsible for the following:

(1) Determining which programs will be overseen by the Agency PMC.

(2) Approving Agency-level PAPAC policies, processes, and requirements.

(3) Ensuring timely resolution of multiple Enterprise program and project issues.

c. Enterprise Associate Administrators are responsible for the following:

(1) Providing program advocacy.

(2) Establishing and documenting program objectives, requirements, and metrics.

(3) Recommending the GPMC for each program/project, to be at the Agency, Enterprise or Center PMC.

(4) Determining the Program Management Structure

(a) Appointing Enterprise Program Officials (e.g.,Program Directors, Program Executives)
(b) Appointing or approving Program Managers

(c) Determining where the Program Manager will be located and institutionally assigned.

(5) Making Program assignments (to the extent desired) and Project assignments to the Center.

(6) Recommending programs to the Agency's PMC for implementation.

(7) Developing, coordinating, maintaining, and signing the PCA.

(8) Approving Program Plans.

(9) Assessing program implementation against requirements and customer expectations.

(10) Serving as (or designating) Chairperson of the Enterprise PMC.

(11) Ensuring timely resolution of multiple program and project issues within the Enterprise.

(12) Serving as a member of the Agency's PMC and participating or delegating participation on Center PMCs.

(13) Allocating budgets to programs and across Centers.

(14) Assuring that products and services meet customer requirements.

(15) Identifying and developing interface with customers.

(16) Assuring that all international programs, under their purview, are conducted in compliance with U.S. export control laws and regulations and the NASA Export Control Program.

d. The NASA CFO/Comptroller is responsible for the following:

(1) Concurring with and recommending changes to the cost commitment by signing the 300B or equivalent as part of the PCA.

(2) Appointing ILCCA teams, certifying ILCCA's, and submitting those estimates to Congress in compliance with Pub. L. 106-391.

(3) Member of the Agency PMC.

e. The NASA Chief Engineer is responsible for the following:

(1) Serving as the process steward for the PAPAC process, including development and maintenance of NPG 7120.5.

(2) Providing for independent evaluation for programs/projects under oversight of the Agency PMC.

(3) Collecting, analyzing, and disseminating lessons learned/process knowledge.

(4) Approving Terms of Reference (TOR) and membership for independent review teams on programs/projects under the oversight of the Agency PMC.

(5) Developing Agency-level PAPAC policy, processes, and requirements and providing oversight of their implementation.

(6) Concurring on PCA's prior to submitting to the Administrator for approval.

(7) Serving as a member of the Agency PMC

D.2 Center Responsibilities

a. The Center Director is responsible for the following:

(1) Serving as (or designating a) chairperson of the Center PMC.

(2) Ensuring implementation of the program responsibilities assigned by the EAA.

(3) Recommending Program Managers to the EAA for Programs assigned to the Center.

(4) Approving Program Plans for programs with responsibilities assigned to the Center by the EAA.

(5) For Projects assigned to the Center by the EAA:

(a) Performing advanced concept studies in support of Agency and Enterprise Strategic Plans.
(b) Appointing Project Managers in consultation with Program Manager.
(c) Approving Project Plans.
(d) Ensuring implementation of assigned projects.
(e) Developing and maintaining program/project implementation policies and procedures, compliant with NPD 7120.4, this document, and ISO 9000.

b. Center Line Management is responsible for the following:

(1) Adequately staffing programs and projects;

(2) Developing personnel for programs and projects through hands-on experience, mentoring, and training;

(3) Delivering quality products to meet program and project requirements;

(4) Supporting program and project activities (e.g., reviews);

(5) Championing lessons learned and knowledge sharing;

(6) Ensuring compliance with Agency and Center policies and procedures;

(7) Ensuring a climate of open communications and trust;

(8) Ensuring the application of sound engineering and management practices.

APPENDIX E. Key Document Content

This appendix establishes the content for the following basic commitment documents associated with programs/projects:

E.1 Formulation Authorization Document.

E.2 Program Commitment Agreement.

E.3 Program Plan.

E.4 Project Plan.

The format may be tailored, but all applicable content will be addressed.

E.1 Formulation Authorization Document

Formulation Authorization Document

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis, if appropriate.)

