■ NASA Procedures and Guidelines

NPG: 7120.5A
Effective Date: April 3, 1998
Expiration Date: April 3, 2003

Responsible Office: Code AE/Office of Chief Engineer

NASA Program and Project Management Processes and Requirements

■ NASA Procedures and Guidelines

NPG: 7120.5A
Effective Date: April 3, 1998
Expiration Date: April 3, 2003

Responsible Office: Code AE/Office of Chief Engineer

NASA Program and Project Management Processes and Requirements

---

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Preface

P.1 Purpose

P.1.1 This document establishes the management system for processes, requirements, and responsibilities for implementing NPD 7120.4A, 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 accomplishment of the NASA programs and projects, consistent with established Agency strategic planning, on schedule, and within budget, while satisfying the 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 the 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 space and aeronautics, flight and ground systems, technologies, and operations. It is not required but may be used for other projects, such as nonflight infrastructure, Construction of Facilities (CoF) Small Business Innovation Research (SBIR), or Research & Analysis (R&A) projects.

P.2.3 While all process activities and requirements shall be addressed, program and project managers should tailor implementation of the requirements to the specific needs of the program/project consistent with program/project size, complexity, criticality, and risk. Tailoring is a mechanism to encourage innovation and achieve "faster, better, cheaper" products while meeting that expectations of the customer. Results of the tailoring are to be documented in Program Commitment Agreementís (PCA), Program Plans, and Project Plans. All programs and projects shall comply with requirements established by law, regulations, Executive orders, and Agency directives.

P.2.4 The NASA Strategic Management Handbook, NPD 7120.4A, and the present document rank first, second, and third 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 7120.4A and this document. This document contains references to laws, regulations, and other NPDís and NPGís which provide more detailed information pertaining to these requirements and processes.

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, Strategic Plan.
b. NPG 1000.2, Strategic Management Handbook.
c. NPD 7120.4A, Program/Project Management.
d. Additional references are inserted at the beginning of some chapters and others are accessible in appendix A. Definitions and acronyms are included in appendices B and C, respectively.

P.5 Cancellation

P.5.1 This document replaces NHB 7120.5, Management of Major System Programs and Projects.

Original signed by:

__ _____

J. R. Dailey
Acting Deputy Administrator

DISTRIBUTION:

NASA On-line Directives Information System (NODIS)

CHAPTER 1. Overview

This chapter provides an introduction to the overall document, highlights the Agencyís framework for managing programs and projects, specifies major themes which are reflected throughout the document, describes the overall 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 (LCCís), 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. Today, a major emphasis is being placed on executing projects ìbetter, faster, cheaper,î and these projects differ significantly from earlier large, lengthy development projects. The disciplined approach of program and project management is now being applied to technology development programs to enable future Agency missions. The reinvention of Government initiative also allows streamlined, new ways of doing business that should be incorporated into the NASA methodology.

1.1.3 This document responds to these challenges and 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.

1.1.4 This document defines the requirements that managers must meet in formulating, approving, implementing, and evaluating programs and projects per NPD 7120.4A. 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 reduce cycle time, reduce cost, and improve the safety and quality of the product or capability delivered.

1.1.5 Programs will be reviewed by the Agency Program Management Council (PMC), unless delegated to a Center PMC by approval of the PCA. Projects will be reviewed by the Governing Program Management Council (GPMC) as authorized in the approved PCA, program plan, or project plan.

1.1.6 The requirements specified in this document adhere to the Government Performance and Results Act.

1.2 Framework

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

a. Earth Science.
b. Space Science.
c. Human Exploration and Development of Space.
d. Aeronautics and Space Transportation Technology.

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 four critical crosscutting processes. These are as follows:

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

Figure 1-1 provides a graphical illustration of these Agency crosscutting processes and their interrelationships.

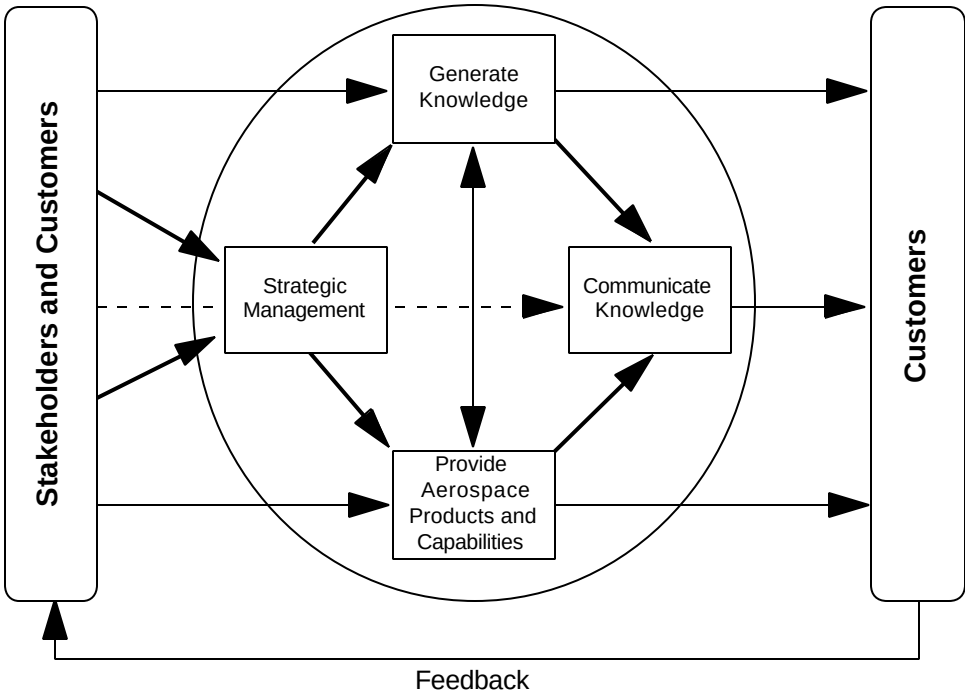


Figure 1-1. NASA Integrated Process map: Interrelationships of crosscutting processes.

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 crosscutting process provides policy, objectives, priorities, and resources to allow the Agency to develop, conduct, and evaluate programs and projects. The Generate Knowledge process provides new scientific and technological knowledge resulting from program and project implementation. 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 In concert with process management, the Strategic Management Handbook defines the responsibilities of management officials for the process. The Administrator is the Agencyís highest level internal decisionmaker and has sole authority to approve all new programs. The Enterprise Associate Administrators (EAA) are responsible for establishing Enterprise strategy, formulating programs, defining customer requirements and objectives, recommending Lead Center assignments, allocating resources for programs and some projects, and assessing performance. NASA Centers are responsible for implementing NASAís programs and projects, based on Center mission and Center of Excellence designations. Each NASA program Lead Center assignment is approved by the Associate Deputy Administrator (Technical). Lead Center Directors (LCD) have full program management responsibility and authority, thus, full accountability for assigned programs including the assignment of work to other Centers. The LCDís delegate program management responsibility to program managers who ensure the most expeditious and cost-effective implementation. Center Directors select project managers who report to the program manager for individual project elements. 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 PCA, Program Plan, and Project Plan. The PCA is the agreement between the Administrator and the EAA that documents the Agencyís commitment to execute the program requirements within established constraints. Additional commitments are documented in Program and Project Plans which detail the approach and plans for formulating, approving, implementing, and evaluating program and projects. This ensures that the Agency and all supporting organizations understand the programmatic, technical, and management systems 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 PMCís. Hierarchical PMCís are referred to as governing PMCís or GPMCís throughout this document. The NASA PMC is responsible for evaluating proposals for new programs, providing recommendations to the Administrator, and assessing existing programs to evaluate cost, schedule, and technical content to ensure that the Agency is meeting its commitments. The NASA PMC may delegate the review of an Agency program to a Lead Center PMC. Appendix A provides access to the charter for the NASA PMC. Other PMCís are established at the Lead Center and Center levels, and at lower levels as required and authorized. Similar to the NASA PMC, these councils evaluate the cost, schedule, and technical content to ensure that NASA is meeting its commitments specified in the PCA, the Program Plan, and the Project Plan.

1.3 Themes

1.3.1 Several important themes that embody principles for executing Program/Project Management (PPM) in todayís environment recur throughout this document. They are as follows:

a. Tailoring the Process. PAPAC processes and requirements provide managers the framework to tailor approaches for formulating and implementing the Agencyís increasingly diverse programs and projects. While the PAPAC process and all requirements should be addressed, managers can tailor approaches consistent with program or project characteristics such as size, complexity, cost, and risk. Approved PCAís and Program/Project Plans will document the tailoring decisions.

b. End-to-End Customer Involvement. Managers shall identify customers and ensure that they are actively involved in program and project activities throughout the PAPAC process. Customer participation will increase the ability of the program or project to achieve customer objectives within established constraints.

c. Comprehensive Definition and Requirements Control. NASA shall only undertake programs and projects that have clearly defined objectives, are consistent with the NASA Strategic Plan, and have a comprehensive definition of cost, schedule, and content commitments. Agreements and requirements must be controlled throughout the program or project life cycle, from formulation to retirement.

d. Risk Management. The program or project manager shall apply risk management principles as a decision making tool which enables programmatic and technical success. Program and project decisions shall be made on the basis of an orderly risk management effort, including the identification, assessment, mitigation, and disposition of risks throughout the PAPAC process.

e. 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.

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

g. International Standards Organization (ISO) 9000. NASA's priority for achieving ISO 9000 certification reflects a commitment to implement a high quality of controlled and defined work processes. The PAPAC process and associated requirements provide the framework which shall be supported by Center-certified processes.

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 1-2 illustrates the interrelationships of the four PAPAC subprocesses with each other as well as with the Agencyís three other crosscutting processes. The PAPAC obtains its requirements from the Generate and Communicate Knowledge Process (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.

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 either the NASA or 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; and performs LCC and performance analyses to feasible concepts. The outcome of the formulation subprocess, documented in the PCA and Program/Project Plans, are as follows:

(1) A comprehensive definition of the program or project concept and program/project performance objectives.

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

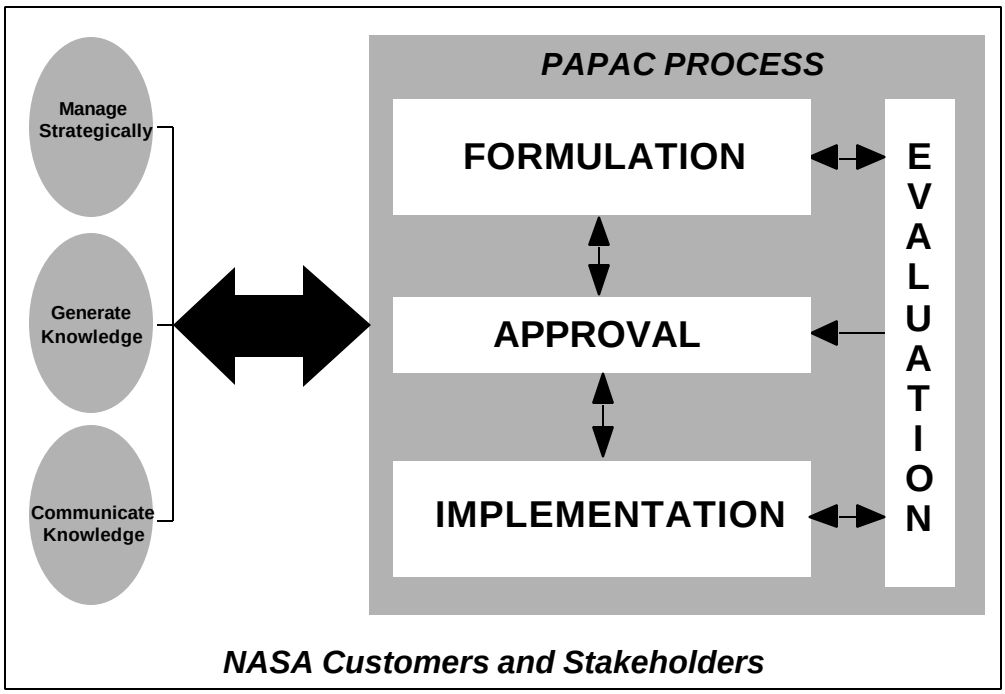


Figure 1-2. Crosscutting processesí interrelationships.

b. Approval subprocess. The purpose of the approval subprocess is to initially decide on a program/projectís readiness to proceed from formulation to implementation. Approval for a program 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, based on budgetary or technical issues or strategic redirection. NASA will only approve the baseline or rebaselining of those programs and projects that have firm 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.

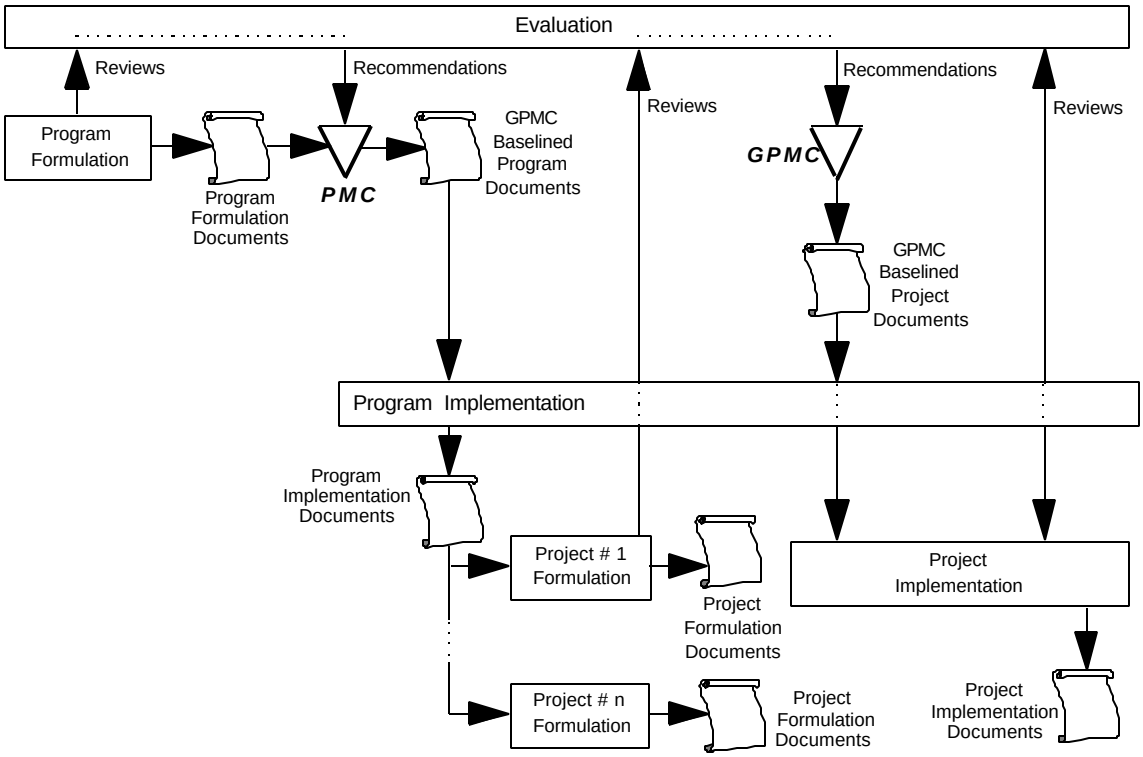
(2) Authorization for the program or project to proceed to the implementation subprocess.

c. Implementation subprocess. The purpose of this subprocess is to deliver the program and project 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 meets the needs of the customer community.

d. Evaluation subprocess. The purpose of the evaluation subprocess is to provide an independent assessment 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 review of program or project concepts, plans, status, risk levels and performance. Requirements for the reviews and assessments should be tailored, based on such factors as program and project size, criticality, and risk and are detailed in program/project plans. 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.

e. Process Execution. The execution of these four PAPAC subprocesses is depicted in figure 1-3 which provides the process flow, associated levels of PPM approval, and the key documentation. The effort is overseen by the hierarchy of GPMCís.

1.4.4 As illustrated in figure 1-3, new programs are formulated, based on the advice and recommendations of customers, stakeholders, external Agency advisory committees, and Agency studies. As programmatic approaches and plans are established, the evaluation subprocess is used to ensure that the concepts and requirements meet the needs of the customer community.



Note: Triangles are recommendations for approval made to approving official.

Figure 1-3. Process flow.

1.4.5 When a program is approved by the NASA Administrator following assessment and endorsement by the NASA PMC, it moves into the implementation subprocess. Project elements may be formulated in the initial program baseline during program implementation. In some cases, e.g., a competitively selected science project within a program, the EAA makes the selection and approves the Lead Center recommendation to move into implementation, unless the specific project has been elevated to the NASA PMC.

1.4.6 Following approval, the project transitions to the project implementation subprocess. During both program and project implementation, the evaluation subprocess continues to conduct assessments against changing resource availability, requirements, and customer needs. While this process flow is iterative and dynamic, it provides a disciplined approach for managing concurrent and interdependent activities.

1.4.7 In NHB 7120.5, only ìmajor projectsî were included, and the process was defined as sequential, rigid ìphasesî of A, B, C, D, and E, although the reality was different. Today, these ìphasesî are being combined through the PAPAC process, and the new ways of doing business are no longer impeded by the previous rigid structure. PAPAC can be visualized as a two-phase process focused on formulation and implementation, but even at this level, the processes are highly interactive.

1.4.8 The PAPAC process requirements shall be addressed, and all (except legal) may be tailored to meet the specific needs of the program or project, given driving characteristics such as size, complexity, criticality, and risk. These requirements are contained in the process activities and management system requirements, described in chapter 4. In addressing the PAPAC process and requirements, tailoring is reflected in the decision to accomplish the following:

a. Use the process and meet the requirement, as stated.
b. Modify the process with supporting description and rationale.
c. Modify the management systems requirements with supporting rationale.

1.4.9 The PCA, Program Plan, and Project Plan document the results of the tailoring process.

1.5 Document Structure

1.5.1 Chapters 2 and 3 detail each of the four subprocesses. Subprocess flows provide detail on subprocess 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. 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 manager.

1.5.2 Chapter 4 provides requirements for some key management system processes that span the program/project life cycle. Cited references in chapter 4 and other NASA regulations and directives (see appendix A.) provide additional management system requirements which should be tailored in program and project plans. In addition, all applicable statutory and regulatory requirements shall be met. Appendices provide other supplemental information.

1.5.3 There are a number of references throughout this document to NPDís and NPGís which relate to PPM processes and requirements. Only the critical requirements relevant to PPM are summarized in this guidance. Appendix A provides access to additional references derived from the NODIS database.

1.5.4 Centers shall implement Center-level policies, processes, procedures, and requirements to ensure successful program/project execution. A requirement is identified by ìshall,î a good practice by ìshould,î permission by ìmayî or ìcan,î expectation by ìwill,î and descriptive material by ìis.î

1.6 Program/Project Management Initiative (PPMI)

1.6.1 NASA has established a Program/Project Management Initiative (PPMI) to develop and maintain world-class program and project managers. The PPMI includes Agencywide professional development programs to promote project development and competency skills, training, and education programs to meet PPMI knowledge and skill requirements; team consultation services; and support to facilitate dialog throughout the PPM community. The Agency encourages managers to join the growing network of NASA program and project managers who have taken advantage of this valuable resource. Access the PPMI home page at URL http://www.hq.nasa.gov/office/HR Education/training/ppmi.htm to learn more about this initiative and other related PPM information.

CHAPTER 2. Program Management Process and Functional Requirements

2.0.a NASA programs are major activities within an Enterprise having defined goals, objectives, requirements, and funding levels, and consisting of one or more projects. Programs vary significantly in their complexity, cost, and criticality; however, they are all the core of the work NASA delivers to the American public. The program manager is responsible for the successful accomplishment of the program that meets the needs of the customer. To that end, the program manager is also responsible for the total range of program activities from supporting formulation of requirements through delivery of the final products. The program management role varies as a function of the type of program as well. For single project programs (e.g., Cassini), the program manager may also serve in the role of project manager; in these instances, the activities and requirements applicable to both programs and projects must be met by the program manager. For programs with multiple independent projects (e.g., Discovery), the role of the program manager is one of initiating projects and providing assistance to the projects, LCC, and EAA in the management of program implementation. For these types programs, there is minimal need for cross-project integration. For programs with multiple interdependent projects (e.g., Space Shuttle), the role of the program manager includes the added responsibility for integrated program planning and execution.

2.0.b The program manager is responsible for the program cost, schedule, and technical performance and the management system requirements. Chapter 4 is dedicated to these critical functions that are being performed throughout the life of the program. The program manager should be knowledgeable in all these areas and call on the experts to assist. As the program progresses, the emphasis in these areas will vary. For instance, during the formulation of the program, acquisition management will be focused on the acquisition strategy to obtain the skills and assets required for the program.

2.0.c Use of the acquisition team will ensure that appropriate planning is put in place that provides the best value for the NASA. During the implementation subprocess, emphasis is on the management of the contracts or agreements against the metrics applicable to the deliverables. Similar statements can be made for the other program/project management system requirements functions.

2.0.d The program manager is responsible for reporting program performance lessons learned, according to 4.5.3. The program manager is also responsible for reporting process lessons learned to the NASA Chief Engineer for each subprocess.

2.0.e The program manager should develop a cooperative and performance-oriented team that includes the project managers. The relationship between the program manager and the project manager(s) is critical to each other's success. The program manager works with the EAA to advocate for the totality of the program, including advocacy for projects. The EAA and program manager will ensure that the interface with the Manage Strategically process is used to coordinate 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 other Government agencies. It is imperative that both program managers and project managers be mutually supporting and empower each other to do their functions with open communication.

2.0.f Good program managers are the key to successful achievement of the Agencyís strategic goals and objectives through the planning and implementation of programs. Their ability to draw the best from the program participants and manage all program aspects is essential. The process discussed in this chapter and the management system requirements of chapter 4 are the foundation for innovation and achievement for the program team.

2.1 Program Formulation

2.1.a The formulation subprocess is to define an affordable program concept and plan to meet mission objectives or technology goals specified in the NASA and Enterprise Strategic Plans. The formulation subprocess explores the full range of implementation options, including concept and technology availability and needs; establishes the internal management control functions that will be used throughout the life of the program; assesses the technology requirements and develops the plans for achieving the technology options, including options for partnering and commercialization; performs LCC and performance analyses on concepts deemed to have a high degree of technical and operational feasibility; and identifies both reserves associated with program risk management and other estimated project reserves. Through this subprocess, the top level requirements are generated for incorporation into the PCA, Program Plans, and/or Project Plans.

2.1.b During program formulation, the PCA, Program Plans, and Project Plans (as appropriate) are developed to document the program concept and objectives. Agreements, approaches, and plans to meet all the objectives are included (see appendix E).

2.1.c The program formulation subprocess is the responsibility of the appropriate EAA, although an EAA may delegate to others specific activities making up the overall formulation subprocess. The EAA relies on the advice and recommendations of NASA-chartered panels and scientific advisory committees, who, in many cases, represent customers of the Enterprise. 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 to provide high confidence that the program is ready to proceed into implementation. The formulation subprocess is an iterative activity rather than a discrete set of linear steps. It starts with customer requirements, strategic planning goals and objectives, and an authorization to begin the subprocess, the formulation authorization document. 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 functional requirements can be tailored to match the needs of the unique program. This means that there may be a different approach developed for space

and Earth science missions, human space flight, and aeronautics technology, as long as the intent of the activities described within the subprocess are accounted for as part of the PCA and Program Plan. For example, in space and Earth science missions, Principal Investigators (PI) are solicited through a continuing Announcement of Opportunity (AO) process in which the PI proposals constitute the first cycle of formulation, and subsequent cycles are conducted to refine selected proposals to complete the formulation subprocess and proceed to implementation. Microgravity and Life Sciences utilizes NASA Research Announcements (NRA) in a similar fashion. The human space flight approach may include prime contractor development or contracted service operations, major international corporations, or Space Act agreements. Aeronautics technology may use industry/Government partnerships with contracts or Space Act agreements for development or services.

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 Plans) shall be modified, reviewed by the GPMC, and signed by the approving official upon GPMC recommendation.

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 inputs to the program formulation subprocess are Communicate Knowledge, Manage Strategically, and Generate Knowledge. Formulation authorization is a concisely written direction by the EAA, authorizing resources for formulation with a scope of work for the study and schedules as defined in appendix E.1. 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 are as follows:

1. Program Planning (2.1.1). The objective of this activity is to develop the detailed definition of the program requirements and to establish program control to manage the program formulation subprocess.

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

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

4. Program Technology and Commercialization Plans (2.1.4). This activity develops the technology options and partnering and commercialization options that satisfy candidate concepts' identified needs.

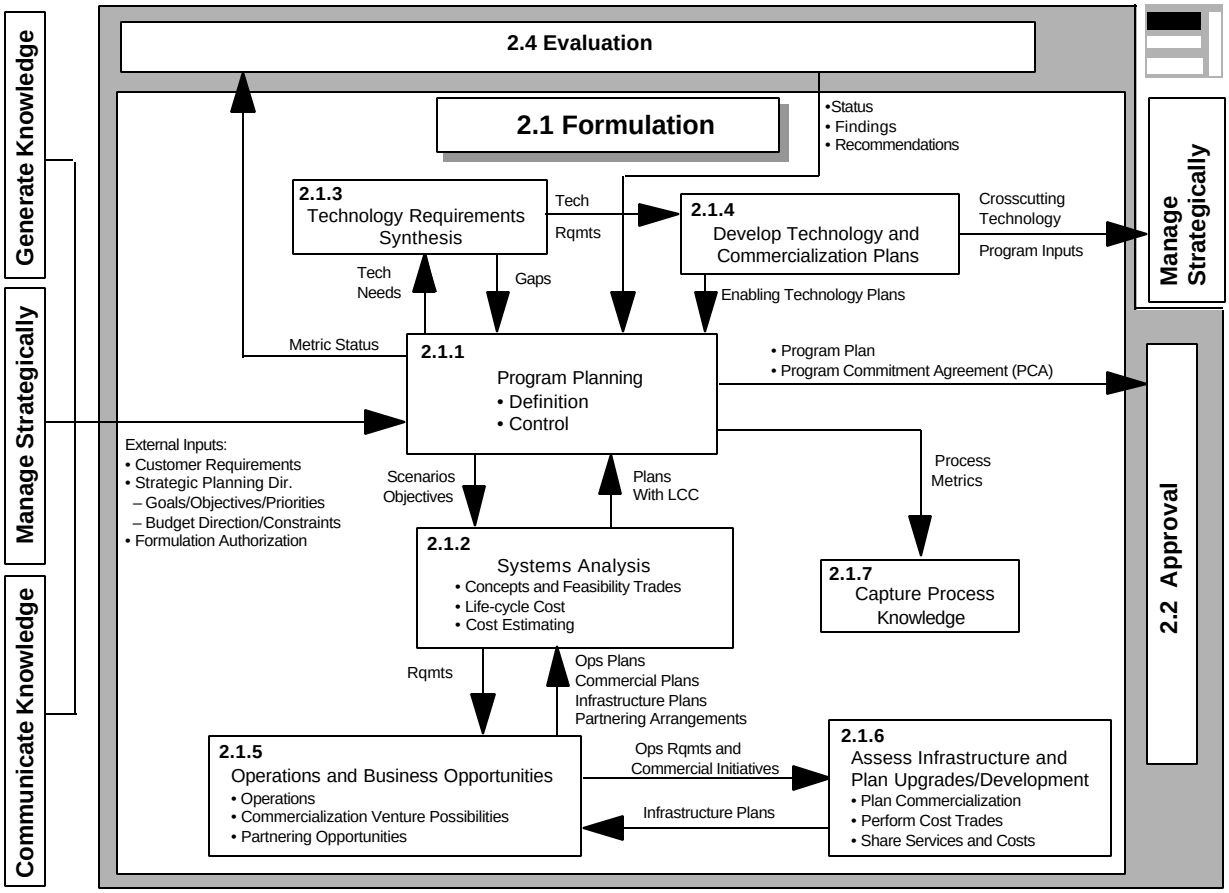


Figure 2-1. Program formulation subprocess.

5. Program Operations and Business Opportunities (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 (2.1.6). This activity minimizes program LCC's by assessing the infrastructure of NASA, other national and international agencies, industry, and academia to satisfy program requirements.

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

2.1.1 Program Planning

2.1.1.1 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 programís affordability, technical content, management, budget, risk management, acquisition, and institutional support plans enables a firm Agency commitment to accomplish the programís 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.

2.1.1.2 To accomplish Program Planning, the program team should perform the following:

a. Prepare and maintain a preliminary PCA that shall be available for the Non-Advocate Reviews (NAR).

b. Develop and incorporate concepts, mission development strategies, data management plans, acquisition strategies, implementation plans, Space Operations Service Level Agreements (SLA), Launch Services Agreements, and management plans into a preliminary Program Plan.

c. Identify program LCC elements, schedule, and performance baseline and refine throughout the formulation subprocess (see paragraphs 4.1 and 4.3).

d. Ensure that the basic concept of the program is defined; synergistic activities with other NASA, industry, academia, and international parties are considered; and that the program is within the framework of the NASA Strategic Plan.

e. Work with the Office of External Relations and the EAA to develop agreements with non-NASA partners; ensure that the division of responsibility with the partner is consistent with policy guidelines established by the EAA.

f. Develop and manage acquisition strategy for the conduct of the remainder of the formulation subprocess and a preliminary acquisition strategy for executing the program (see paragraph 4.4).

g. Define program metrics for assessment of program formulation performance (see paragraph 4.3).

h. Review, approve, and monitor progress of technology and development plans.

i. Define the number and scope of program.

j. Use risk management planning as a basis for decisions to release reserves to recover from cost, schedule, or technical impacts.

k. Identify and plan for management system requirements which address Work Breakdown Structure (WBS) development, contract management, configuration control, Information Technology (IT) requirements, Earned Value Management (EVM), and schedule management that are instituted for the program and projects per the Management Systems Requirements of chapter 4.

l. Capture program history of performance, margins, schedule, risk, and cost over the formulation period as lessons learned for future managers.

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

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 technology alternatives, operations, business opportunities, schedule, and infrastructure useful to the program. Risk assessment planning (see paragraph 4.2) is accomplished as part of the systems analysis; risks are identified, and risk mitigation planning is developed and included in the analyses. To accomplish systems analysis, the program team shall accomplish the following:

a. Perform trade studies among candidate program concepts that consider affordability, technology, content, risk, and potential acquisition strategies.

b. Perform advanced studies to define needed engineering, technology, or commercial activities, and provide Center resources to fund these studies and analyses.

c. Examine program options which consider estimated cost in tradeoffs of commercialization possibilities, operational needs, and infrastructure availability from 2.1.5 and 2.1.6.

d. Develop program performance requirements.

e. Develop a preliminary assessment of risks and risk mitigation actions.

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 Requirements Synthesis

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. The technology and synthesis activity defines which technologies should be incorporated into the program and which should be considered for a crosscutting technology program to enable future NASA endeavors. Technology is in the following two general categories:

a. Those technologies that provide fundamental capabilities without which certain program-specific objectives cannot be met.

b. Those crosscutting technologies that reduce cost or risk to such a degree that they enable completely new mission opportunities.

2.1.3.2 Both types of technology are essential in meeting NASA's goals. The former category generally represents more mission-specific needs that are tied to detailed mission objectives, while the latter category represents multimission applications in which aggregate cost savings or higher performance effectively enable entire new program elements.

2.1.3.3 Program-specific technology development activities are managed by the specific program requiring that technology. To accomplish technology requirements synthesis, the program team shall perform the following:

a. Identify technology efforts required to support the proposed program needs, including the continued assessment of enabling technologies.

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

c. Identify where significant technology gaps exist, such that it would be difficult for a concept to be realized.

2.1.3.4 The crosscutting technology programs have formulation, approval, and implementation subprocesses separate from the programs which will eventually utilize those technologies, and they are executed consistent with the subprocesses described in this document.

2.1.4 Develop Technology and Commercialization Program Plans

This activity plans the technology options that satisfy candidate conceptsí identified needs. 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. Plans may be developed for program-specific technology, multiuse technology, or new crosscutting technology. To accomplish technology and commercialization planning, the program team shall perform the following:

a. Use the assessment of 2.1.3, plan technology to accomplish program-specific objectives through identification of technology development strategies to remove capability/cost gaps.

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

c. Explore how 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 that have resulted from assets or partnerships referred to in item c. above.

e. Assess teaming and partnering options to achieve various aspects of the program.

f. 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, and other funding) and the confidence that the partnership will remain in force through their commitment.

g. Where the ability of the Agency to proceed with a program is predicated on partnering or obtaining resources from sources external to NASA, the PCA shall include the partnering considerations.

h. Where possible, integrate NASA plans with the technology and commercialization plans of its customers. All potential cooperative technology and commercialization opportunities must be vigorously explored and, where advantageous to NASA, agreements enacted.

i. Ensure that the planned technology exchange and partnership agreements comply with all laws and regulations regarding the transfer of sensitive and proprietary technologies.

2.1.5 Operations and 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 concentrate on 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 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 activity 2.1.2 and the final agreements negotiated. To accomplish this assessment, the program team shall perform the following:

a. Assess operational requirements to ensure that innovative approaches are pursued that meet the program needs with minimal impact to Agency resources.

b. Solicit commercial ventures for development and operational elements that reduce the program LCC.

c. Develop requirements for the Space Operations Management Office (SOMO) support to the program for communications, tracking, data processing, and mission operations, unless a more cost-effective life cycle can be proposed.

d. Identify external organizations with business interests aligned with the programís objectives and assess possible partnerships.

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 LCCís. To accomplish this assessment, the program team shall perform the following:

a. Identify capability gaps and produce plans for infrastructure upgrades or new development, and reflect the results in the Program Plan.

b. Perform multiprogram 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 materiel support needs.

d. Identify testing requirements (e.g., ground and flight facilities, data needs) for Aeronautical Flight Research programs to meet the operational flight research requirements and verify infrastructure capability.

2.1.7 Capture Process Knowledge

The objective of this activity is to assess the value of the formulation process and to determine the effectiveness and efficiency with which the formulation subprocess is executed. A formulation subprocess history is maintained which includes the significant events, options studied, tradeoffs made, resources expended, time consumed, and any other performance information that may be relevant for understanding this program formulation subprocess. Lessons learned shall be developed for improvement of the PAPAC process and provided to the Chief Engineer.

2.2 Program Approval

2.2.a The program approval subprocess determines whether a program is ready to proceed from the formulation subprocess to the implementation subprocess. It may also provide approval for a program to continue in the formulation subprocess in which iterative formulation is required or to approve changes to the PCA or Program Plan based on budgetary or technical considerations.

2.2.b 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 cost, schedule, and content commitment can be made will be approved. Within NASA, the Administrator has sole authority to approve all new programs. 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 Capital Investment Council (CIC) are a direct input to program approval,

through the approving official. Each program shall execute the approval subprocess. To begin the approval subprocess, the EAA shall present to the NASA PMC a proposed PCA and Program Plan.

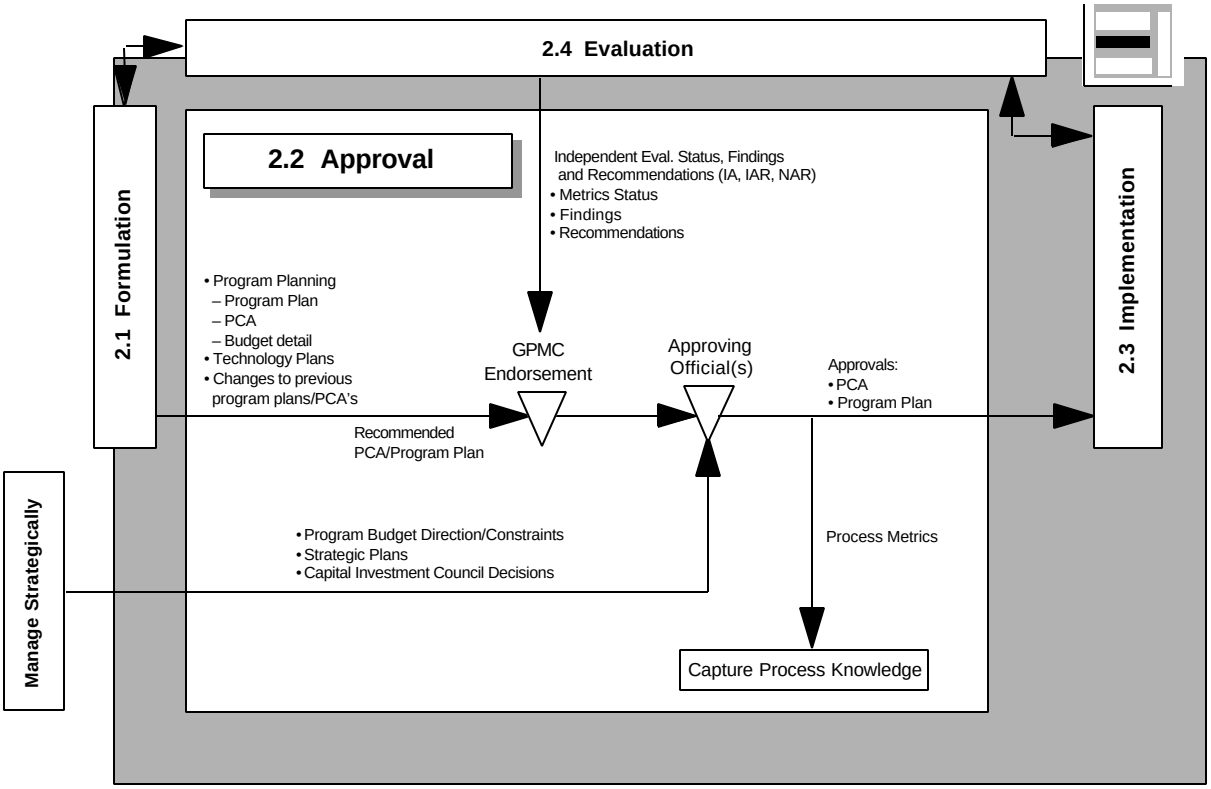


Figure 2-2. Program approval subprocess.

2.2.c Information from the evaluation subprocess developed during formulation, such as the NAR or Independent Assessment (IA), shall also be provided to the PMC. Based on the NASA PMC recommendation, the Administrator signs the PCA with the EAA, thereby approving the PCA. The Program Plan is signed by the LCD, the EAA, and the program manager. A signed PCA and Program Plan are provided for the implementation subprocess as the baseline for detailed implementation planning and execution.

2.2.d The PCA will be updated annually when NASA's budget is submitted to Congress, if changes are required. Changes in budget, strategic planning criteria used to approve the program, or changes within the program that violate the original approval criteria could necessitate program reformulation and reevaluation for rebaseline or termination. The approval may be simplified by focusing on the elements that cause reevaluation.

2.3 Program Implementation

2.3.a The program implementation subprocess implements the approved program requirements and plans. This activity is executed through conduct of the overall activities depicted in figure 2-3. The implementation subprocess focuses on translating the input products from the formulation and approval subprocesses into the production of formal output products and services for the designated customers.