_____ _____

Enterprise Associate Administrator Date

(Note: This can also be used for the authorization of project formulation to be consistent with the Program Plan).

Figure E-1.1 Formulation Authorization Document Title Page

FORMULATION AUTHORIZATION DOCUMENT
(PROGRAM TITLE)

PURPOSE

Identify the purpose of the program whose goals and objectives are referenced in the Enterprise Strategic Plan. This need is independent of any particular technological solution and is stated in terms of functional capabilities.

AUTHORITY

Clearly describe the NASA organizational structure for managing the formulation process from the EAA to the NASA Center project managers, as applicable. Include lines of authority, coordination, and reporting.

TERMS OF REFERENCE

Describe the level or scope of work to be accomplished in the formulation study, goals and objectives, any cost targets or constraints, the time available to do the studies, and any other constraints.

INTERNAL PARTICIPANTS

Identify other Enterprises and Centers to be involved in the activity, their scope of work, and any constraints related to their efforts (e.g., the program must be co-funded by a different Enterprise).

EXTERNAL PARTICIPANTS

Identify participation external to NASA to be involved in the activity, their scope of work, and any constraints related to their efforts (e.g., the program must be co-funded by the external participant).

FUNDING

Identify, by fiscal year, the funding that will be committed for formulation.

REVIEWS

Describe the reviews, including independent reviews, required during the Formulation subprocess.

E.2 PROGRAM COMMITMENT AGREEMENT

Program Commitment Agreement

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis, if appropriate.)

It is the responsibility of each of the signing parties to notify the other in the event that a commitment cannot be met and to initiate the timely renegotiations of the terms of this agreement.

_____ _____

Enterprise Associate Administrator Date

_____ _____

Administrator Date

Figure E-2.1 Program Commitment Agreement Title Page

PROGRAM COMMITMENT AGREEMENT
(PROGRAM TITLE)

PROGRAM OBJECTIVES

Identify the broad program objectives. Describe the program's relationship to the Enterprise Strategic Plan. Convey the public good of the program to the taxpayer, stated in a way that can be understood by the average citizen.

PROGRAM OVERVIEW

Provide a broad description of the strategy to achieve the above-mentioned objectives. Relationships with external organizations, other agencies, or international partners should be addressed if achievement of the program objectives is dependent on their performance.

PROGRAM AUTHORITY

Clearly describe the NASA organizational structure for managing the program and projects from the EAA to the NASA Center project managers. Include lines of authority and reporting, Center(s) responsibilities, the GPMC(s) for the oversight of the program and its projects, and the approving official for new projects.

TECHNICAL PERFORMANCE COMMITMENT

Summarize the technical requirements needed to achieve the program objectives. If the objectives include a technical performance target in addition to a threshold requirement (e.g., as for an applied technology research program), the commitment could be stated as a range.

SCHEDULE COMMITMENT

Identify the following key target milestones for each project in the program: Start of Formulation, Start of Implementation, Launch or its equivalent for ground based projects; and end of prime operations. Add an end of data analysis milestone, if appropriate. Other milestones or time periods can be added if appropriate for a specific program, such as:

a. Date for a vehicle first flight or first element launch;
b. Target date or time frame for the NAR;
c. Time period allowed for development;
d. Minimum period of operation of vehicles;
e. The time frame in which validated science results will be archived for use by the general science community or when user services would be made available to the user community.

COST COMMITMENT

Provide the maximum value for the Life Cycle Cost (LCC) for the program including all projects in Formulation and Implementation. The actual cost plan is developed during the annual POP process and this document shall reference the form 300B or equivalent for the budget year. The LCC given shall include all costs necessary to perform the program, including, in addition to the standard project activities, facilities costs, launch vehicles, tracking, and mission operations and data analysis.

ACQUISITION STRATEGY

Provide a brief statement of the proposed acquisition strategy for major elements.

HIGH RISK AREAS

Identify the areas of highest risk for the program (covering safety, technical, cost, or schedule issues) in which failure may result in serious consequences. This section should identify, where possible, the specific risk drivers, such as high-risk technologies upon which the program is dependent.

INTERNAL AGREEMENTS

If the program is dependent on other NASA activities outside of the EAA's control, identify the required support and list any formal agreements required.

EXTERNAL AGREEMENTS

Explain the involvement of external organizations, other agencies, or international partners including a brief overview of the external support necessary to meet the program objectives. Include an identification of the commitments being made by the external organizations, other agencies, or international partners and a listing of the specific agreements to be concluded. Any unique considerations affecting implementation of NPD 7120.4 policies and the processes of this document necessitated by the external involvement should be clearly identified.

INDEPENDENT REVIEWS

Specify the type of independent reviews, (e.g., NAR) that will be performed during the life cycle of the program, and whether or not the program will have a dedicated Independent Review Team (IRT).

TAILORING

Identify those requirements for which the approach to compliance has been tailored consistent with program characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. Provide rationale for such tailoring.

PCA ACTIVITIES LOG

Provide and maintain a log of all PCA activities, depicting revisions that reflect all deviations to the original PCA. This log includes the information shown in Figure E-2.2 and may be supplemented with an attached addendum for each change, describing the change. The PCA should be updated to add approved projects or whenever substantial change makes it necessary.

Date	Event	Change	Addendum	Cancellation Review Req'd	EAA Signature	Administrator Signature
dd/mm/94	Revalidation	None	N/A	No		
dd/mm/95	Revalidation	None	N/A	No		
dd/mm/96	POP 96 Reduced FY97 by $15M	Deleted Real-Time Data Products to Users	Ref. #1	No		

Figure E-2.2. Sample Program Commitment Agreement Activities Log.

E.3 Program Plan

Program Plan

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis, if appropriate.)

_____ _____

Enterprise Associate Administrator Date

_____ _____

Center Director (as appropriate) Date

_____ _____

Program Manager Date

Figure E-3.1 Program Plan Title Page

PROGRAM PLAN
(PROGRAM TITLE)

INTRODUCTION

Briefly state the background of the program and its current status, including the results of formulation activities, decisions, and documentation.

PROGRAM OBJECTIVES

State program objectives, performance goals, and performance indicators, and their relationship to NASA program goals as set forth in the NASA Strategic Plan. Performance goals should be expressed in an objective, quantifiable, and measurable form.

CUSTOMER DEFINITION AND ADVOCACY

State the main customers of the program (e.g., PI, science community, technology community, public, education community, Enterprise Sponsor) and the process to be used to ensure customer advocacy.

PROGRAM AUTHORITY AND MANAGEMENT STRUCTURE

Identify the location (Center or Headquarters) where the Program Manager resides and each Center's responsibilities, the GPMC(s) for oversight of the projects within the program, and the approving official for Projects.

Briefly describe the major components of the program and the way they will be integrated, including the way the program will relate to other institutions within NASA as well as outside of NASA. Identify the responsibilities of each NASA Center as they relate to their respective requirement allocations referenced in PROGRAM REQUIREMENTS below. Describe the overall architecture of the program and the process by which new Projects are formulated and approved.

a. Organization. Describe the NASA organizational structure for managing the program and projects from the EAA to the NASA Center project managers. Include clear lines of authority and reporting; illustrate the organization graphically.

b. Responsibilities. Clearly define management responsibilities of the EAA, the Program Manager, the Center Director, and the Project Manager, including the authority of these. Indicate their responsibilities for developing, concurring, and approving principal program documents, such as the formulation authorization, the Program Plan, Project Plan, RFP's and other contract-related documents, reports associated with major reviews, and other key activities.

PROGRAM REQUIREMENTS

Document the program requirements, including performance requirements, and success criteria, in an objective, quantifiable and measurable form. For multiple projects within a program, describe the way in which the program requirements will be allocated to the respective projects. The approving authority is required to document objectives and requirements for each project as they are formulated. If the mission characteristics indicate a greater emphasis is necessary on maintaining either technical, cost, or schedule, then this section should also identify which is more important to be considered, (e.g. it should address if the mission is cost capped, or if schedule is paramount, as for a planetary mission, or if it is critical to accomplish all of the technical objectives.)