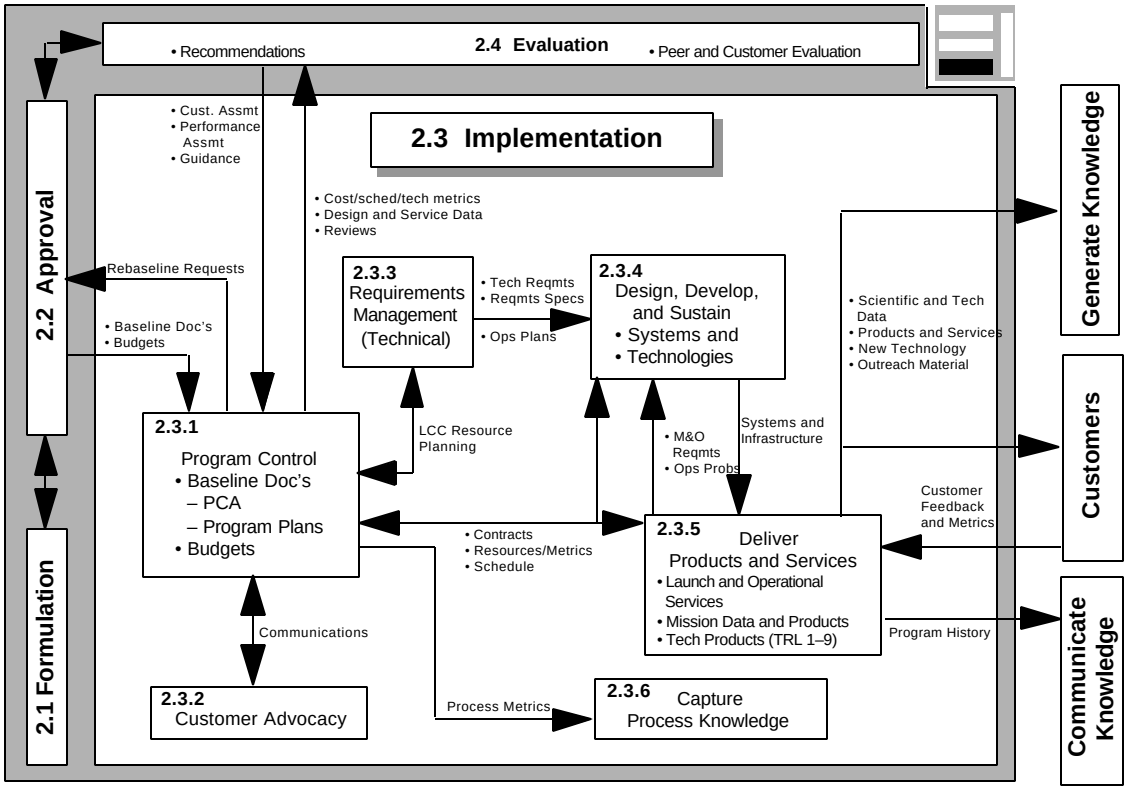


Figure 2-3. Program implementation subprocess.

2.3.b The completion of the implementation activities and output products shall be approved by the program manager. Each program shall execute the following implementation subprocess:

1. Program Control. This activity develops, integrates, and provides direction and exercises control over budget, schedules, and procurement.

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

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

4. Design, Develop, and Sustain Technology and/or Systems. This activity produces the specific program systems, hardware, and software, through developing and executing the design, manufacturing, testing, and verification processes and developing and establishing the systemsí supporting infrastructures for continuing production, sustaining engineering, logistics, and operations.

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

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

2.3.c The activities described below shall be executed consistent with the implementing Centerís policies and procedures.

2.3.1 Program Control

2.3.1.1 This is an activity through which the program manager provides direction and exercises control over budget, schedules, procurement, and overall program management. 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 available resources with which to meet those requirements. The activity maintains program plans, PCAís, budgets, and top-level performance requirements as inputs to the implementation subprocess. This activity develops and integrates the overall implementation approach and provides management oversight of all aspects of the program. The program control functions and internal control functions are executed by this activity.

2.3.1.2 The program control activity includes both performance of the traditional NASA program control functions and program manager oversight of the remaining implementation subprocess, obtains its formal external direction, and provides formal internal direction. It is, therefore, the principal program interface to external participants as well as being the top-level internal program implementation authority. To accomplish program control, the program team shall perform the following:

a. Implement integrated planning to maintain program requirements and logic, understand the roles of implementers, understand program interdependencies, and maintain the program management structure to ensure an effective team.

b. Exercise financial management per the requirements in section 4.1 to ensure the appropriate acquisition of and distribution of resources. This information is used to support the Agency budget process and program decisions.

c. Manage acquisition per the requirements in section 4.4 to maintain acquisition plans, execute procurement in accordance with Federal law and regulations, and ensure monitoring and reporting of both contract and nonprocured goods and services. Nonprocured means include cooperative agreements, Space Act agreements, and agreements with other Government agencies or foreign entities.

d. Manage schedules per the requirements in section 4.3 to maintain the baselined schedule consistent with program milestones and the program WBS.

e. Manage configuration to provide the required visibility of all interacting and interdependent elements of the program.

f. Assess and report performance per the requirements in section 4.3 to include the assessment of program status against established metrics, the evaluation of variances, and corrective action with the GPMC, if required.

g. Implement risk management per the requirements in section 4.2 to identify risk and its impact and prioritize risks for mitigation or elimination and maintain the risk management planning.

2.3.2 Customer Advocacy

2.3.2.1 This is an activity through which the program management maintains implementation contact with customers in order to understand customer objectives, plans, and requirements. It provides internal implementation process advocacy of customer interests in program decision forums. 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.

2.3.2.2 It provides continuous communication with the program on requirements, plans, designs, strategies, and general development and operations activity affecting customers. By early and continuous customer involvement, the best product can be achieved.

2.3.2.3 The program shall describe its approach for maintaining a customer advocacy activity in the Program Plan. Customer involvement at both the program and project levels is typically necessary.

2.3.3 Requirements Management

2.3.3.1 This activity entails decomposition of higher level requirements into ìimplementable packagesî and communication of these more specific requirements to the implementing projects. A configuration management process is used to ensure compatibility across multiple projects. This process must consider operations plans and associated requirements as well as specific requirements for Government-furnished equipment/products as part of developing a complete specification for program/project systems. To accomplish Requirements Management, the program team shall perform the following:

a. Ensure that program implementation requirements are defined, consistent with Program Plan technical content, cost, and schedule requirements.

b. Ensure that program implementation requirements are collected into ìimplementable packages.î

c. Ensure that program implementation requirements are defined at the proper technical level for project implementation.

d. Ensure that program implementation requirements are suitably documented and controlled.

2.3.3.2 Requirements management may be ìcapability-drivenî rather than ìperformance-driven,î thereby allowing for extensive iteration and trade study between technology readiness assessment and mission requirements before implementation requirements are finalized. In all cases, program systems engineering and technical trade studies shall be accomplished to ensure that cost-effective requirements are specified and to validate LCCís. Traceability of the formulation requirements to implementing requirements must be maintained.

2.3.3.3 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. Therefore, requirements management is the major activity responsible for defining the projectís content within the program.

2.3.3.4 Requirements management will produce the program implementation requirements for submission to the projects and provide a forecast of available technology related to these requirements. It also provides top-level agreements such as memoranda of understanding, cooperative agreements, commercial initiatives, launch vehicle services agreements, and program SLAís with SOMO.

2.3.4 Design, Develop, and Sustain

2.3.4.1 This activity ensures the development by supporting projects of the specific technology and/or systems design, manufacturing or development; testing, and verification and establishes the systems supporting infrastructure for sustaining engineering, logistics, continuing production, and operations, as required. Design development and review, verification testing, certification, operations capability development, and overall systems development monitoring and control are major elements of this activity. The purpose of this activity at the program level is the following:

a. Ensure that integrated designs meet intended systems top-level requirements.

b. Ensure that systems development plans are cost- and schedule-effective.

c. Ensure that program progress meets content, cost, schedule, quality, and other program metrics.

d. Ensure that program technology interdependencies are understood and coordinated.

2.3.4.2 This activity provides program oversight of project implementation activity. To perform this function, the following shall be accomplished:

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

b. Develop processes for and conduct program integrated system verification/acceptance testing.

c. Ensure incorporation of new technology/commercialization per technology/commercial development plan and validate the program technology utilization approach.

d. Ensure interface control between various program elements.

e. Maintain top-to-bottom requirements traceability to system designs.

f. Provide visibility and report status of the program.

g. Through program directives and plans, establish and maintain logistics support capability to sustain delivered hardware and software systems, consistent with intended mission requirements and plans.

h. Ensure program integration of the following:

(1) Technical standards and guidelines with preference given to voluntary consensus standards where practical.

(2) The International System of Units (metrics) measurement system, where practical.

i. Ensure the identification, control, distribution, and reporting of all engineering and technical management information generated during the program implementation subprocess.

j. Ensure that practical and cost-effective software is integrated with hardware system verification and in compliance with Agency-independent verification and validation requirements.

k. Ensure application of intellectual property protection measures, as appropriate.

2.3.4.3 In general, this program activity is to ensure that a quality integrated system (flight and ground) and its supporting infrastructure are delivered within cost, content, schedule, and performance metrics.

2.3.5 Deliver Products and Services

2.3.5.1 This activity ensures delivery of the programs, products, services, and technology to the customer. It includes operations of delivered systems and production of intellectual as well as systems products for science and technology customers. It includes routine interaction and outreach with the program/project customer community to aggressively pursue customer satisfaction. This activity also performs program retirement/closeout planning and execution. The purpose of this activity is the following:

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

b. Ensure that customer satisfaction is aggressively pursued, consistent with approved customer agreements (technology, commercialization, and mission performance).

c. Ensure that supporting infrastructures/capabilities are maintained to sustain product delivery activities.

d. Ensure that program history is delivered.

2.3.5.2 This activity provides program oversight of project delivery of products and services. In order to perform this function, the following shall be accomplished:

a. Establish and maintain capability to operate delivered hardware and software systems consistent with intended mission requirements and infrastructure definition.

b. Establish and maintain program interaction with customers for the program's life cycle.

c. Collect and analyze metrics and report program status.

d. Integrate and catalog program lessons learned, decisions and rationale, and historical records from implementation (see 4.5.3).

2.3.5.3 This activity produces program deliverables to its customers per program requirements (customer agreements). This includes the program history, lessons learned, and program performance data, including customer satisfaction, cost, schedule, and technical content metrics.

2.3.6 Capture Process Knowledge

The capture process knowledge activity supports continuous improvement of the implementation subprocess through assessment of process performance metrics. The Chief Engineer, as owner of the

PAPAC process, shall provide process metrics requirements that are compliant with the Government Performance and Results Act (GPRA) and NASA requirements. The program manager shall be responsible for the following:

a. Collection and analysis of program process metrics and the identification of areas of exceptional or substandard performance.

b. Performance of root-cause analyses in identified problem areas.

c. Development of recommendations for correcting deficiencies and/or adopting ìbetter of classî processes.

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, as required. The evaluation subprocess is applied throughout the life cycle of programs and consists of the planning and conducting of reviews and assessments during the formulation and implementation of a program. The evaluation subprocess is in addition to internal review and evaluation.

2.4.b The evaluation subprocess, shown in figure 2-4, utilizes the experiences and perspectives of customers and other experts independent of the program. Evaluation during formulation ensures that programs support the Agency goals and strategic planing and that programs can be successfully conducted within allocated resources and applicable constraints. Evaluation supports the approval subprocess by developing recommendations and supporting data necessary to arrive at decisions either to proceed or not to proceed with subsequent portions of program life cycles. Evaluation during implementation ensures that 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 PCA and/or Program Plan shall specify the methods, including numbers, types, levels, and schedules for reviews and assessments. The evaluation subprocess should be planned to minimize disruptions to the program and avoid unnecessary duplications.

2.4.d Note that requests for additional review and assessment of programs may arise outside the normal PAPAC process. Requests 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 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 additional reviews and assessments with the program manager and GPMC, when required.

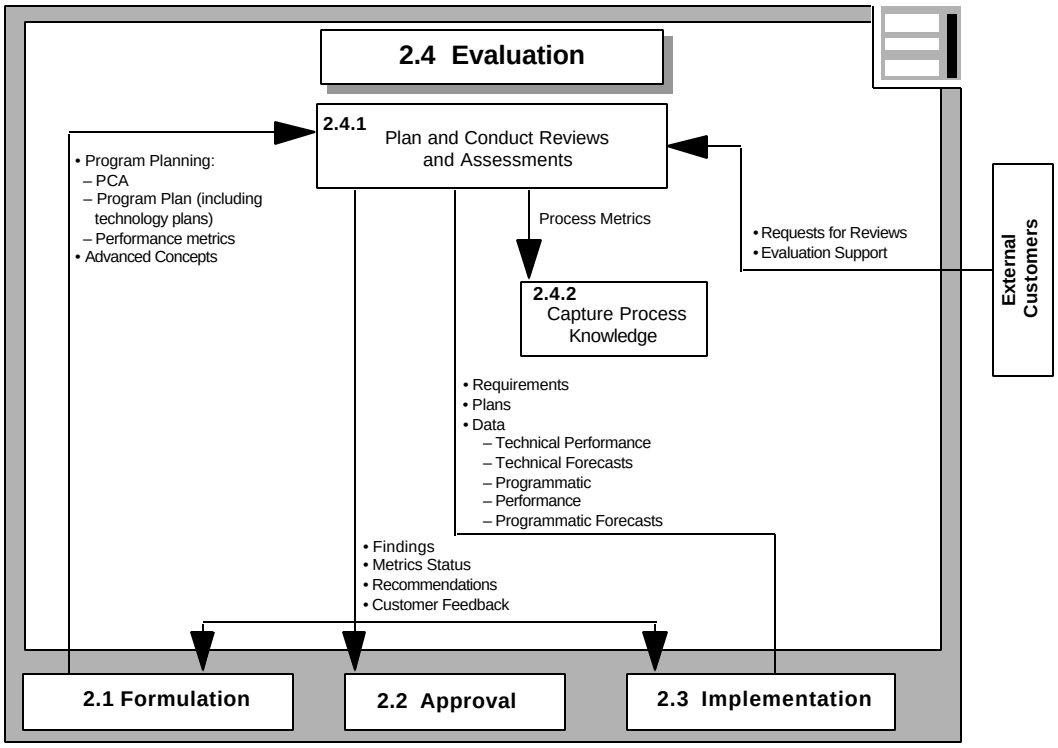


Figure 2-4. Program evaluation subprocess.

2.4.1 Plan and Conduct Reviews and Assessments

2.4.1.1 This activity is to design and conduct the specific assessment or reviews required by the PCA and Program Plan developed in the formulation subprocess. Requirements, implementation plans, data, and customer feedback are all made available for the evaluation subprocess from the implementation subprocess.

2.4.1.2 The conduct of each review and assessment shall ensure the benefits of peer experiences and perspectives and shall provide opportunities for customer participation. The purpose of each assessment and review, and the methods, measures, and bases for findings shall be defined. Each assessment and review shall develop recommendations and supporting data for the approval subprocess.

2.4.1.3 The content of the IA, IAR, and NAR assessments are presented in appendix F. All programs shall conduct an IAR. The conduct of each assessment and review shall be coordinated between the Independent Program Assessment Office (IPAO) (if under the NASA PMC) and the program manager to minimize program disruption. Where practicable, reviews shall be combined in order to reduce total numbers and costs.

2.4.1.3 For programs with exceptional risk, higher cost, or high visibility, the EAA may choose to establish an External Independent Readiness Review (EIRR) to validate the programís performance against the

program-level requirements and objectives set forth in the Program Plan. The EIRR will report to the EAA who will in turn report the results to the governing PMC.

2.4.1.5 The GPMC chair shall ensure that review and assessment teams incorporate knowledgeable experts, both from within and external, including customer representatives, as appropriate.

2.4.1.6 Concurrent with the formulation subprocess, evaluation shall include one or more NARís, which includes an Independent Cost Estimate (ICE), to determine the readiness of the program, either to proceed with further formulation or to request approval to enter implementation. The NAR of a program is conducted by an independent review team upon request of the EAA. The review is coordinated by the IPAO at Langley Research Center (LaRC).

2.4.1.7 In addition, at the request of either the GPMC or Deputy Administrator, the Chief Engineer will direct an IA of a program. IAís are conducted by the IPAO and are technical and LCC assessments. An IA can satisfy the requirement for a NAR, if all of the requirements of a NAR can be addressed in the review.

2.4.1.8 Concurrent with the implementation subprocess, evaluation shall consist of reviews that measure program performance and compare that performance with program plans. Reviews shall address, as a minimum, technical achievements, adherence to schedules, projected costs, issues, concerns, plans for addressing previously unanticipated occurrences; and other program metrics.

2.4.1.9 Special purpose reviews (e.g., Termination Review) shall be conducted, as required, by the GPMC at its discretion. Requests for special purpose reviews may come to the GPMC from customers or line organizations. In requesting a Termination Review, the GPMC shall consider 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 planing, or an unanticipated change in the NASA budgets.

2.4.1.10 Based on the information developed therein, the evaluation subprocess generates findings regarding the continuing ability of the program to meet its technical and programmatic commitments. The process develops recommendations for proceeding or terminating the program. Further recommendations for enhancing the technical and programmatic performance are developed, as appropriate. Findings, metrics status, and recommendations are provided as inputs to the approval subprocess. These items are provided in parallel as information to the formulation subprocess or the implementation subprocess in order to enhance the execution of these processes in a timely fashion.

2.4.2 Capture Process Knowledge

The objective of this activity is to assess the value to programs of the evaluation subprocess and to determine the effectiveness and efficiency with which the subprocess is executed. Lessons learned shall be developed for improvement of the PAPAC process.

CHAPTER 3. Project Management Process and Functional Requirements

3.0.a Projects 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 all the core of the work 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 and program management roles vary as a function of the type of project. Project managers always have a responsibility to participate as part of the program management team, providing information and assisting the program manager in the execution of the integrated program.

3.0.b The project manager is responsible for the cost, schedule, and technical performance of the project, but there are other major responsibilities. Forming the project team, financial and acquisition management, risk management, performance management, and safety and mission assurance are critical functions under the cognizance of the project manager. Chapter 4 is dedicated to these functions since they are being performed throughout the life of the project. The project manager must be knowledgeable in all these areas and call on experts throughout the Agency to assist in activities leading to project success. As the project progresses, the emphasis in these areas will vary. For instance, during the formulation of the project, acquisition management will be focused on the acquisition strategy to obtain the skills and assets required. Use of the acquisition team will ensure that appropriate planning is put in place that provides the best value for NASA. During the implementation phase, emphasis is on the management of the contracts or agreements against the metrics applicable to the deliverables. Similar statements can be made for the other program/project management system requirements.

3.0.c The project manager is responsible for reporting project performance lessons learned, according to 4.5.3. The project manager is also responsible for reporting process lessons learned, through the program manager, to the NASA Chief Engineer for each subprocess.

3.0.d The project manager should develop a cooperative and performance-oriented team that supports the program manager. The relationship between the program manager and the project manager is critical to the success of each. 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 Government agencies. The manager must ensure 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.

3.0.e A good project manager is the key to successful development of NASA's products and services through the planning and implementation of projects. A project managerís ability to draw the best from the participants and manage all aspects of the project is essential. The process discussed in this chapter and the management system requirements of chapter 4 are the foundation for innovation and success for the project team.