PROGRAM SCHEDULE

Provide a schedule of program activities and events covering the life of the program; include all applicable events, such as approval dates for entry into subprocesses, approval dates for major program and project documents, instrument selection dates, dates of major project reviews, launch dates (or equivalent system "delivery" dates), and other Administrator or EAA decisions. Include all PCA milestones.

PROGRAM RESOURCES

For each participating NASA Center, identify yearly New Obligation Authority (NOA) estimates for system development and operations, facility construction, institutional support, and management. Civil service workforce levels should be included.

CONTROLS

Describe the process by which project requirements are validated for compliance with the program requirements. Describe the process for controlling changes. Describe the process for updating the PCA as a result of any changes. Indicate key program parameters (cost, schedule, and technical) which will require Administrator, EAA, or Program Manager approval for change. Identify the APA and reserves management strategy and approval authority.

RELATIONSHIPS TO OTHER PROGRAMS AND AGREEMENTS

Describe the way the program will relate to other institutions within NASA, e.g., crosscutting technology efforts, space communications and launch services. List the internal agreements necessary for program success and projected dates of approval. This list should include those agreements which are concluded with the authority of the Program Manager, and reference those agreements concluded with the authority of the EAA.

Describe the way the program will relate to entities outside of NASA, e.g., interagency or international. List the external agreements necessary for program success and projected dates of approval. This list

should include those agreements, which are concluded with the authority of the Program Manager, and reference those agreements concluded with the authority of the EAA and/or Administrator.

ACQUISITION STRATEGY

Briefly describe the acquisition approach to be applied at the program level toward each project. The respective roles, responsibilities, and relationships between the government and its contractors, vendors, and/or partners are addressed, including a description of integration and surveillance responsibilities.

TECHNOLOGY ASSESSMENT

Identify the NASA crosscutting or other technology thrusts to be utilized by the projects. Identify those technologies the program expects to mature during the life of the program. Briefly describe how the technologies will be developed and infused. Describe how and when the program will evaluate the feasibility, readiness, cost, risk, and benefits of the new technologies.

COMMERCIALIZATION OPPORTUNITIES

Identify commercialization opportunities and the approach to be employed to identify others during the life of the program.

DATA MANAGEMENT

Program data management planning for science missions, is provided as a section of this Program Plan or as a separate document, to address the data being captured by NASA science missions and its availability. It contains plans for data rights and services to the science community, addressing issues which are community-wide and often require tradeoffs between project/Center interests and the science community.

SAFETY AND MISSION SUCCESS

Safety and mission success planning is provided either as a section of this Program Plan or as a separate document. Address the activities and steps to be taken to ensure safety of the public, the NASA astronauts and pilots, the NASA workforce, and NASA's high value equipment and property. Address both hardware and software aspects of the program, and identify all activities such as safety, reliability and maintainability, quality assurance, environmental related design and test including orbital debris mitigation, program surveillance, and failure reporting/resolution which are used to ensure the success and safety of the mission

RISK MANAGEMENT

Summarize the risk management approach to be used for the program, including appropriate actions to mitigate risk and program de-scope plans. Also identify primary risks consistent with Paragraph 4.3.2.d.

A stand-alone risk management plan is also developed and includes the content shown in NPG 8000.4, Risk Management Procedures and Guidelines.

ENVIRONMENTAL IMPACT

Identify the documentation and schedule of events associated with environmental compliance considerations (NEPA and other requirements). This may include an Environmental Assessment or an Environmental Impact Statement. See Paragraph 4.6.5.

LOGISTICS

Describe the program's logistics requirements.

TEST AND VERIFICATION

Describe the program's approach to test and verification for the assurance of program success. Address requirements for hardware and software verification and validation as well as software independent verification and validation.

REVIEWS

List the reviews that the program will conduct, including independent reviews, in response to EAA and GPMC requirements.

TERMINATION REVIEW CRITERIA

Provide the technical, scientific, schedule, cost, and other criteria, which will be utilized to consider whether a termination review should be conducted.

TAILORING

Identify those requirements for which the approach to compliance has been tailored consistent with program characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. Provide rationale for such tailoring.

CHANGE LOG

Changes to the Program Plan should be documented in a change log.

E.4 Project Plan

Project Plan

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis, if appropriate.)

_____	_____
Center Director	Date
_____	_____
Program Manager	Date
_____	_____
Project Manager	Date

Figure E-4.1 Project Plan Title Page

PROJECT PLAN
FOREWORD

INTRODUCTION

The project is identified by an officially approved title, NASA program, PCA, and/or unique project number. A brief general history and summary are given, including the project's purpose, goals, overall approach, and timeframe. For multiple NASA Center projects, describe the NASA Center's project in relationship to the other participating NASA Centers.

OBJECTIVES

State the specific project objectives, performance goals, and their relationship to the program objectives and goals. Performance goals should be expressed in an objective, quantifiable, and measurable form.

CUSTOMER DEFINITION AND ADVOCACY

State the main customers of the project (e.g., PI, science community, technology community, public, education community, Program and Enterprise sponsor) and the process to be used to ensure customer advocacy.

PROJECT AUTHORITY

Identify the Center where the Project Manager resides and other Center's responsibilities , and the GPMC responsible for the oversight of the project. Provide a chain of accountability and decision path that outlines the roles and responsibilities of the Project Manager, Program Manager, Center Director, and other authorities as required.

MANAGEMENT

Describe the project management structure, including organization and responsibilities, its integration into the program management structure, and NASA Center participation. Identify all significant interfaces with other contributing organizations. Identify specific management tools to support management in planning and controlling the project. Describe any use of special boards and committees. Address any requirement for a NASA Resident Office including duties and authority.

PROJECT REQUIREMENTS

Document the project requirements, including performance requirements and success criteria, as a flow down from the program requirements. This includes the allocation of these requirements and success criteria among the systems to be developed, both hardware and software.

TECHNICAL SUMMARY

Present a technical description of the project. This includes the systems to be developed (hardware and software), use of the SI measurement system, facilities, flight plans, operations and logistics concepts, and planned mission results analysis and reporting.

a. System(s).
b. System operations concept.
c. System constraints.
d. Ground systems and support.
e. Facilities.
f. Mission results analysis and reporting.
g. End of life cycle.

LOGISTICS

Describe the project's logistics requirements, for example, spares, shipping and handling equipment, transportation, user manuals, simulators, training and training materials, and supporting personnel.

SCHEDULES

Document the project's master schedule for all major events, independent reviews, and other activities throughout the life cycle of the project. Include approval dates for principal project documentation, life-cycle transitions, major reviews, program-controlled milestones, and significant contract milestones. Identify lower level schedules to be developed and maintained.

RESOURCES

a. Funding Requirements. Present a funding requirements chart that includes the same elements as for the acquisition summary. Indicate the NOA in real-year dollars for the prior, current, and remaining fiscal years. The displayed detail should cover major elements of cost (typically reflecting at least at the second level of the WBS or its equivalent).

b. Institutional Requirements. Present the institutional requirements (use of or development of facilities, workforce) for the entire project throughout its life cycle. Include civil service workforce requirements on the providing organizations for the prior (e.g., actuals), current, and remaining years.

CONTROLS

All technical performance, cost, or schedule parameters specified as requiring approval by the Administrator, the EAA, CD, or Program Manager, should be identified. Examples include funding by year, success criteria, program requirements, project objectives, management structure, and major program/project documentation. Identify the thresholds associated with each parameter that could

cause a change request. Describe the process by which project requirements are validated for compliance with program requirements. Describe the process for controlling changes to these requirements.

IMPLEMENTATION APPROACH

The implementation approach of the project is provided (e.g., in-house, NASA Center, contractor prime), as well as a project WBS.

a. Implementation approach.
b. Project summary WBS.

ACQUISITION SUMMARY

Provide summary information on procurement items, such as element (engineering design study, hardware and software development, mission and data operations support); type of procurement (competitive, AO for instruments); type of contract (cost-reimbursable, fixed-price); source (institutional, contractor, other Government organizations); procuring activity; and surveillance.

PROGRAM/PROJECT DEPENDENCIES

Other NASA, U.S. agency, and international activities, studies, and agreements are summarized with emphasis on their effect on the program.

a. Related activities and studies, e.g., space communications, launch services, crosscutting technology.
b. Related non-NASA activities and studies.