3.1 Project Formulation

3.1.a The formulation subprocess is to define 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, including concept and technology availability and needs; establishes the internal management control functions that will be used throughout the life of the project; assesses the technology requirements and develops the plans for achieving the technology options, including options for partnering and commercialization; performs LCC and performance analyses for concepts deemed to have a high degree of technical and operational feasibility; and identifies reserves associated with risk management and estimated project reserves.

3.1.b The products of the formulation subprocess, documented in the Project Plan, are as follows:

1. A comprehensive definition of the project concept.

2. Agreements, approaches, and plans for meeting the technical, budget, schedule, risk management, commercialization, acquisition, and related project requirements and performance objectives.

3.1.c The responsibility for project formulation is defined in the Program Plan. The approving authority relies on the project manager and on the advice and recommendations of panels, scientific advisory committees, and customers.

3.1.d The formulation activities shall be executed consistent with the implementing Centerís policies and procedures, which should be certified to ISO 9000 standards. The formulation subprocess and all requirements shall be addressed and may be tailored to meet the specific needs of the project given driving characteristics such as size, complexity, criticality, and risk. Requirements are contained in the subprocess activities, the project documentation, and the management system requirements in chapter 4. All NASA projects shall implement the formulation subprocess to provide assurance that the project is ready to proceed into implementation.

3.1.3 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.

3.1.f 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. The formulation subprocess is an iterative activity rather than a discrete set of linear steps. Many times, it is interactive with concurrent execution of the activities, until subprocess products have matured and are acceptable to the program manager. The primary inputs to the project formulation subprocess are derived from the Program Plan which specifies the mechanism to authorize the formulation of projects. The primary outputs are a

Project Plan and budget. A brief summary of the project activities contained within the formulation subprocess are as follows:

1. Planning (3.1.1). The objective of this activity is to develop the detailed definition of the project requirements and to establish project control to manage the formulation subprocess.

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

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

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

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

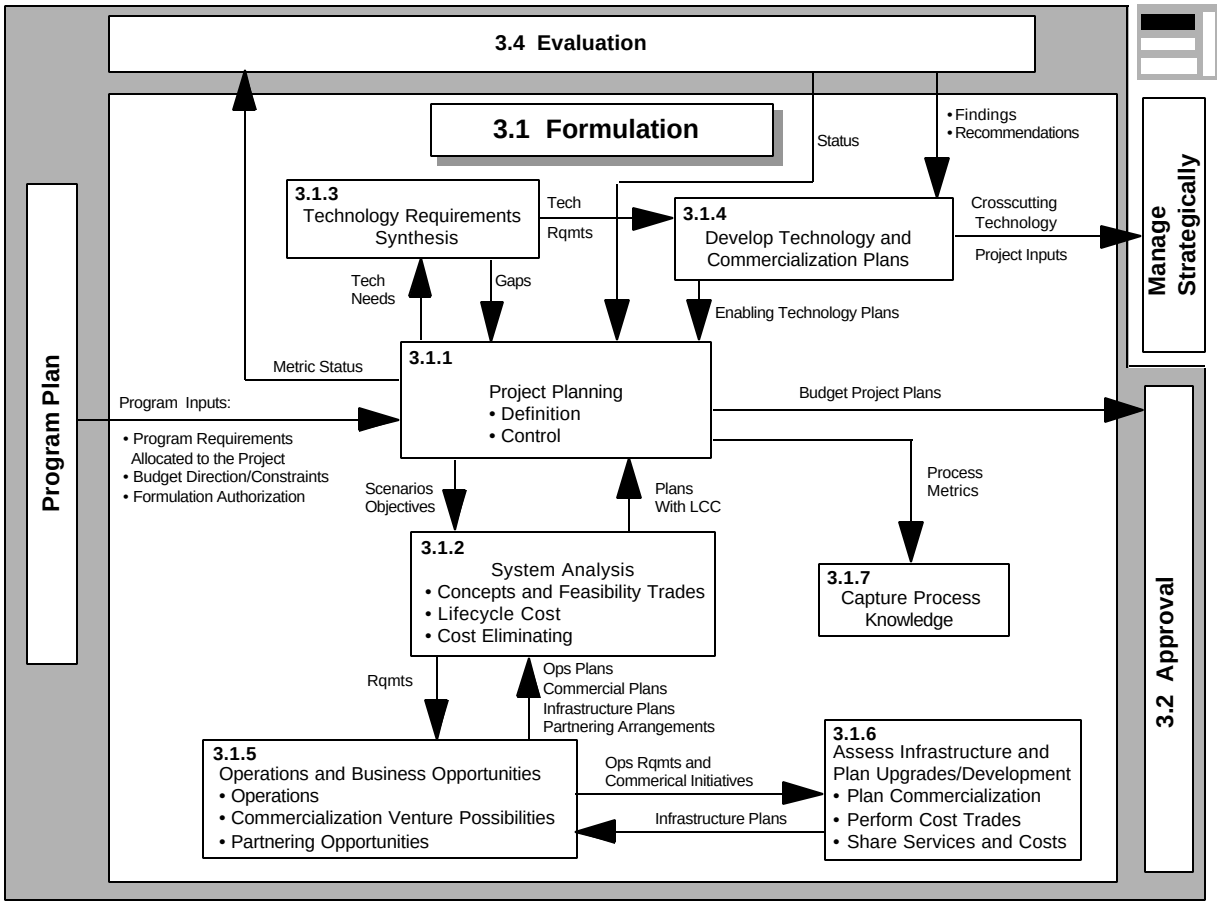


Figure 3-1. Project formulation subprocess.

6. Assess Infrastructure and Plan Upgrades/Development (3.1.6). This activity minimizes project LCCís by assessing the infrastructure of NASA, other national and international agencies, industry, and academia for suitability and availability to satisfy project requirements.

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

3.1.1 Project Planning

3.1.1.1 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. The project manager supports the annual POP cycle through the project control activity by providing assessments of affordability as input to the programís funding requirements. This enables a firm program commitment to accomplish the project and programís goals and objectives on schedule and within budget.

3.1.1.2 The project control activity provides the project manager with project control and oversight of performance. The project obtains its formal external direction and provides formal internal direction through project planning. To accomplish project planning, the project team shall perform the following:

a. Develop and incorporate concepts, mission development strategies, acquisition strategies, implementation plans, Space Operations SLA's, Launch Services Agreements, and management plans into a preliminary Project Plan (see appendix E.4.).

b. Identify project LCC elements, schedule, and performance baselines definition and refine throughout the formulation subprocess (see paragraphs 4.1 and 4.2).

c. Ensure that the basic concept of the project is defined; synergistic activities with other NASA, industry, academia, and international parties are considered; and that the project is within the mission of the Center and is responsive to Project Plan requirements.

d. Develop implementation plans with non-NASA partners. All plans must be consistent with program or Agency-level agreements with the partners.

e. Develop and manage a preliminary acquisition strategy for executing the project and an acquisition strategy for the conduct of the remainder of the formulation subprocess (see paragraph 4.4).

f. Define project metrics and assessment of project formulation performance (see paragraph 4.3.5).

g. Review, approve, and monitor progress of technology and development plans.

h. Tailor the number and scope of project reviews to the size, complexity, and risk associated with the project.

i. Utilize risk management planning as a basis for establishing reserves to recover from cost, schedule, or technical impacts (paragraph 4.2).

j. Ensure that configuration management and internal monitoring and control systems management, including WBS development, contract management, configuration control, information technology management, EVM, and schedule management, are established per chapter 4.

k. Capture project history of performance, margins, schedule, risk, and cost over the formulation period as lessons learned for future managers.

l. Identify and plan for management system requirements related to project activity.

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

n. Maintain a formulation subprocess history which includes the significant events, options studied, tradeoffs made, resources expended, time consumed, and any other performance to improve the project formulation subprocess.

3.1.2 Systems Analysis

This activity provides the systems analysis and life-cycle costing analysis necessary to produce feasible concepts and explore a wide range of implementation options to meet project objectives. It considers technology alternatives, operations, business opportunities, schedule, and infrastructure for the project. Risk assessment planning identifies risks and plans risk mitigation. To accomplish systems analysis, the following shall be accomplished:

a. Perform trade studies among candidate project concepts that consider affordability, technology, content, risk, and potential acquisition strategies.

b. Perform advanced studies to define needed engineering, technology, or commercial activities, and provide Center resources to fund these studies and analyses.

c. Examine project options which consider estimated cost in tradeoffs, commercialization possibilities, operational needs, and infrastructure availability from 3.1.5 and 3.1.6.

d. Develop technical performance requirements.

e. Develop a preliminary assessment of risks and risk-mitigation actions.

f. Develop the LCC 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 Requirements Synthesis

3.1.3.1 This activity examines the project concepts and assesses the technology requirements for feasibility, availability, technology readiness, opportunities for leveraging research, and new technologies. Technology synthesis defines which technologies should be incorporated into the project and which should be considered as crosscutting technology projects to enable future NASA endeavors. Technology is in the following two general categories:

a. Those technologies that provide fundamental capabilities without which certain project-specific objectives cannot be met.

b. Those crosscutting technologies that reduce cost or risk to such a degree that they enable completely new mission opportunities.

3.1.3.2 Both types of technology are essential in meeting mission goals. The former category generally represents more project-specific needs that are tied to detailed mission objectives, while the latter category tends to represent multimission applications whose aggregate cost savings or higher performance would effectively enable an entire project. Crosscutting technology projects have formulation and approval subprocesses separate from the projects which will eventually utilize those technologies and are executed consistent with the subprocesses described in this document. Project-specific technology development activities are managed by the project requiring that technology. To accomplish technology requirements synthesis, the following shall be accomplished:

a. Identify technology efforts required to support the proposed project needs, including the continued assessment of enabling technologies to meet requirements, as a preliminary project technology plan.

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

c. Identify where significant technical gaps exist, such that it would be difficult for a concept to be realized.

d. Identify and involve technology customers to ensure that the studies will lead to a crosscutting program that satisfies the customers needs.

3.1.4 Develop Technology and Commercialization Project Plans

This activity plans the technology options that satisfy candidate conceptsí identified needs. 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. Plans may be developed for technologies that are at a sufficient level of readiness to be an integral part of the project. Multiuse technology which has been identified as important can be recommended as a technology project to the crosscutting technology program. To accomplish technology and commercialization planning, the following shall be accomplished:

a. Plan technology to be developed to accomplish specific project objectives through identification of technology development strategies to remove capability/cost gaps, using the assessment of 3.1.3.

b. Explore all 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 that have resulted from assets or partnerships referred to in item b. above.

e. Assess teaming and partnering options to achieve various aspects of the project.

f. 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, or other funding), and the confidence that the partnership will remain in force through their commitment.

g. Where possible, integrate NASA plans with the technology and commercialization plans of their customers. All potential cooperative technology and commercialization opportunities must be vigorously explored and, where advantageous to NASA, agreements enacted.

h. Ensure that the planned technology exchange and partnership agreements comply with all laws and regulations regarding the transfer of sensitive and proprietary technologies.

3.1.5 Operations and 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 development 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 concentrate on 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. This activity is interdependent with 3.1.6 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 activity 3.1.2, and the final agreements negotiated. This activity is interdependent with the following activity, 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 operational requirements to ensure that innovative approaches are pursued that meet the project needs with minimal impact to project resources.

b. Assess commercial ventures for development and operational elements to reduce the project LCC.

c. Develop requirements for SOMO support to the project for communications, tracking, data processing, and mission operations, unless a more cost-effective, life-cycle approach can be proposed.

d. Negotiate with external organizations whose business interests are aligned with the projectís objectives and assess possible partnerships.

3.1.6 Assess Infrastructure and Plan Upgrades/Development

In this activity, the project manager 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 LCCís. Plans are developed for any required upgrades and development that may minimize multiprogram or multiproject LCCís. To accomplish this assessment, the following shall be performed:

a. Identify capability gaps and produce plans for infrastructure upgrades or new development, and reflect the results in the Project Plan.

b. Investigate opportunities to share services and costs, or seek ways to support the Agencyís initiative of increased outsourcing and commercialization.

c. Ensure that an appropriate level of logistics analysis is accomplished during formulation to quantify the Agencyís infrastructure and project material support needs.

d. Identify testing requirements (e.g., ground and flight facilities, data needs) to meet the operational flight research requirements for Aeronautical Flight Research projects and verify infrastructure capability.

3.1.7 Capture Process Knowledge

3.1.7.1 The objective of this activity is to assess the value of the formulation subprocess and to determine the effectiveness and efficiency with which it is executed. Lessons learned shall be developed for improvement of the PAPAC process and provided to the Chief Engineer.

3.1.7.2 A formulation subprocess history shall be maintained which includes the significant events, options studied, tradeoffs made, resources expended, time consumed, and any other performance information that may improve the project formulation subprocess.

3.2 Project Approval

3.2.a The project approval subprocess determines whether a project is ready to proceed from the formulation subprocess to the implementation subprocess. It may also provide approval for a project to continue in the formulation subprocess in which iterative formulation is required or approve changes to the Project Plan based on budgetary or technical considerations.

3.2.b Programs will undertake only projects whose objectives are clearly documented and consistent with the Program Plan. Only those projects for which a firm cost, schedule, and content commitment can be made will be approved. Projects shall be approved by a change to the Program Plan. For science projects,

Center recommendations for proceeding into implementation shall be presented to the EAA for approval. The project approval process flow is presented in figure 3-2.

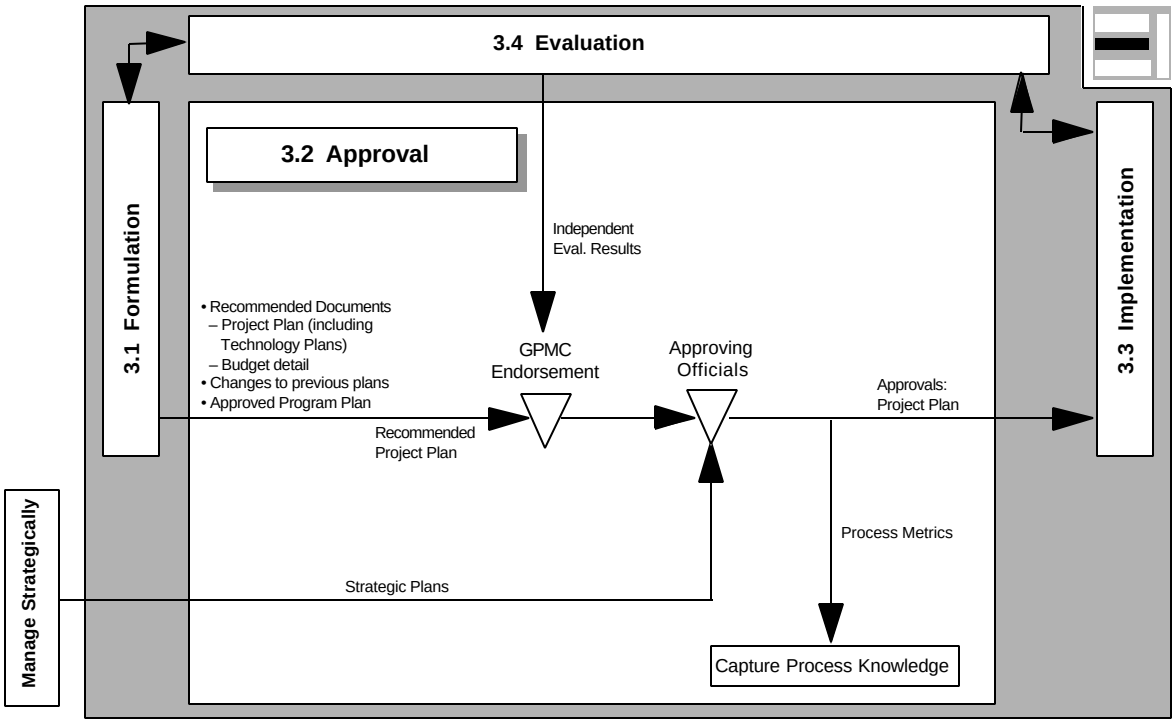


Figure 3-2. Project approval process.

3.2.d The NASA and Enterprise Strategic Plans and Program Plan are information provided to the Approving Official as project approval is considered. In requesting approval for a new project, the project manager obtains a commitment of Center resources from the appropriate Center Director and obtains the approval of the program manager. The project manager presents project information developed in formulation to the GPMC. This information consists of a Project Plan and supporting information. The compliance of the Project Plan to the Program Plan must be clear. The evaluation subprocess provides independent evaluation results to the GPMC in support of the approval activity.

3.2.d Based on the GPMC review and recommendation, the Project Plan is signed by the program manager, project manager, and Center Director. The Project Plan is provided to the implementation subprocess as the baseline for implementation planning and execution.

3.2.e The Project Plan shall be updated, as required, to maintain compatibility between the plan and the resources available. Changes in budget, the program, criteria used to approve the project, or changes within the project that violate the original approval criteria would necessitate project reformulation and reevaluation for rebaseline or termination. The approval may be simplified by focusing on the element that caused reevaluation.

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. Implementation culminates in the delivery of the project products and services to the customer.

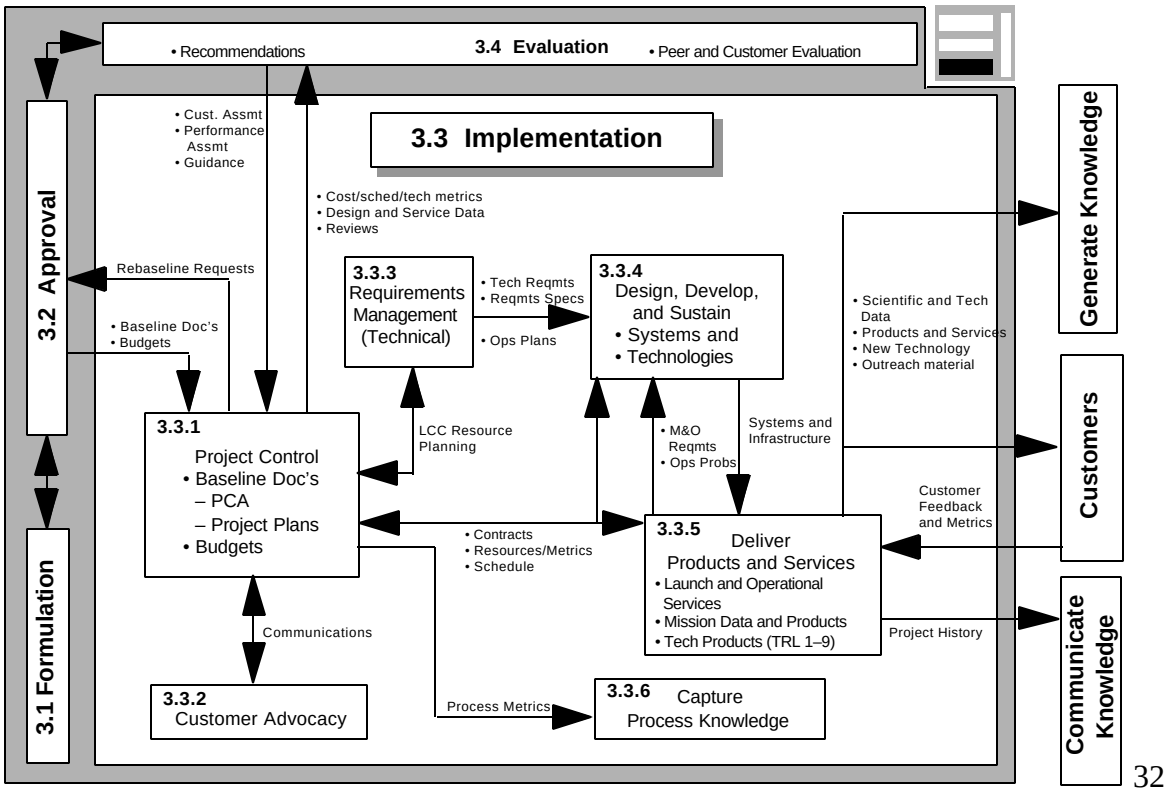


Figure 3-3. Project implementation subprocess.