AGREEMENTS

List all agreements necessary for project success and the projected dates of approval. Include all agreements concluded with the authority of the Project Manager and reference agreements concluded with the authority of the Program Manager and above.

a. NASA agreements, e.g., space communications, launch services.
b. Non-NASA agreements.
   (1) Domestic.
   (2) International.

SAFETY AND MISSION SUCCESS

Safety and mission success planning is developed either as a section of this Project Plan or as a separate document. Address the activities and steps to be taken to ensure safety of the public, the NASA astronauts and pilots, the NASA workforce, and NASA's high-value equipment and property.

Address both hardware and software aspects of the project, and identify all activities, such as safety, reliability and maintainability, quality assurance, environmental related design and test including orbital debris mitigation, project surveillance, and failure reporting/resolution which are used to ensure the success and safety of the mission.

RISK MANAGEMENT

Summarize the risk management approach to be used for the project, including appropriate project de-scope plans. Also identify primary risks consistent with paragraph 4.3.2.d. A stand-alone Risk Management Plan is also developed and includes the content shown in NPG 8000.4, Risk Management Procedures and Guidelines.

ENVIRONMENTAL IMPACT

Identify the documentation and schedule of events associated with environmental compliance considerations (NEPA and other requirements). This may include an EA or an Environmental Impact Statement, (see paragraph 4.6.5).

TEST AND VERIFICATION

Describe the project's approach to test and verification for the assurance of project success. This should address requirements for hardware and software verification and validation, as well as software IV&V.

TECHNOLOGY ASSESSMENT

Identify the NASA crosscutting or other technology thrusts to be utilized by the project. Identify those technologies the project expects to mature during the life of the program. Briefly describe how the technologies will be developed and infused. Describe how and when the project will evaluate the feasibility, readiness, cost, risk, and benefits of the new technologies.

COMMERCIALIZATION

Identify near-term opportunities for commercialization. Describe the methods to be used to identify additional opportunities throughout the project's life cycle.

REVIEWS

Provide the names, purposes, content, and timing of all reviews. Explain the reporting requirements for program and project reviews.

TERMINATION REVIEW CRITERIA

Provide the technical, scientific, schedule, cost, and other criteria, which will be utilized to consider a termination review.

TAILORING

Identify those requirements for which the approach to compliance has been tailored consistent with project characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. Provide rationale for such tailoring.

CHANGE LOG

Changes to the Project Plan should be documented in a change log.

APPENDIX F. Reviews

This Appendix provides information to guide compliance with the requirements for an integrated and comprehensive continuum of reviews (contained in paragraph 2.1.1.3.i for programs, and in paragraph 3.1.1.3.h for projects) and for agency imposed independent assessment associated with the evaluation subprocess (contained in paragraph 2.4 for programs and in paragraph 3.4 for projects).

F.1 Guiding Principles of Reviews

- Reviews are a resource. They offer an opportunity to add value to the products and to the sharing of knowledge by inviting outside experts that can provide confirmation of the approach and/or recommend options.

- Reviews are a tool for communication. They offer an opportunity to organize, assess, and communicate critical data and information between providers, customers, and stakeholders.

F.2 Major Classes of Reviews

The objectives and salient features of the four major review classes are provided to guide program/project managers in the formulation and implementation of an integrated and comprehensive continuum of reviews. The term "integrated and comprehensive continuum" is used to emphasize that there is both a life-cycle relationship and a hierarchical relationship to these reviews. Reviews provide the opportunity to confirm the approach or offer options, if needed, and communicate progress and risks toward meeting the success criteria.

Reviews also serve the needs of the various levels of the management hierarchy from an individual product lead on a project to the NASA Administrator. The output of these reviews (i.e., assessments, options, recommendations, and decisions) flows as inputs into subsequent reviews as appropriate to ensure alignment between providers, customers, and stakeholders, and ensure proper disposition of issues. It is the responsibility of the Program or Project Manager to propose options to combine reviews to providers, customers, and stakeholders, provided that the objectives of each are met. The goal is to maximize the probability of mission success through added value and efficiencies.

F.2.1 Independent Reviews

Independent reviews, discussed here and prescribed as requirements in paragraphs 2.4 and 3.4, provide senior Agency managers with objective assessments of program/project planning, resource requirements, status, and risks. They are conducted during formulation and implementation activities and are the mechanisms used to convey the project's status to Senior Agency Management. Reviews conducted in formulation support the approval subprocess. Implementation reviews allow the approving official(s) to be an integral part of the decision making process. These reviews foster an

environment that provides for informed decisionmaking relative to the project's continuing ability to meet its technical and programmatic commitments. These reviews are delineated in the appropriate formulation and implementation documentation.

Review team members are experts from organizations outside of the advocacy chain of the program/project being reviewed. To the extent possible, continuity of review panel membership is maintained from review to review and throughout the life cycle of a project.

The Program Manager negotiates with Enterprise and GPMC officials to optimize the value of independent reviews for a program/project. The agreement for independent reviews tailored for each program is documented in the FAD, PCA, and Program Plan. The Program Manager flows down the agreed requirement for independent reviews, as appropriate, to the projects within the program. Independent reviews planned during project execution are documented in the FAD (or equivalent) and in the Project Plan.

F.2.1.1 Formulation Subprocess Reviews

F.2.1.1.1 Non-Advocate Review (NAR)

A NAR is an example of an independent review that provides the GPMC with an independent verification and evaluation of a program or selected project's readiness to proceed to implementation.

A NAR, or similar type of review (e.g., Confirmation Assessment Review), assesses the following:

a. Compatibility with NASA policy and baselined documentation.

b. Clarity of goals and objectives.

c. Thoroughness/realism of technical plans, schedules, and cost estimates (including reserves and de-scoping options).

d. Adequacy of management plans, including organizational structure and key personnel credentials.

e. Technical complexity, risk assessment, and risk mitigation plans.

The findings of the review document each of the areas above. NASA senior management uses the conclusions and recommendations in the deliberations to determine if the program or project will continue.

F.2.1.1.2 Independent Assessment (IA)

An IA is another example of an independent review performed in support of the Agency PMC oversight of a program or project in formulation. An IA is typically a validation of an advanced concept. It

provides the Agency PMC with an in-depth, independent validation of the advanced concepts, program/project requirements, performance, design integrity, system/subsystem trades, LCC, realism of schedule, risks and risk mitigation approaches, and technology issues. It also provides suggestions of alternative system and/or subsystem design approaches which offer potential for reduced costs and risks or improved system performance.

An IA uses a team of highly knowledgeable specialists from outside the program/project advocacy chain to accomplish the following:

a. Validate an advanced concept.
b. Evaluate the program/projects requirements, performance, and design integrity.
c. Evaluate system/subsystem trades.
d. Assess LCC and realism of schedule.
e. Evaluate risk and mitigation approaches.
f. Identify technology issues.

The results are used in support of budget decisions and by the Agency PMC in its deliberative process for developing recommendations regarding continuation further into formulation.

F.2.1.2 Implementation Subprocess Reviews

F.2.1.2.1 IIR.

Governing PMC's and Enterprises define and conduct periodic IIR's to ensure that they remain cognizant of the implementation status and performance of the programs and projects over which they have responsibility and accountability. An IIR is used by the GPMC to validate conformance to the PCA for programs and projects over which it has responsibility. The IIR team assesses status and changes since the last NAR or IIR.

The IIR's--

a. Assess technical, cost, schedule, and other programmatic achievements against the Program/Project Plan baseline.

b. Assess technical progress, risks remaining, and risk mitigation plans.

c. Identify any deficiencies that may result in revised projections exceeding predetermined thresholds.

F.2.1.2.2 EIRR.

An EIRR may be performed in support of an EAA's oversight of programs and projects in implementation. EIRR's are composed of highly knowledgeable experts generally from organizations outside NASA with a focus on risk areas. The EIRR evaluates program/project risk and risk mitigation

approaches. The results include identification of risks which NASA faces as it proceeds with the project and suggested actions to reduce or mitigate risk. These results will be used by the EAA in determining project readiness to proceed to the next stage.