3.3.b Project implementation is generally characterized by the derivation of project requirements from program or other requirements, design, and integration of these requirements into suitably enabling systems and/or technologies, and mission operations, thereby delivering products and services to the customers. In all instances, the approval of completion of these activities and output products is by the project manager. To accomplish Project Implementation, the following shall be accomplished:

1. Project Control. This activity develops, integrates, and provides direction and exercises control over budget, schedules, and procurement.

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

3. Requirements Management (Technical). This activity is the decomposition of requirements received from project formulation into detailed implementation requirements that are suitable for design and operations performance specifications (functional, performance, essential physical characteristics, or detail design).

4. Design, Develop, and Sustain Technology and/or Systems. This is the activity of developing the specific technology and/or project systems hardware and software, through designing, developing, and executing the manufacturing, testing, and verification processes, and developing and establishing the systems supporting infrastructures for sustaining engineering, logistics, continuing production, and operations, as required.

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

6. Capture Process Knowledge. This activity collects and evaluates process performance metrics to identify process corrective actions and/or to communicate the lessons learned in using these processes. The activities described below shall be executed consistent with the implementing Centerís policies and procedures. In tailoring, the implementation subprocess and all requirements shall be addressed and may be tailored to meet the specific needs of the project, given driving characteristics such as size, complexity, criticality, and risk. These requirements are contained in the subprocess activities, the project documentation, and the management system requirements in chapter 4.

3.3.1 Project Control

3.3.1.1 This is an activity through which the project management provides direction, assesses progress, and exercises control over project activities, including budget, schedules, procurements, customer agreements, and overall project management. The purpose is to ensure that project implementation execution is consistent with approved program and/or project customer agreements, budgets, schedules, risk management planning, acquisition strategies, requirements, and baseline documents. The project implementation subprocess must be managed in an effective manner, including the management of external or internal changes or events which require rebaselining of the projects after they have entered the implementation subprocess. This may necessitate going back through the formulation and approval subprocesses to change any baseline documents. Additionally, the purpose is to ensure that project commercialization efforts, technology integration, and technology development occur in a satisfactory manner and that risks are understood and mitigated.

3.3.1.2 This activity includes project control and management of all project implementation activities to meet performance requirements within cost, schedule, and quality commitments in compliance with baseline project documentation and the management systems requirements in chapter 4. This activity shall ensure the collection, tracking, reporting, and management of the project according to performance metrics. This shall

be accomplished according to NASA's EVM policy and requirements in chapter 4. Additionally, this activity shall ensure project variance control through cause, impact, and corrective action efforts.

3.3.1.3 External reviews shall be conducted as specified in the project plans, consolidating internal and external reviews when practical. Electronic reporting shall be used where practical.

3.3.1.4 To accomplish project control, the following shall be performed:

a. Execute and maintain currency of the project risk management planning and associated project reserves. The risk management planning is used as the basis for decision making and the subsequent release of reserves.

b. Perform acquisition management of procurement and nonprocurement activities as specified in the approved project acquisition planning. This includes the management and execution of all intra-agency and external agreements.

c. Ensure establishment and maintenance of an effective safety and mission success activity throughout all design, development, delivery, and operations activities.

d. Ensure that technology resources are provided as required by the technology planning. Additionally, ensure that Agency infrastructure resources and upgrades are provided according to project plans.

e. Ensure that baselined project documents are maintained under configuration management.

f. 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. Prepare recommendations and request rebaselining through the approval subprocess via the program manager. The approval subprocess shall provide direction, if required, to return all or part of the project back to the formulation subprocess to develop changes to project documents. The direction shall also establish the conditions under which the project can continue with implementation while formulation efforts are being conducted. The approval subprocess may initiate a Termination Review request.

g. Document work authorization including scope, schedule, and budget.

h. Develop performance metrics and reporting requirements.

i. Perform and document performance assessments of individual activities and the overall implementation subprocess through communication with other activities in the implementation subprocess.

j. Issue project directives on technical and project management matters to ensure success of the project.

k. Respond to recommendations from customer advocacy and evaluation subprocess assessments and recommendations.

l. Support NASA's budget activities such as the POP, development of Operating Plans, and special budgetary exercises.

3.3.2 Customer Advocacy

3.3.2.1 The purpose of customer advocacy is to proactively consult and involve customers in the implementation subprocess to ensure customer satisfaction with the delivery of safe, quality products and services within performance, budget, schedule, and other program and project commitments. The customers are identified during program and project formulation subprocesses and are specified in the Program and Project Plans.

3.3.2.2 Through this activity, the customers are an integral part of the program to clarify requirements and assess implementation progress against commitments. By early and continuous customer involvement, the best product value can be achieved.

3.3.3 Requirements Management

3.3.3.1 This activity shall decompose requirements received from project formulation into detailed implementation requirements that are suitable for design and operations performance specifications. It ensures that project requirements are maintained, consistent with approved budgets and schedules, and that project requirements changes are suitably documented and controlled, consistent with program change management processes. Requirement trade studies are conducted and LCCís analyzed, with any impacts to LCC constraints communicated to the project manager. A configuration management process is used to maintain requirements and to provide traceability of requirements to design and operations.

3.3.3.2 The formulation subprocess-generated baseline requirements are decomposed into lower level requirements (performance, operations, and verification) such that project and system specifications and development assignments can be prepared. In some instances, this activity is ìcapability-drivenî rather than ìperformance-driven,î thereby allowing for extensive iteration and trade study between technology approach readiness assessment and mission requirements before implementation requirements are finalized. This activity will involve interaction with the customer for requirement clarification and agreement. The configuration management system shall maintain traceability to program requirements. Project systems engineering and technical trade studies shall be accomplished
to ensure cost-effective requirements are specified and shall refine and validate LCCís. Specifically, the following activities will be accomplished and reported to the project manager. To accomplish Requirements Management, the following shall be performed:

a. Prepare, and maintain under configuration control, project requirements and performance specifications.

b. Review and finalize all agreements.

c. Update project technology forecasts/requirements and commercial agreements.

d. Prepare resource requirements needed to implement the total set of requirements including LCCís.

3.3.4 Design, Develop, and Sustain

3.3.4.1 This activity executes the design and development of the project technology and/or systems, including the manufacturing, software development, testing, and verification. This includes establishing and/or upgrading the systems supporting infrastructure for sustaining engineering, logistics, continuing production technology and operations, as required. This activity also provides for the sustaining engineering of project products and services and for supporting technology and operations infrastructure. This activity shall execute technology and project design and development activities, consistent with the baseline project. This activity ensures that technology commitments and/or system design and development proceeds with reasonable technical, cost, and schedule risk. It is to conduct project design and development, consistent with the Agency shift from technology derived from missions, to missions enabled by technology. Additionally, ensure that continuing operations are cost-effective through sustaining engineering, technology infusion, and evolution of supporting infrastructure and systems to commercial services.

3.3.4.2 This activity shall perform technology research/development and project system design/development to meet all requirements, as specified by the implementation requirements management activity. This activity will involve the customer in assessing design, development, and operations plans and decisions. Additionally, peer review recommendations and assessments from the evaluation subprocess will be evaluated, including identification of new science and technology or commercialization opportunities. Note that this technology development and project design, development, and sustaining activities will be accomplished in accordance with Center ISO 9000 validated processes to ensure quality products and services. To accomplish this activity, the following shall be performed:

a. Conduct architectural, functional, system, and subsystem design reviews as specified in the Project Plan; e.g., system design review, preliminary design review, and functional design review.

b. Execute contracts and surveillance oversight of contractor and/or supporting staff.

c. Maintain traceability of requirements to system designs.

d. Ensure the accomplishment of system verification and acceptance testing.

e. Provide performance metrics, visibility, and status per project plan and project direction, including any project variance with cause, impact, and corrective action.

f. Design, develop, test, and verify technology materials and information for delivery to Agency, scientific community, and commercial customers per agreements in NASA's technology plans.

g. Conduct technology infusion and/or transfer in accordance with project technology and/or commercialization plans, including incorporating new technology and commercialization as available and where appropriate per approved plans. Technology commercialization plans shall be updated annually.

h. Provide for design, implementation, and sustaining engineering for technology, commercial, obsolescence, and capacity upgrades to existing operations infrastructures that deliver cross-project/program products and services to the project.

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

j. Use technical standards and guidelines with preference given to voluntary consensus standards where practical.

k. Use the International System of Units (metrics) measurement system, where practical.

l. Ensure the generation, identification, control, distribution, and reporting of all engineering and technical management information generated during project formulation and implementation.

m. Ensure that design and sustaining activities provide cost-effective logistics support, including operational delivery of services and products to the customers.

n. Ensure practical and cost-effective software that is integrated with hardware system verification and in compliance with Agency independent verifications and validation requirements.

o. Document the design and development of any new technology developed as part of the project to ensure legal protection of new intellectual property.

3.3.5 Deliver Products and Services

3.3.5.1 This activity delivers the programs, products, services, and technology to the customer. It includes launch, operations of delivered systems, and production of intellectual as well as systems products for science and technology customers. The mission projects move into the operations phase, usually with a launch or some similar event that commences the delivery of scientific data and specific products to the customer. In many instances, these projects, upon completion of development, are integrated into implementation and operations activities of a large program; therefore, the projects are completed. The projects may continue into operations to continually deliver products and services based upon program directives and plans. For both mission and technology projects, the purpose of this subprocess is the delivery of committed Project Plan products and services to all customers.

3.3.5.2 This activity shall collect, integrate, and catalog the lessons learned and all other project information that should be retained for historical purposes (see 4.5.3). In addition, this activity shall deliver the following science, technology, and systems products and services to the customer such as--

a. Project flight and ground systems, including spares, logistics, and ground support equipment.

b. Scientific breakthrough and new technology through data, information, products, and services per agreements in the project technology plans.

c. Space operations infrastructure upgrades for cross-program/customers.

d. Agency labs and technology infrastructure upgrades.

e. System maintenance and operating procedures and training.

f. As-built documentation.

3.3.5.3 These service-provided activities shall satisfy all requirements and operations plans and include the following as required:

a. Perform operational readiness tests for project end-to-end system readiness and support integrated program testing to execute the Operations Plan and to deliver customer products and services.

b. Launch, operate, and maintain project flight and ground elements to deliver customer products and services per approved Operations Plan.

c. Provide customer support services, including the delivery of materials and information to commercial customers. Develop and deliver user guides, training, and simulation support for customers.

d. Maintain configuration management of mission and operations plans, including upgrades.

e. Collect, analyze, and report operations performance metrics including Technology and Commercialization Plan performance data and status.

f. Develop maintenance and operations requirements for new systems/upgrades and support sustaining engineering activities.

3.3.5.4 This activity will additionally develop and deliver the following items to customers and to the Generate Knowledge and Communicate Knowledge crosscutting processes:

a. Technology capabilities forecasts, synergistic opportunities, and commercialization opportunities.

b. Information and materials for nonaerospace and commercial customers such as outreach materials.

c. Project history and lessons learned.

3.3.6 Capture Process Knowledge

The capture process knowledge activity supports continuous improvement of the implementation subprocess through assessment of process performance metrics. The Chief Engineer, as owner of the PAPAC process, shall provide process metrics requirements which are compliant with the GPRA and Agency requirements. The project manager shall be responsible for the following:

a. Collection and analysis of project process metrics and the identification of areas of exceptional or substandard performance.

b. Performance of root-cause analyses in identified problem areas.

c. Development of recommendations for correcting deficiencies and/or adopting ìbetter of classî processes.

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 or program manager as required. The evaluation subprocess is applied throughout the life cycle of projects and consists of the planning and conducting of reviews and assessments during the formulation and implementation of a project.

3.4.b The evaluation subprocess, depicted in figure 3-4, utilizes the experiences and perspectives of customers and other experts independent of the project to provide assessments of the continuing ability of the project to meet its technical and programmatic commitments.

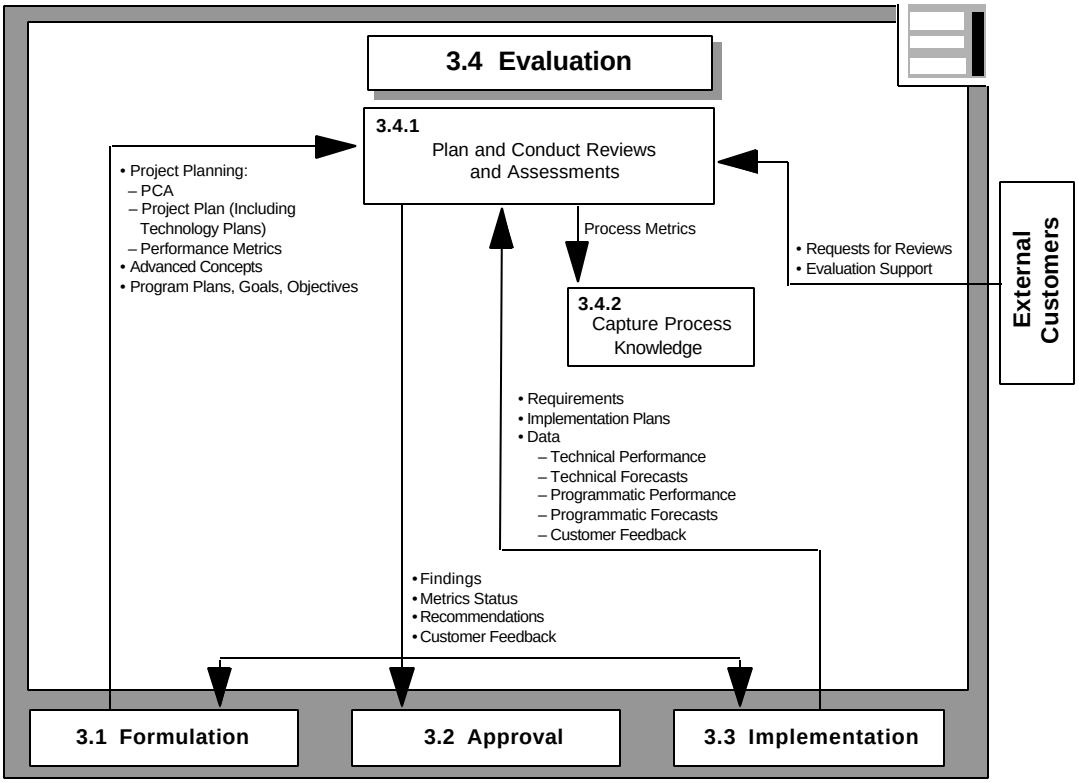


Figure 3-4. Project evaluation subprocess.

3.4.c Evaluation during formulation ensures that programs and their projects support the NASA's goals and strategic plans and that the project can be successfully conducted within allocated resources and applicable constraints. Evaluation supports the approval subprocess by developing recommendations and supporting data necessary to arrive at decisions, either to proceed or not to proceed, with subsequent portions of project lifecycles. Evaluation during implementation ensures that projects are being successfully executed according to plans and provides recommendations for enhancing the technical and programmatic performance of projects.

3.4.d Projects that report to the NASA PMC may be required to have an independent evaluation. Independent reviews for evaluation may be held at the program level and will, to some extent, involve the assessment of the contained projects. Independent reviews for other projects are held at the discretion of the Lead Center or Center PMC. The evaluation subprocess will be executed in a manner to minimize any disruptions to the project, and reviews will be scheduled to avoid unnecessary duplications.

3.4.e Note that requests for additional review and assessment of projects may arise outside the normal PAPAC process. Requests may come from the Congress, the NASA Inspector General, the GAO, advisory groups such as the Space Science Advisory Committee, and other similar sources. The Chief Engineer will coordinate responses to external review requests, work in concert with the EAA, the office responsible for management controls, and the Lead Center to disposition such requests and coordinate scheduling of additional reviews and assessments, when required.

3.4.1 Plan and Conduct Reviews and Assessments

3.4.1.1 This activity is to design and conduct the specific assessment or reviews required by the Project Plan developed in the formulation subprocess. The Project and Program Plans are provided from the formulation subprocess. Requirements, implementation plans, data, and customer feedback are all made available for the evaluation subprocess from the implementation subprocess.

3.4.1.2 The conduct of each review and assessment shall ensure the benefits of peer experiences and perspectives and shall provide opportunities for customer participation. The purpose of each assessment and review and the methods, measures, and bases for findings shall be defined Recommendations and supporting data for the approval subprocess shall be developed from these assessments and reviews

3.4.1.3 The content of the IA, IAR, and NAR assessments are presented in appendix F. The conduct of each assessment and review shall be coordinated with the project manager to minimize project disruption. Where practicable, reviews shall be combined in order to reduce total numbers and costs.

3.4.1.4 For projects with exceptional risk, higher cost, or high visibility, the EAA may choose to establish an EIRR to validate the projectís performance against the program-level requirements and objectives set forth in the Program Plan for the project. The EIRR results will be reported to the EAA who will in turn report the results to the GPMC.

3.4.1.5 The GPMC chair shall ensure that review and assessment teams incorporate knowledgeable experts, both internal and external, including customer representatives. To assure compliance with the Federal Advisory Committee Act, advice concerning the use of non-Governmental personnel should be solicited from the General Counsel.

3.4.1.6 Concurrent with the formulation subprocess, evaluation shall include one or more NARís, which includes an ICE, to determine the readiness of the project, either to proceed with further formulation or to request approval to enter implementation. The NAR of a project is coordinated by an independent review team as specified in the Project Plan. The review is conducted by the IPAO for projects reviewed by the NASA PMC. Each NAR includes an LCC estimate.

3.4.1.7 In addition, at the request of either the LCD or program manager, the project manager will support an IA of a project. IAís are conducted by the IPAO and are technical and LCC assessments of advanced concept.

3.4.1.8 Concurrent with the implementation subprocess, evaluation shall consist of reviews that measure project performance and compare that performance with program and project plans. Reviews shall address, as a minimum, technical achievements, adherence to schedules, projected costs, issues, concerns, plans for addressing previously unanticipated occurrences, and other project metrics.

3.4.1.9 Special purpose reviews, e.g., a Termination Review, shall be conducted at the discretion of the GPMC. Requests for special purpose reviews may come to the GPMC from customers or line organizations. In requesting a Termination Review, the GPMC shall consider 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 by the Project Plan, an unanticipated change in Agency strategic planing, or an unanticipated change in NASA's budget.

3.4.1.10 Based on the information developed therein, the evaluation subprocess generates findings regarding the continuing ability of the project to meet its technical and programmatic commitments. The process develops recommendations for proceeding or terminating the project. Further recommendations for enhancing the technical and programmatic performance are developed, as appropriate. Findings, metrics status, and recommendations are provided as inputs to the approval subprocess. These items are provided in parallel as information to the formulation subprocess or the implementation subprocess in order to enhance the execution of these processes in a timely fashion.

3.4.2 Capture Process Knowledge

The objective of this activity is to assess the value to projects of the evaluation subprocess and to determine the effectiveness and efficiency with which the subprocess is executed. Lessons learned shall be developed for improvement of the PAPAC process.

CHAPTER 4. Program/Project Management System Requirements

4.0.a This chapter addresses the following topics which include program/project life-cycle activities, functions, tools, and disciplines:

1. Generally applicable to all projects and programs.
2. Applicable to all subprocesses described in the PAPAC process.
3. Vital to the success of project or program management.
4. Unique requirements driven by statutory, regulatory, or executive direction.

4.0.b Program and project managers are responsible for meeting all relevant requirements for their particular application, including management systems requirements. This chapter addresses several critical management areas that are universally applicable to programs and projects. In addition to these areas, other requirements set forth in laws, regulations, and directives may affect program and project plans. Other disciplines which also enable and support PPM were not included because their applicability is far broader than the scope of this document. Program and project managers are encouraged to contact appropriate functional office staff to ensure that all applicable management system requirements have been identified, planned for, and implemented appropriately (also, see appendix A).

4.1 Resources Management

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

References:

a. OMB Circular A-94, Guidelines and Discount Rates for Cost-Benefit Analysis of Federal Programs.

b. OMB Circular A-11, Preparation and Submission of Budget Estimates.

c. NHB 7400.1, Budget Administration Manual.

d. NPD 9050.3, Administrative Control of Appropriations and Funds.

e. NPD 9501.1F, NASA Contractor Financial Management Reporting.

f. NPD 9501.3, Earned Value Performance Management.

g. NHB 9501.2C, NASA Contractor Financial Management Reporting.

h. NPD 7000.3, Allocation and Control of Agency Resources.

i. 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.

j. 44 U.S.C. 3501 *et seq,*. the Paperwork Reduction Act of 1995 (Pub. L. 104-13 of May 22, 1995), as amended.

k. 40 U.S.C. 1441 *et seq.*, the Computer Security Act of 1987 (Pub. L. 100-235 of January 8, 1988), as amended.

l. NASA Financial Management Manual, Volumes 9000, 9100, and 9300.

m. NPD 2800, Managing Information Technology.

n. NPD 1240.3, Internal Controls.

o. NPD 2810, Ensuring the Security of IT.

4.1.1 Financial Management

4.1.1.1 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.

4.1.1.2 Requirements.

a. Budget Development and Execution. Program and project managers shall 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 will be 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 CIC shall provide strategic guidance for Enterprises, Centers, and staff offices.

(b) Detailed guidance is developed by Enterprises and Functional/Staff Offices, working with the program managers and LCD's, and provided to the CFO. The CFO shall issue a single set of budget guidance annually.

(2) Budget Submissions

(a) Initial submissions are prepared by the Projects, Programs, and Centers and forwarded to both the program managers/LCD's and the Institutional Program Office (IPO). Feedback is provided from both program managers/LCD's and the IPOís. Center Directors, program managers, and project managers then revise their full cost submissions. Final submissions shall be made to the appropriate Associate Administrators (AA's). Functional/Staff Offices provide their assessments to the EAA's.

(b) The Enterprise and Functional/Staff Offices are responsible for submitting and advocating their requirements to the CFO, the CIC, 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 shall be implemented in accordance with Agency direction on operating and phasing plans. Program/project managers shall support requirements for both initial and updated plans.

(b) Program and Project status reporting shall be accomplished in accordance with directions from the AA'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 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 Project Plans.

(d) Support the EAA in reporting compliance with the PCA to the NASA 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.

4.1.2 Life-Cycle Cost (LCC) Management and Accounting

4.1.2.1 Purpose. 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 of each program is minimized.

4.1.2.2 Requirements.

a. LCC shall be estimated, assessed, and controlled throughout each program or project life cycle.

b. LCC shall be determined on the basis of the full cost initiative guidance available at the point of its calculation.

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

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

e. LCC estimates shall be prepared in support of the following:

(1) The development of program commitment.
(2) Major reviews
(3) Budgetary submissions.
f. Financial reserves shall be established and maintained commensurate with the identification and assessment of programmatic, technical, cost, and schedule risks. The total program and project management flexibility is comprised of the financial reserves, schedule margin, and technical performance margins. The financial reserves shall be sized accordingly. These reserves shall include the following:

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

(2) Contingency. These reserves shall be allocated to and managed by the project manager for the resolution of problems normally encountered while ensuring compliance to the specified project scope. A project shall have sufficient contingency to allow the manager to solve the routine problems that typically arise during implementation.

4.1.3 Information Technology Management

4.1.3.1 Purpose. This section establishes the unique requirements for managing, implementing, and reporting of information technology in Agency programs and projects.

4.1.3.2 Requirements.

a. IT must be distinguished as a program/project investment that is planned for, budgeted, managed, and evaluated in terms of its return on investment. It must be tracked and reported to ensure that investments are meeting programmatic and technical requirements within established cost and schedule parameters.

b. 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, managed by the SOMO at Johnson Space Center; NASA supercomputing resources, managed by the Consolidated Supercomputing Office at Ames Research Center; NASA mainframe and midrange computing resources, managed by the NASA Automated Data Processing Consolidation Center at Marshall Space Flight Center; and desktop and intra-Center communications, managed by local Center resources.

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

d. IT requirements shall be integrated into the planning and technical management effort throughout the execution of the PAPAC process.

4.1.3.3 Information Technology Security. Security policies and procedures must be applied to all NASA programs and projects. Specifically, programs and projects shall address security policies and requirements for all IT, for embedded software throughout its life cycle and for other embedded IT through design, development, test, and evaluation (until deployment). Directives relevant to IT security that comply with the NASA Strategic Management Handbook, NASA Policy Directive, NASA Procedures and Guidelines, and IT security-related laws, regulations, and best practices may be found in the NODIS Directives Library.

4.2 Risk Management

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

References:
a. 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*, taught by the Software Assurance Technology Center, NASA Goddard Space Flight Center, NASA-GSFC-SATC-98-001.
b. NPG 8715.xx (NHB 1700.1 (Vol. 1-B)), ìNASA Safety Program Manual.î

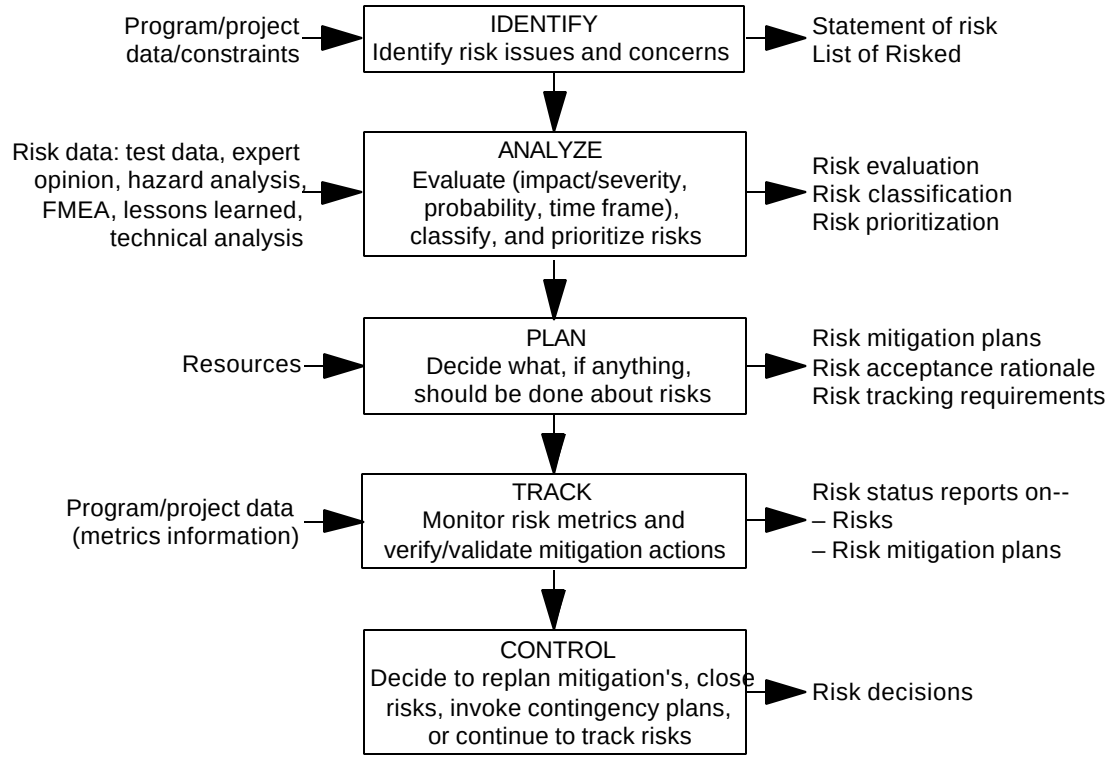
4.2.1 Purpose. As depicted in figure 4-1 (reference a), risk management is a continuous process that identifies risks; analyzes their impact and prioritizes them; develops and carries out plans for risk mitigation, acceptance, or other action; tracks risks and the implementation of mitigation plans; supports informed, timely, and effective decisions to control risks and mitigation plans; and assures that risk information is communicated among all levels of a program/project. Risk management begins in the formulation phase with an initial risk identification and development of a Risk Management Plan and continues throughout the product's life cycle through the disposition and tracking of existing and new risks.

Figure 4-2. Continuous risk management.

4.2.2 Requirements.

a. Risk Management Planning. Risk management planning shall be developed during the formulation phase, included in the Program/Project Plans (see appendices E.3. and E.4. for required content), and executed/maintained during the implementation phase.

b. Risk Management Process. 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 and tools may be tailored for each program/project, but the functional areas described below shall be addressed on a continuous basis throughout the life cycle. This process begins with risk identification and an assessment of program/project constraints which will shape the risk policy; e.g., mission success criteria (primary and secondary); development schedule; budget limits; launch window and vehicle availability; international partner participation; legal, security, or environmental concerns; human space flight safety issues; "fail ops/fail safe" requirements; technology readiness; oversight 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 extend throughout all of the functions.

Figure 4-3. Description of risk management functions.

c. Risk Management Functions.

(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.

(2) Analyze. Evaluate risk probability, impact/severity, and timeframe (when action needs to be taken); classify/group with similar/related risks; and prioritize.

(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; execute plan.

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

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

(6) Communication and documentation. These are present in all of the preceding functions and are essential for the management of risks. A system for documentation and tracking of risk decisions shall 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 b.), the program/project shall develop and maintain the following information (for program/project approval, include this information in the risk sections of the Program/Project Plans (appendices E.3. and E.4.) and, as appropriate, in the PCA (appendix E.1.):

(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) Significant cost impacts, given its occurrence.

(5) Significant schedule impacts, given its occurrence.

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

(7) Characterization of the risk as "acceptable" or "unacceptable" with supporting rationale.
NOTE: Characterization of a primary risk as ìacceptableî 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.

4.3 Performance Management

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.

References:

a. NPD 9501.3, Earned Value Management.
b. NPG 9501.4, Earned Value Management Implementation on NASA Contracts.
c. NPG 5101.33, Procurement Guidance.
d. OMB Circular A-11, Preparation and Submission of Budget Estimates.

e. MIL-STD-881B, Work Breakdown Structures for Defense Material Items.
f. MIL-HDBK-245D, Preparation of Statement of Work.
g. The Government Performance and Results Act of 1993 (Pub. L. 103-62 of August 3, 1993).

4.3.1 Earned Value Management (EVM)

4.3.1.1 Purpose. EVM is to enable effective execution, management, and control and the integrated evaluation of cost, schedule, and technical performance against the baseline.

4.3.1.2 Requirements. 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. EVM is the primary management tool to satisfy the performance-based management system requirement of OMB Circular A-11, Part 3.

The program/project manager shall perform the following:

a. Ensure proper use of EVM on the following:

(1) All required contracts according to references a. and b.

(2) Research, Development, Test, and Evaluation (RDT&E) contracts with values of $60M or more and a period of performance exceeding 1 year.

(3) Production contracts of $250M or more.

b. Ensure proper implementation of noncriteria-based EVM (as specified in NPD 9501.3) on the following:

(1) Contracts with values greater than $25M, but less than $60M.

(2) Production contracts less than $250M.

c. Ensure that EVM solicitation provisions and requirements of references a. and b. are included in Requests for Proposals (RFP).

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

4.3.2 Performance Assessment

4.3.2.1 Purpose. Performance assessment is to confirm satisfactory program/project performance and ensure timely identification of all project performance problems.

4.3.2.2 Requirements.

a. Each program and project shall assess and report program and project performance against commitments throughout the life of the program or project.

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

c. Each program/project shall establish a set of metrics related to the program commitments and project cost, schedule, and technical baselines and ensure that metric data are collected and reported according to PCAís, GPRA implementation requirements, and the strategic planning requirements.

d. For programs required to provide Project Status Reports (PSR), as defined in Government Accounting Office Report B-237602, ìProject Status Reports,î the appropriate EAA shall report data necessary for preparation of the PSRís. The CFO shall, through the Office of Legislative Affairs, provide the completed PSRís to the appropriate congressional committees.

4.3.3 Schedule Management

4.3.3.1 Purpose. Schedule management is to ensure 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.

4.3.3.2 Requirements.

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

(1) Provide a controlled baseline for program or project management, including regular status reporting.

(2) Provide hierarchical traceability to both the detailed (lower level) schedules and the milestones which are controlled by the approving officials (e.g., EAA, LCD, program manager, project manager).

(3) Provide for the planning of the total scope of work that are based on the approved WBS.

(4) Identify the program/project ìcritical pathsî for management and control.

(5) Contain all critical milestones for external (interfacing) activities.

(6) Provide horizontal 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.

4.3.4 Work Breakdown Structure (WBS)

4.3.4.1 Purpose. The WBS is to serve as the basis 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).

4.3.4.2 Requirements.

a. A WBS shall be developed for the program or project that includes the following:

(1) Defines all work, both governmental and contractual, included in the life cycle that hierarchically relates all work, products, and end items.

(2) Provides a framework for project work definition to a level of detail consistent with cost, schedule, technical, and risk oversight as desired by management and required by EVM.

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.

A preliminary WBS dictionary shall be developed during the formulation phase, with the final WBS following contractor selection or approval to implement. Each shall be accompanied by a WBS dictionary.

4.3.5 Program and Project Management Process Metrics

4.3.5.1 Purpose. These process metrics are to support Agency compliance with the requirements in the GPRA and will reflect the general objectives reflected in the NASA Strategic Plan. They will include a suitable mix of efficiency, output, levels of customer satisfaction, and outcome measures. The process metrics for the PPM activities will be developed by the Chief Engineer and are included with other measures of the PAPAC crosscutting process.

4.3.5.2 Requirements. At a minimum, the process metrics will include the following:

a. Process descriptions.
b. Goals.
c. A description of the metric and how it relates to the objective.
d. A target level of performance for the fiscal year.

e. A 3-year trend.

4.4 Acquisition Management

Whenever NASA must accomplish its mission by means other than in-house resources; e.g., civil service, it is involved in ìacquisition.î Historically, NASA spends approximately 90 percent of its budget on acquisition, including contracts, grants, and cooperative agreements. This section describes the role of acquisition with respect to PPM.

References:

a. Federal Acquisition Regulation (FAR).
b. 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 5101.32, Procurement.
f. NPG 5101.33, Procurement Guidance.
g. NPG 4800.1D, Grant and Cooperative Agreement Handbook.
h. NPD 9501.3, Earned Value Performance Management.
i. Office of Procurement Home Page: http://www.hq.nasa.gov/office/procurement.
j. NPD 7500.1, Program and Project Logistics Policy.
k. Space Act Agreement.

4.4.1 Acquisition

4.4.1.1 Purpose. Acquisition delivers the required product or service to a program or project when it is not available internally to NASA. The component activities of acquisition are identifying requirements, strategizing implementation, executing contracts and nonprocurement instruments, and monitoring performance.

4.4.1.2 Requirements. References a. through k. above describe the way acquisitions are to be conducted. Numerous laws and Governmentwide regulations pertain to the acquisition process. All members of the program and project offices should be broadly aware of key concerns; e.g., competition, and conflicts of interest. However, the procurement member is directly responsible for providing definitive advice on conducting acquisitions. Therefore, it is critically important to have the contracting activity involved early in program/project planning activities.

4.4.2 Identifying Requirements/Strategizing Implementation

4.4.2.1 Purpose. The identifying requirements/strategizing implementation activities identify the needs of the program or project, determine how best to satisfy those needs, and develop an implementation strategy.

4.4.2.2 Requirements.

a. The acquisition team shall generate a requirements set for the acquisition, including, as applicable, statements of work, specifications, documentation deliverables, and applicable documents. All stakeholders 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 DRFPís are not required, a less formal method for obtaining industry comment should be considered.

c. The program/project team shall develop and acquisition strategy that address all acquisition requirements and considers all necessary elements and issues (see NFS Part 1807).

4.4.3 Executing Contracts and Nonprocurement Instruments

4.4.3.1 Purpose. This activity is to select the most appropriate instrument, contract or otherwise, to satisfy the goals of the project or program.

4.4.3.2 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 (money, resources, data) to another (generally educational institutions, but may be to either a nonprofit or commercial firm or organization) to carry out a public purpose of support or stimulation; e.g., further general research or educate the public. Interagency funds transfers are used when NASA needs to use another Federal agencyís 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 NASAís 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 applicability of the Space Act Agreements and on procurement laws and regulations.

4.4.4 Monitoring Performance

4.4.4.1 Purpose. Monitoring performance ensures that value is received, commensurate with funds expended, as well as to ensure that the contractor complies with the terms of the contract. It is the responsibility of the program/project office and the contracting officer to monitor performance.

4.4.4.2 Requirements.

a. The program/project office and the contracting officer shall report the Governmentís assessment of performance back to the contractor.

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

4.5 Safety and Mission Success, and Environmental Management

This section addresses the requirements and activities that constitute effective safety and mission success and environmental compliance within programs and projects. Topics include safety and mission success, nuclear safety launch approval, application of lessons learned, emergency preparedness, and environmental management. The section was written to be applicable to programs/projects executed in-house or where NASA is the integrator. When a prime contractor is selected to have total system integration responsibilities, many of the activities discussed below may then be delegated to the prime contractor.

4.5.1 Safety and Mission Success

References:

a. NPD 8700.1, NASA Policy for Safety and Mission Success.
b. NPD 8710.2B, NASA Safety and Health Program.
c. NPG 8715.x (NHB 1700.1 Vol 1-b), NASA Safety Program Manual.
d. NPD 8621.1G, NASA Mishap Reporting and Investigation Policy.
e. NPD 8730.x (NMI 1270.3), Quality Management System (ISO 9000).
f. ANSI/ASQC Q9001-1994.
g. NPD 8720.1, NASA Reliability and Maintainability Planning.
h. NPD 8730.x, NASA Parts Policy.
i. NPD 2820.x, NASA Software Policies.
j. NTS 8719.13A, NASA Software Safety.

4.5.1.1 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.

4.5.1.2 Requirements

The program/project manager shall establish a safety and mission success activity as a part of the risk management process (section 4.2). To implement the effort, the program/project manager, with the assistance of any 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 plan should detail such activities as system safety, reliability engineering, electronic and mechanical parts reliability, quality assurance for both hardware and software, surveillance of the development processes, ìclosed loopî problem failure reporting and resolution and environmental design and test requirements. The plan shall be developed early in the program formulation process. Mission success criteria shall be defined to aid in early assessment of the impact of risk management trade-off decisions. The safety and mission success activity shall accomplish the following:

a. Provide for formal assessment and documentation of each hazard, with risks identified, analyzed, planned, tracked, and controlled in accordance with section 4.2.2.c. and the hazard reduction protocol in reference c.

b. Provide for a safety assessment and certification regarding readiness for flight or operations, explicitly noting any exceptions arising from safety issues and concerns.

c. Utilize a quality management system governed by the ISO 9000 standard (reference e.), appropriate surveillance, and NASA Engineering and Quality Audit (NEQA) techniques.