F.2.1.3 Reports

The independent review reports contain the following:

a. Findings and conclusions relative to compliance with the PCA or Program/Project Plan.

b. Conclusions regarding additional reviews or individual program/project briefings that the review team deems necessary.

c. Findings and conclusions on the advisability of continuing the program/project.

d. Findings and conclusions regarding program/project budget decisions.

e. Minority reports as desired by individual team members.

F.2.2 Critical Milestone Reviews (CMR)

CMR's are the life-cycle series of rigorous system-level technical and programmatic evaluations conducted at key formulation and implementation milestones. Key milestones in this context are the major transition points in the life cycle, such as the transition from requirements development to design activities, final design to manufacturing, and the transition from the assembly and integration of components to system-level environmental testing. CMR's may include, but are not limited to, System Concept Review, Requirements Review, Preliminary Design Review, Critical Design Review, Pre-Environmental Review, Pre-Ship Review, Operational Readiness Review. Managers define the appropriate critical milestone reviews and document them as internally imposed requirements. The purpose of a CMR is to assess the technical and programmatic health of a program, project, or major element of a project with respect to the success criteria and acceptable risk. The reviews provide top-down systematic evaluations of the derivation and functional allocation of requirements, the engineering implementation to address the requirements, the validation and verification of the requirements, the preparation for operations and data analysis, and the system management processes that tie it all together. The CMR's must also address the resources (e.g., workforce, budget, schedule) required to complete the formulation and/or implementation of the program or project as well as any associated resource constraints, issues/risks, and reserves. This systematic, integrated assessment relies on a robust set of appropriate Engineering Peer Reviews and comprehensive Product Integrity Reviews.

Members of review teams are chosen, based on their combined expertise, objectivity, and their ability to assess the implementation of an entire system that employs numerous engineering and other disciplines. A review team that provides continuity throughout the life cycle of the project is desirable to limit the amount of reeducation that must be done to get new members knowledgeable. Inclusion of

reviewers that are independent of the advocacy chain on CMR teams is essential. Centers are expected to have procedures and guidelines in place to provide guidance on CMR's tailored to the work of the Center.

F.2.3 Engineering Peer Reviews (EPR)

EPR's are focused, in-depth technical reviews used to provide confirmation and offer options by bringing in experts early and at appropriate points throughout the life cycle. A thoughtfully formulated, comprehensive set of EPR's is a cornerstone of a successful project. The reviews provide a penetrating examination of requirements, interfaces, design, analysis, manufacturing, integration, test and operational details, drawings, processes, and data.

EPR's are most frequently applied to subsystem or lower level development activities. They are also well suited for the evaluation of requirements, concepts, designs, and processes associated with combinations of subsystems and crosscutting functional subdivisions such as the end-to-end optical path, command and data pipeline, maneuver planning, or autonomous fault detection/correction system. Project managers and line management define a set of engineering peer reviews appropriate for each project.

EPR's are most effective when accomplished with a small group of reviewers working intimately with the developers. Reviewers are experts independent of the executing team, including experts from outside of the performing organization. Reviewers are appointed in collaboration with the product lead's line management. The customers are the product leads and the Project Manager. They are also accountable for the definition of review objectives and subsequent communication and closure of issues resulting from the reviews.

F.2.4 Product Integrity Review (PIR)

Quality cannot be reviewed into a system. Therefore, lower tier assurances are essential. PIR is an inclusive term for the variety of surveillance mechanisms employed by line management organizations to ensure the quality, viability, and safety of the products they provide. The expectation is that the supervisory chains of all performing organizations within NASA Centers, contractors, suppliers, universities and, foreign partners, exercise their responsibility for the integrity of the products and services their employees deliver.

The management and technical experts of the performing organizations provide surveillance mechanisms according to their internal processes. Examples of Product Integrity Accountability are endless and range in formality from a work unit manager walking around and discussing work status and issues with subordinates, to weekly "Top 10 Issues" reporting to higher levels of management, to a Center PMC conducting periodic status reviews of projects.

This product lead is responsible for ensuring that performing organizations understand and fulfill their accountability for the product.