4.5.2 Nuclear Launch Safety

References:

a. Presidential Directive/National Security Council Memorandum No. 25.
b. NPG 8715.x (NHB 1700.1 Vol 1-b), NASA Safety Program Manual.

4.5.2.1 Purpose. To ensure an internal NASA process for effective intra-agency and interagency coordination in obtaining approval to launch radioactive materials.

4.5.2.2 Requirements.

a. Each program/project shall ensure that system designs and/or planned use of radioactive materials will 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 internal governmental, NASA, and Executive branch interagency coordination processes for nuclear launch safety approval reflected, as applicable, in references a. and b.

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

4.5.3 Application of Lessons Learned

Reference: NPD 8700.1, NASA Policy for Safety and Mission Success
.

4.5.3.1 Purpose. To ensure that lessons learned from previous experiences are used as a resource to the program/project manager. Significant knowledge is gained from past programs and projects that is documented and collected as a benefit to future programs and projects. It protects against the recurrence of past mistakes and provides a vehicle for the promulgation of best practices.

4.5.3.2 Requirements.

a. Each program and project should review and apply significant lessons learned from the past throughout the program/project life cycle, where appropriate.

b. NASAís Lessons Learned Information System (LLIS) (http://llis.gsfc.nasa.gov/) should be consulted, prior to major milestones.

c. Throughout the project's life cycle, each project manager shall document and submit any significant lessons learned to the LLIS in a timely manner.

4.5.4 Program/Project Emergency Planning/Response

Reference:

a. NPD 8710.1, NASA Emergency Preparedness Program Policy.
b. Presidential Directive/National Security Council Memorandum No. 25.
c. NPG 8715.x (NHB 1700.1 Vol 1-b), NASA Safety Program Manual.

4.5.4.1 Purpose. To integrate emergency mitigation, planning, response, and recovery requirements into the program/project planning and management activities.

4.5.4.2 Requirements.

a. Each program/project shall develop emergency response, mitigation, and recovery plans in accordance with reference a. and ensure that program/project preparations are completed and that response capabilities (to include restoration of program-unique resources and capabilities) are available prior to initial operational capability.

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

c. These plans will be coordinated with the local Emergency Preparedness Office.

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 b and c.

4.5.5 Environmental Management

References:

a. NPC 1158.x, NASA Environmental Management Board.

b. NPD 8800.16, NASA Environmental Management.

c. NPG 8800.17, Energy Metrics for NASA Facilities.

d. NPG 8820.x, Pollution Prevention.

e. NPG 8830.x Affirmative Procurement Plan for Environmentally Preferable Products.

f. NPG 8840.x, NASA Procedures and Guidelines for National Environmental Policy Act Implementation.

g. NPG 8850, Environmental Investigation and Remediation—Potentially Responsible Party Identification and Analysis.

h. OMB Circular A-11, Preparation and Submission of Budget Estimates.

i. Executive Order 12088, Federal Compliance with Pollution Control Standards.

4.5.5.1 Purpose. Programs and projects will focus on three areas: minimizing future problems through an active pollution-prevention program, conducting all operations in compliance with environmental requirements, and preserving our rich natural and cultural heritage for future generations.

4.5.5.2 Requirements.

a. The National Environmental Policy Act (NEPA) requires NASA program/project managers to consider environmental impacts in the planning of Agency programs and projects that may have a significant 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.

b. NASA program/project managers shall contact the environmental functional offices to ensure implementation of NEPA requirements in accordance with NASAís policy and procedures (14 CFR Part 1216, NPG 8840, and Executive Order 12114).

c. NASA program/project managers shall consider pollution prevention in all program and project decisions such as reducing or eliminating the use of hazardous materials and operations or processes that produce hazardous/solid waste and other emissions, requiring the use of environmentally preferable products, and factoring in LCC's for ultimate closure and disposal, both by NASA and its contractors and suppliers.

d. NASA program/project managers shall contact the environmental functional offices to obtain all required permits, waivers, documents, or authorizations to ensure that current and future operations meet all Federal, State, or local environmental regulations.

e. NASA program/project managers shall comply with the energy efficiency and water conservation requirements established by the National Energy Conservation Policy Act and Executive Order 12902, design new facilities to meet required energy efficiency standards, and incorporate the use of solar and other renewable energy sources where cost effective.

4.6 Program/Project Management Development

References:
a. NASA Program/Project Management Home Page: http://ppmi.hq.nasa.gov.
b. NASA Project Management Development Process Handbook.
c. NASA Program/Project Management Initiative (PPMI) Charter.

4.6.1 Purpose. The people who manage, support, and work on projects require a vast sum of knowledge, experience, and skill in the profession of project management. NASA provides this population with a large array of development opportunities and potential resources to enhance personal and project team competency. These resources are intended to ensure that project personnel are establishing and staying current in their expertise. These resources can be accessed through local training and development organizations as well as the Agencyís Program Project Management Initiative (PPMI). The responsibility for proper PPM development is shared by both the individual and his/her manager. Managers shall support employees in receiving the proper development and continuous learning.

The PPM development is to ensure that all NASA personnel, being assigned to PPM positions, have received the following:

a. Formal training and developmental experiences which promote optimal PPM performance.

b. Access to PPM tools and information services through the NASA Program/Project Management Home Page.

c. Work assignments that provide growth and preparation for PPM assignments.

Information defining the PPM performance requirements and competencies are identified in the NASA Project Management Development Process Handbook, within the referenced PPM Home Page.

4.6.2 Requirements.

a. Maintain competence in project management by making a commitment to continuous learning is essential. This learning can take the form of formal training, developmental assignments, academic programs, or self-paced study. Program/project managers as well as program/project personnel shall have an annual minimum of 40 hours of project-management-related learning and are strongly encouraged to participate in at least another 40 hours of general learning each year. In order to ensure personal and organizational commitment to learning, Individual Development Plans (IDP) shall be developed and supported by all project personnel and their managers. NASA Senior Management shall promote an environment which enables such continuous learning to occur.

b. The matrix below indicates the minimum formal training required. Program/project personnel should supplement these requirements by taking additional formal training which is person- and position-specific. A list of NASA PPM training and development resources can be found through local training and development organizations as well as the NASA Program/Project Management Initiative (see the PPMI Home Page at ppmi.hq.nasa.gov).

Figure 4-6 MATRIX OF REQUIRED TRAINING COURSES BY CAREER LEVEL

Level of Development	Formal Training Courses (or equivalency)
Program Manager	NASA Program Management (PGM) NASA Advanced Project Management (APM) An Overview of NASA Program/Project Management: 7120.5A
Project Manager (Systems Level & Above)	NASA Advanced Project Management (APM) An Overview of NASA Program/Project Management: 7120.5A
Project Manager (Subsystems Level)	NASA Project Management (PM) An Overview of NASA Program/Project Management: 7120.5A Systems Requirements Systems Engineering
Project Personnel (Discipline Experts)	NASA Task Management (TM) An Overview of NASA Program/Project Management: 7120.5A Fundamentals Of Program Management & Control

4.6.3 PPMI Responsibilities

a. The PMC has established an Agency policy for PPM which will define high-level PPM development requirements.

b. The Program Management Council Working Group will provide guidance for the implementation requirements impacting PPM training and development.

c. The NASA Office of Human Resources and Education will provide functional management support for PPM development.

d. The NASA Training and Development Office will manage and support implementation of the PPM development approach.

e. The NASA Centers' training offices will support Center PPM development requirements.

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.

To access the NODIS Library page, click here. This will provide you access to NASAís Strategic Plan, Handbook, and Agency and Center Directives. Access is also provided to Federal regulations, Executive orders, OMB Circulars, Technical Standards, Charters, and Financial Management Manuals.

Technical Standards. The Agency preferred standards may be viewed at URL: http://standards.nasa.gov

Charters. The Agency Program Management Council Charter may be viewed at URL: http://nodis.hq.nasa.gov/Nodis1.1/attachments/pmc_charter.doc

Management System Requirements. Many of the Management System Requirements referenced in chapter 4 refer to Agency functions that support program and project managers in meeting requirements set forth in laws, regulations, and directives. Management system requirements that apply to a specific program or project should be identified by function. NASA's functions include the following:

Figure A-1.1 Functional Areas

1. Aircraft Management	NPD's, NPG's	9. Legal	NPD's, NPG's
2. Equal Opportunity	NPD's, NPG's	10. Occupational Health	NPD's, NPG's
3. Facilities Engineering (Cof F & Facilities Maintenance)	NPD's, NPG's	11. Procurement	NPD's, NPG's
4. Environmental & Energy Programs	NPD's NPG's	12. Public Affairs	NPD's ,NPG'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 (Including Communications Security)	NPD's,NPG's
7. Industrial Relations	NPD's, NPG's	15. Small and Disadvantaged; Business Utilization	NPD's, NPG's
8. Information Resources Management	NPD's, NPG's	16. Logistics Management	NPD's NPG's

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. Program and project managers can view the Program/Project Managers Initiative (PPMI) web site for NASA functional contacts.

APPENDIX B. Definitions

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 Management Process. This process is comprised of the following subprocesses: acquisition strategy and requirements generation, nonprocurement acquisitions, contract award, and contract management.

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. The term, as used in this document, refers to any of those major program and project management components, as shown in the subprocess flow diagrams for each of the four PAPAC subprocesses, 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).

Affordability. The ability of NASA to provide funding and other resources to acquire and operate the system as determined by the cognizant EAA and CFO and confirmed by the Deputy Administrator or the GPMC.

Allowance for Program Adjustment (APA). Resources allocated for expansion in program requirements resulting from approved changes in program objectives or scope, the resolution of unforeseen major problems, and program/project stretchouts from Agency funding shortfalls.

Baseline. The technical performance and content, technology application, schedule milestones, and budget (including contingency and APA) which are documented in approved program and project plans. See also Performance Measurement Baseline.

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

Configuration Management. The identification, control, accounting, and verification of requirements and implementation documentation for formal orderly control of the program/project configuration.

Contingency Resources. These include funding, schedule, performance, manpower, and services allocated to and managed by the program/project manager for the resolution of problems normally encountered 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, including the public, to which a program or project responds or provides a product(s) and/or service(s).

Development Cost Commitment (DCC). The ceiling established by the Administrator for the total costs to be incurred during the period from the beginning of the formulation phase through the achievement of operational readiness or the equivalent.

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

Environmental Impact Management. The activity of ensuring that program and project actions and decisions which potentially impact or damage the environment are performed according to all NASA policy and Federal, State, and local environmental laws and regulations.

External Independent Readiness Review (EIRR). This is an Enterprise-requested review of a program or project near product delivery. It is usually staffed by personnel that are independent of the program or project, and they may be independent of the Agency.

Financial Resources Management. This function is comprised 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 the following functions:

a. Budget development and execution.
b. Contractor financial reporting.

Formulation Authorization. This document is issued by the EAA to authorize the level of formulation of a program whose goals are referenced in the Enterprise Strategic Plan.

Governing Program Management Council (GPMC). Forums composed of NASA and/or Center Senior Management that assess program and project planning and implementation and provide oversight and direction as appropriate.

Independent Annual Review (IAR). An an analysis of the status of the commitments (performance, cost, and schedule) in a PCA as compared to the program/project baseline and established thresholds.

Independent Assessment (IA). A validation of an advanced concept developed to satisfy an Enterprise strategic goal.

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. This differs from verification and validation in that it is performed by an independent organization.

Information Technology (IT). Any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information that is used by NASA. This includes computers, ancillary equipment, software, firmware and similar procedures, service (including support services) and related resources that support NASA programs and complexes across the Agency.

Infrastructure. The NASA human resources, facilities, equipment, information resources, and administrative and program support services.

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 Centerís civil service workforce.

Lesson Learned. The significant knowledge or understanding gained through past programs and projects that is documented and collected to benefit current and future programs and projects (see http://llis.gsfc.nasa.gov/).

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 lifespan.

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 difference between a cost, schedule, or technical threshold and the current expected value of the parameter.

Metrics. A measurement, taken over a period of time, that communicates vital information about a process or activity. A metric should drive appropriate leadership-management action. Physically, a metric package consists of three parts: (1) an operational definition, (2) measurement over time, and (3) a presentation package.

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

Non-Advocate Review (NAR). The an analysis of a proposed program or project by a nonadvocate team comprised of management, technical, and budget personnel that will not participate in the implementation of the proposed program or project. It provides Agency management with independent assessments of the adequacy of the formulation effort.

Operational Cost Commitment (OCC). The ceiling established by the Administrator for the total expenses to be incurred in the projectís life cycle following achievement of the operational readiness milestone.

Performance Assessments. The evaluation of cost, schedule, and technical execution against corresponding baselines contained in control documents and agreements.

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.

Process. The term, as used in this document, refers specifically to, and is synonymous with, the Provide Aerospace Products and Capabilities (PAPAC) process.

Program. An activity within an Enterprise having defined goals, objectives, requirements, funding, and consisting of one or more projects, reporting to the NASA PMC, unless delegated to a GPMC.

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

Program (Project) Cost Commitment (PCC). The ceiling established by the Administrator
.

Program Management Council (PMC). The Senior Management group, chaired by the Deputy Administrator, responsible for reviewing, recommending approval of proposed programs, and overseeing their implementation according to Agency commitments, priorities, and policies.

Program Operating Plan. A document produced by a Center in response to Headquarters-directed budget guidelines. It is a compilation of the requested budgets by program or project which are needed to execute the Headquarters direction. In cases where estimate exceeds the guideline, the additional funding requirement is displayed as an over guideline request.

Program Plan. The document that establishes the overall baseline for implementation as well as the agreements among the EAA, LCD, Center Director, and program manager.

Program/Project Implementation. Those design, development, and operations necessary to accomplish the objectives of an approved effort.

Program-Specific Technology. That which provides fundamental, unique capabilities that are incorporated into the planning.

Project. An activity designated by a program and characterized as having defined goals, objectives, requirements, LCCís, a beginning, and an end.

Project Plan. The document that establishes the overall baseline for implementation as well as the agreements among the LCD, program manager, and the involved NASA Center managers.

Project Status Report (PSR). A semiannual document to congressional committees on the status, highlighting progress and problems while tracking cost, funding, scheduling, and performance.

Quality Assurance. The effort comprised of the elements of ISO 9000.

Reserves. The APA and contingency resources.

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, 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.

Schedule Management. The establishment, monitoring, and maintenance of the baseline master schedule and derivative detailed schedules. It is comprised 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.

Stakeholders. Individuals and groups that have an interest in the performance of a public system or organization, e.g., teachers in the public schools, or unions and business groups in relation to a workplace safety Agency. Some stakeholders may be customers; others are not.

Subprocess. The term, as used in this document ,refers specifically to any of the four subprocesses of the PAPAC process-- Formulation, Approval, Implementation, or Evaluation. Note: In chapters 2 and 3 of this document, a subprocess is carried as a two-digit item (x.y).

Surveillance. The continual monitoring and verification of status of an entity and analysis of records to ensure that specified requirements are being met.

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

Tailoring. The documentation and approval of the adaptation of the PAPAC process and requirements to specific program or project needs. The results of this activity are documented in the PCA, Program Plan, and Project Plan.

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

Termination Review. An analysis by the GPMC for the purpose of securing a recommendation as to whether to continue or terminate a program or project.

Threshold Requirement. A condition which, if not met, would result in the basic program objective not being achieved or the program need not being satisfied.

User. Any person, organization, or other entity which utilizes the products and/or services provided by a program or project.

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

APPENDIX C. Acronyms

AA	Associate Administrator
AO	Announcement of Opportunity
APA	Allowance for Program Adjustment
C o F	Construction of Facilities
CFO	Chief Financial Officer
CIC	Capital Investment Council
DCC	Development Cost Commitment
DRFP	Draft Request for Proposal
EA	Environmental Assessment
EAA	Enterprise Associate Administrator
EIRR	External Independent Readiness Review
EVM	Earned Value Management
FAR	Federal Acquisition Regulation
FMEA	Failure Modes and Effects Analysis
FY	Fiscal Year
GAO	General Accounting Office
GPMC	Governing Program Management Council
GPRA	Government Performance and Results Act
IA	Independent Assessment
IAR	Independent Annual Review
ICE	Independent Cost Estimate
IDP	Individual Development Plans
IFMS	Integrated Financial Management System
IPAO	Independent Program Assessment Office
IPO	Institutional Program Office
ISO	International Standards Organization

IT	Information Technology
IV&V	Independent Verification & Validation
LaRC	Langley Research Center
LCC	Life-Cycle Cost
LCD	Lead Center Director
LLIS	Lessons Learned Information System
MO & DA	Mission Operations and Data Analysis
NAR	Non-Advocate Review
NEPA	National Environmental Policy Act
NEQA	NASA Engineering and Quality Audit
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
OCC	Operational Cost Commitment
OMB	Office of Management and Budget
PAPAC	Provide Aerospace Products and Capabilities
PCA	Program Commitment Agreement
PCC	Program (Project) Cost Commitment
PI	Principal Investigator
PMC	Program Management Council
POP	Program Operating Plan
PPM	Program/Project Management
PPMI	Program/Project Management Initiative
PSR	Project Status Report
R&A	Research and Analysis
RDT&E	Research, Development, Test, and Evaluation

RFP	Request for Proposal
SBIR	Small Business Innovation Research
SLA	Service Level Agreement
SOMO	Space Operations Management Office
WBS	Work Breakdown Structure

APPENDIX D. Responsibilities for Program and Project Management

D.1 Headquarters Responsibilities

a. The Administrator is responsible for the following:

(1) Agency-level strategic management.

(2) Overall Agency program budget allocation.

(3) Approval of all programs for new starts.

(4) Oversight of NASA programs.

(5) Leading customer interfacing.

b. The Deputy Administrator is responsible for the following:

(1) Supporting the Administrator in his/her responsibilities for overall NASA strategic management, budget allocation, and oversight, including new-start approval.

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

(3) Assessing candidate new-start readiness.

(4) Recommending which programs will be overseen by the NASA PMC.

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

(6) Serving as chairperson of the Agency's PMC and CIC.

(7) Serving as the Acquisition Executive for the Agency.

c. Enterprise Associate Administrators are responsible for the following:

(1) Providing program advocacy.

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

(3) Recommending the level of GPMC oversight for each program.

(4) Recommending program responsibilities for Lead Centers and approving the assignment of project responsibilities according to the Program Plan.

(5) Recommending new programs to the Agency's PMC.

(6) Developing, coordinating, and maintaining the PCA.

(7) Approving Program Plans.

(8) Assessing program performance against requirements and customer expectations.

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

(10) Serving as a member of the Agency's PMC and appropriate GPMCís.

(11) Allocating budgets to programs.

(12) Managing program formulation.

(13) Ensuring that products and services meet customer requirements.

(14) Identifying and developing interface with customers.

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

(1) Reviewing results of the NAR and IAR with the Chief Engineer.

(2) Concurring with and recommending changes to the PCC during program and project implementation that arise from economic and fiscal changes outside the control of the Agency.

(3) Providing notification to the Administrator and EAA whenever the projected fiscal resource requirements exceed the baseline PCC or the DCC component of the baseline PCC as specified in the PCA.

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

(1) Serving as the process owner for the PAPAC process, including development and maintenance of this document.

(2) Providing ICEís for proposed new starts.

(3) Providing for the IARís, NARís, and IAís.

(4) Collecting, analyzing, and disseminating lessons learned/process knowledge related to this document.

(5) Appointing NAR chairpersons for programs/projects under the oversight of the NASA PMC.

D.2 Center Responsibilities

a. The Lead Center Director is responsible for the following:

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

(2) Supporting the EAA in program formulation.

(3) Providing overall direction, control, and oversight of program implementation.

(4) Appointing the program manager.

(5) Approving the Program Plan with the EAA.

(6) Assigning work to other Centers.

(7) Integrating institutional resources with program needs.

(8) Coordinating cross-Center activities.

(9) Ensuring compliance to policy/standards.

(10) Developing and maintaining program/project implementation policies and procedures, compliant with NPD 7120.4A, this document, and ISO 9000.

b. The Center Director is responsible for the following:

(1) Performing advanced concept studies in support of Agency and Enterprise Strategic Plans.

(2) Supporting the LCD in program formulation.

(3) Approving the Project Plan.

(4) Appointing the Project Manager.

(5) Implementing and overseeing the project.

(6) Developing and maintaining program/project implementation policies and procedures, compliant with NPD 7120.4A, this document, and ISO 9000.

(7) Serving as (or designating) chairperson of the Center PMC, consistent with the LCD responsibilities in D.2.a.

c. The Program Manager is responsible for the following:

(1) Program planning, including recommendation of program objectives, requirements, implementation guidelines, budget and milestones, and preparation of Program Plans and supporting development of PCAís.

(2) Developing, recommending, and advocating the program resources.

(3) Allocating budget to projects.

(4) Establishing support agreements.

(5) Executing and overseeing the Program Plan .

(6) Controlling of program changes.

(7) Approving Project Plans and associated changes to these documents.

(8) Establishing project performance metrics.

(9) Integrating the planning and executing of individual projects on programs comprised of multiple, interdependent projects.

(10) Reviewing and reporting program/project performance.

(11) Complying with applicable Federal law, regulations, Executive orders, and Agency Directives.

d. The Project Manager is responsible for the following:

(1) Preparing and maintaining the Project Plan, specifications, schedules, and budgets.

(2) Establishing support agreements.

(3) Acquiring and utilizing participating contractors.

(4) Executing the Project Plan.

(5) Supporting the program management and integration.

(6) Reporting project performance and status, including contracts.

(7) Complying with applicable Federal law, regulations, Executive orders, and Agency Directives.

APPENDIX E. Key Document Content

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

E.1 Formulation Authorization.

E.2 Program Commitment Agreement.

E.3 Program Plan.

E.4 Project Plan.

E.1 Formulation Authorization

Formulation Authorization

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

Agreements:

_____ _____

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 Title Page

FORMULATION AUTHORIZATION
(PROGRAM TITLE)

PURPOSE

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

TERMS OF REFERENCE

Describe the level or scope of work to be accomplished in the formulation study, any cost targets or constraints which bind the feasible solutions, the time available to do the studies, and any other constraints. This document will be used to authorize partial or full formulation by the EAA within the approved NASA budget.

FUNDING

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

INTERNAL PARTICIPANTS

Identify other Enterprises and Centers to be involved in the activity.

EXTERNAL PARTICIPANTS

Identify participation external to NASA to be involved in the activity.

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.

Agreements:

_____ _____
Enterprise Associate Administrator Date

_____ _____
Administrator Date

Figure E-2.1 Program Commitment Agreement Title Page

PROGRAM COMMITMENT AGREEMENT
(PROGRAM TITLE)

PROGRAM OBJECTIVES

This paragraph shall convey the following:

a. The broad program objectives in clear English.

b. The public good of the program to the taxpayer, stated in a way that can be understood by the average citizen.

PROGRAM OVERVIEW

This paragraph should provide a broad description of the strategy to achieve the above-mentioned objectives while retaining the flexibility of the EAA in implementing the program. Describe the programís relationship to the Enterprise Strategic Plan, and identify the customer. 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

Identify the Lead Center and supporting Centers responsible for implementation, the GPMC for the oversight of the program and its projects, and the approving official for projects.

TECHNICAL PERFORMANCE COMMITMENTS

This section shall provide the following:

a. The technical requirements needed to achieve the program objectives shall be defined in an objective, quantifiable, and measurable form.

b. If the programís objectives include a technical performance target in addition to a threshold requirement (e.g., as for an applied technology research program), the commitment should be stated as a range.

c. Establish performance indicators to be used in assessing the relative outputs, service levels, and outcomes.

SCHEDULE COMMITMENTS

This section shall provide the following:

a. Key milestones in each year of the program, such as--

(1) Launch date of each spacecraft and launch date for a vehicle first flight, first element launch.

(2) Date on 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.

(3) Preliminary Design Review, Critical Design Review, AO, or major tests.

b. Minimum period of operation of each spacecraft.

COST COMMITMENTS

This section contains the PCC and its component elements presented in figure E-1. These commitments shall be specified according to the definitions of figure E-1 and with the following:

a. All costs through the end of nominal program lifetime shall be included, such as facility usage changes and civil service Full Time Equivalent (FTE).

b. The C o F costs shall include all costs required to construct, modify, or outfit facilities to satisfy the systemís technical and schedule commitments.

c. The launch vehicleís related costs shall include the launch vehicle; launch site; and any project-unique, vehicle-related costs necessary to satisfy the systems technical and schedule commitments.

PROGRAM COST COMMITMENTS (PCC), $M FOR XYZ PROGRAM

COST COMMITMENT CATEGORIES		FY 1	FY 2	FY 3	.....	FY N	TOTALS	RESPONSIBLE AA SIGNATURE
DEVELOPMENT (DCC)	Formulation (Preapproval/Definition)	xxx					xxx	
	Implementation (Development)	xxx					xxx	EAA
	Totals	**XXX**					**XXX**	
OPERATIONS (OCC)	Implementation (Operations/MO&DA)	xxx					xxx	
	Totals	**XXX**					**XXX**	
OTHER	CoF	xxx					xxx	
	Launch Vehicle	xxx					xxx	SSA #1
	Tracking and Data	xxx					xxx	SSA #2
	Other							SSA #N
	Totals	**XXX**					**XXX**	CFO/Comptroller*
	Totals (PCC)	**XXX**					**XXX**	

* Budget Profile consistent with FY Budget submittal

Figure E-2.2. Program cost commitment content.

ACQUISITION STRATEGY

Provide a brief statement of the proposed acquisition strategy.

HIGH RISK AREAS

This should identify the areas of highest risk for the program (covering technical, cost, and schedule issues) in which failure might expose NASA to adverse social or political consequences and/or generate serious technical consequences. This section should identify, where possible, the specific risk drivers, such as high-risk technologies upon which the program is dependent and the proposed actions to mitigate the risks, including reserves and APA allocations, and the descope strategy.

INTERNAL NASA AGREEMENTS

If the program is dependent on other NASA activities outside of the EAAís control, agreements need to be made that provide the details of the required support. At a minimum, agreements are required for each supporting cost commitment in the PCC. This paragraph shall list the crosscutting Enterprise agreements.

EXTERNAL AGREEMENTS

This should 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. This shall include an identification of the commitments being made by the external organizations, other agencies, or international partners and a listing of the specific agreements concluded with the authority of the EAA and other Headquarters officials. Any unique considerations affecting implementation of NPD 7120.4A policies and the processes of this document necessitated by the external involvement should be clearly identified.

INDEPENDENT EVALUATION

This specifies the number and type of independent reviews that will be performed during the life cycle of the program or project (NAR, EIRR).

TAILORING

This should identify the process and requirements which have been revised with supporting rationale in reference to NPG-7120.5A. It identifies the unique approaches to be approved by management.

PCA ACTIVITIES LOG

This section shall contain a log of all activities associated with maintenance of the PCA, depicted the annual revalidations and all deviations to the original PCA. This log shall include the information shown in figure E-

2 and shall be supplemented with an addendum for each change, which describes the change, and is attached to the PCA.

Note: The process for the addition of projects to the program should be defined in the Program Plan, including the responsibility to select and implement individual projects. The PCA shall be updated to add approved projects.

Date	Event	Change	Addendum	Cancellation Review Req'd	EAA Signature	Administrator Signature
dd/mm/94	Annual Revalidation	None	N/A	No		
dd/mm/95	Annual 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-2.3. 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.)

Agreements:

_____ _____
Lead Center Director Date

_____ _____
Enterprise Associate Administrator Date

_____ _____
Program Manager Date

Figure E-3.1 Program Plan Title Page

PROGRAM PLAN
(PROGRAM TITLE)

INTRODUCTION AND PROGRAM OVERVIEW

Briefly state the background of the program and its current status, including the results of formulation activities, decisions, and documentation. Indicate that the main purpose is to establish the following:

a. Program objectives and performance goals.
b. Program requirements.
c. The management organizations responsible for the program throughout its life cycle.
d. Program resources, schedules, and controls.
e. Briefly summarize the scope of the information covered in the remaining sections.

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 and the process to be used to ensure customer advocacy.

PROGRAM AUTHORITY AND MANAGEMENT STRUCTURE

Identify the Lead Center and supporting Centers responsible for implementation, the GPMC 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 systemís program and projects from the EAA to the NASA Center project managers. Include lines of authority, coordination, and reporting; illustrate the organization graphically, using as guidance NPD 7120.4A and NPG 7120.5A.

b. Responsibilities. Define management responsibilities of the EAA, the program manager, and project manager, including the authority of these persons as described in NPD 7120.4A. Indicate their responsibilities for developing, concurring, and approving principal program documents, such as the

formulation, project requirements, the Program Plan, Project Plan, RFPís and other contract-related documents, reports associated with major reviews, and other key activities.

PROGRAM REQUIREMENTS

Define the performance required of the program. For multiple projects within a program, describe the way in which the program requirements will be allocated to the respective projects.

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 ìdeliveryî dates), and other Administrator or EAA decisions. Identify 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, SOMO, 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 LCD and/or 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, 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 LCD and/or 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 shall be addressed, including a description of integration and oversight responsibilities.

COMMERCIALIZATION OPPORTUNITIES

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

TECHNOLOGY ASSESSMENT

Identify the NASA technology thrusts to be utilized by the projects. Identify those technologies the program expects to mature during the life of the program.

DATA MANAGEMENT

Program data management planning shall be developed for science missions, either 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 shall contain 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.

RISK MANAGEMENT

The risk management planning required by paragraph 4.2.2.a. shall include the following:

a. Introduction. Purpose, scope, assumptions, constraints, and policies pertaining to this plan and the program risk management process.

b. Overview of process. Overview of risk management process and data flow and the way it integrates and relates to other program management activities.

c. Organization. Organization, roles, and responsibilities of the program, customer, and suppliers.

d. Process details. Risk management process and related procedures, methods, tools, and metrics for each major function in figures 4-1 and 4-2.

e. Resources and schedule. Schedule, milestones, and required resources for risk management activities.

f. Documentation of risks. Describe the way risk information is documented (e.g., data base and templates), retained, controlled, and used.

g. Methodology. Describe the methodology to be used should descoping be required. Provide the ultimate descoped performance below which the activity would no longer be valid.

LOGISTICS

Provide the guidance to be applied to the program and projects in the planning and provisioning of logistics.

TEST AND VERIFICATION

Describe the programís approach to test and verification for the assurance of program success. This should address requirements for software verification and validation.

REVIEWS

List the reviews that the program will conduct and reviews in response to EAA requirements, e.g., EIRRís, Quarterly Status Reports, as well as independent evaluation reviews such as NARís or IARís.

TAILORING

This paragraph should identify the process and requirements which have been revised with supporting rationale in reference to NPG-7120.5A. It identifies the unique approaches and highlights to be approved by management.

CHANGE LOG

This section shall contain a log of changes to the Program Plan, specifically including any project added by the process described in PROGRAM AUTHORITY AND MANAGEMENT STRUCTURE above. The log will be supplemented by records from the change control system in section CONTROLS above.

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.)

Agreements:

_____ _____
Center Director (if required) 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 projectís purpose, goals, overall approach, and timeframe. For multiple NASA Center projects, describe the NASA Centerís project in relationship to the other participating NASA Centers.

OBJECTIVES

State the specific project objectives, performance goals, and performance indicators 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 and the process to be used to ensure customer advocacy.

PROJECT AUTHORITY

Identify the Lead Center and supporting Centers responsible for the implementation and the GPMC responsible for the oversight of the project.

MANAGEMENT

Describe the project management structure, including its integration into the program management structure and NASA Center participation. Identify all significant interfaces with other contributing organizations. Be consistent with the roles and responsibilities prescribed in Appendix D: Responsibilities for Program and Project Management. Identify specific management tools to support management in planning and controlling the project. Describe the use of special boards and committees. This section should address any requirement for a NASA Resident Office including duties and authority.

a. Organization and responsibilities.
b. Special boards and committees.
c. Management support systems.

TECHNICAL SUMMARY

Project requirements are presented with a technical description of the project. This includes the allocation of these requirements among the systems to be developed (hardware and software), use of the metric system, facilities, flight plans, operations and logistics concepts, and planned mission results analysis and reporting.

a. Project requirements.
b. System(s).
c. System operations concept.
d. System constraints.
e. Ground systems and support.
f. Facilities.
g. Logistics.
h. Mission results analysis and reporting.

SCHEDULES

Document the project's master schedule for all major events and activities planned for the entire project throughout the life cycle of the program. Include approval dates for principal program/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 level of detail should be at WBS 2.0 level or its equivalent.

b. Institutional Requirements. Present the institutional requirements 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, the LCD, or program manager, should be identified. Examples include funding by year, program requirements, project objectives, PPM structure, and major program/project documentation. Identify the thresholds associated with each parameter which 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.

a. Administrator.
b. Enterprise Associate Administrator.
c. Lead Center Director.
d. Program Manager.

IMPLEMENTATION APPROACH

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

a. Implementation approach.
b. Project summary WBS.

ACQUISITION SUMMARY

Provide summary information on procurement items, such as element (engineering design study, hardware 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 (NASA Center); and technical monitoring (NASA Center).

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., SOMO, 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. This list shall include all agreements concluded with the authority of the project manager, and should reference agreements concluded with the authority of the Lead Center program manager and above.

a. NASA agreements, e.g., SOMO Service Level Agreements, Launch Services Agreements.
b. Non-NASA agreements.

(1) Domestic.
(2) International.

PERFORMANCE ASSURANCE

For each of the subsections, cite the relevant requirements documents and summarize the way in which they will be followed. The plans and specific procedures should be identified to accomplish the applicable performance assurance items listed in the subsections.

a. General.
b. Reliability.
c. Quality assurance.
d. Parts.
e. Materials and processes control.

f. Performance verification.
g. Contamination allowance and control.
h. Software assurance.
i. Maintainability.

RISK MANAGEMENT

The Risk Management Planning, required by paragraph 4.2.2.a., shall include the following:

a. Introduction. Purpose, scope, assumptions, constraints, and policies pertaining to this plan and the project risk management process.

b. Overview of process. Overview of risk management process and data flow and how it integrates and relates to other project management activities.

c. Organization. Organization, roles, and responsibilities of the project, customer, and suppliers.

d. Process details. Risk management process and related procedures, methods, tools, and metrics for each major function in figures 4-1 and 4-2.

e. Resources and schedule. Schedule, milestones, and required resources for risk management activities.

f. Documentation of risks. Describes how risk information is documented (e.g., data base and templates), retained, controlled, and used.

g. Methodology. Describe how the project will apply the program descope methodology deriving the point at which the project is no longer viable.

ENVIRONMENTAL IMPACT

The required Environmental Assessment (EA) and Environmental Impact Statements for the project should be identified with the schedule for their accomplishment.

SAFETY

For each of the subsections, cite the relevant safety requirements documents and summarize the way in which they will be followed. Refer to paragraph 4.5 for requirements on safety planning (e.g., Industrial, Range, and System).

TECHNOLOGY ASSESSMENT

Identify the NASA technology thrusts to be applied. Identify those technologies in the project that will mature during its life cycle.

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 shown in SCHEDULES above. Explain the reporting requirements for program and project reviews.

TAILORING

This paragraph should identify the process and requirements which have been revised with supporting rationale in reference to NPG-7120.5A. It identifies the unique approaches to be approved by management.

CHANGE LOG

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

APPENDIX F. Independent Reviews

F.1 Non-Advocate Review (NAR)

F.1.1 Purpose

The approval subprocess for all programs and selected projects must include a NAR which provides an independent verification of a candidate program or projectís plans, LCC status, and readiness to proceed to the next phase of the programís life cycle. A NAR is conducted by a team comprised of highly knowledgeable specialists from organizations outside of the advocacy chain of the program or project being reviewed.

F.1.2 Content

A NAR provides the NASA PMC with an independent verification and evaluation of a program or selected projectís readiness to proceed. The NAR shall assess 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 descoping options).

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

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

When an EAA is ready to have a NAR performed, the Chief Engineer will be requested to initiate the review process. The Chief Engineer will direct the IPAO at LaRC to establish the NAR team and conduct the review for presentation to the NASA PMC. To the extent possible, continuity of the team membership will be maintained from IA to NAR and carried forward to the IAR.

To effectively support the NASA PMC in its recommendations for progressing, the review team shall gain a thorough understanding of the present status and position of the program or project, as well as an understanding of the major tradeoffs and alternatives explored by the design team. The program or project shall brief the following information to the NAR team:

a. Program/project background.
b. Scientific and technological objectives.
c. Formulation and implementation plans and schedules.

d. Documentation and agreements status.
e. Management structure and acquisition strategies.
f. LCC estimate which includes the following:

(1) Funding resource requirements.
(2) Reserves allocations (contingency and APA).
(3) Workforce requirements.
(4) Infrastructure requirements.
(5) External contributions or partnering efforts.

g. Program risk assessment and plans for mitigating risks.

F.1.3 Outcomes

The findings of the review shall document each of the areas above. The conclusions and recommendations will be used by NASA Senior Management in deliberations and recommendations for moving the program or project into the next phase of its development.

F.2 Independent Annual Review (IAR)

F.2.1 Purpose

The NASA PMC shall establish procedures to ensure that it remains cognizant of the status and performance of the programs and projects over which it has responsibility.

An IAR provides a validation of conformance to the PCA.

F.2.2 Content

An IAR shall provide for the following:

a. Assess progress/milestone achievement against original baseline.

b. Review and evaluate the cost, schedule, and technical content of the program over its entire life cycle.

c. Assess technical progress, risks remaining, and mitigation plans.

d. Determine if any program deficiencies exist which result in revised projections exceeding predetermined thresholds.

To accomplish this, the IAR team will assess progress to date against the plan to date, incorporating

the use of performance indicators and milestone success criteria, as well as assessing risk for completing future efforts as presently planned. The program/project presentation to the IAR team should include, at a minimum, the following:

a. Quick overview of program/project.

b. Status and changes since the last NAR or IAR of the following:

(1) Primary goals and objectives.
(2) Scientific and technical objectives that drive mission requirements and implementation plans.
(3) Implementation plans.
(4) Progress against performance indicators and productivity measures (technical, cost, schedule).

c. The NASA Chief Engineer, with process responsibility, along with the NASA CFO and LaRC Center Director shall establish standards to ensure continuity of reviews and for their conduct.

d. The program manager will ensure that a current and accurate PCA and program baseline is available to the IAR team to facilitate the conduct of the assessment.

F.2.3 Outcome

The IAR shall support the deliberative process of the NASA PMC by providing realistic status on Agency commitments.

The IAR team report shall contain the following:

a. Recommendations to the NASA PMC relative to compliance with the PCA.

b. Recommendations for additional reviews or individual program/project briefings that the IAR team deems necessary.

c. A recommendation on the advisability of continuing the program. This shall specifically include a recommendation as to whether or not a Termination Review is required.

d. Minority reports in the event that team consensus is not reached.

F.3 Independent Assessments (IA)

F.3.1 Purpose

An IA is performed in support of the NASA PMC oversight of approved programs/projects.

a. The IA is a validation of an advanced concept typically conducted in the formulation subprocess.

b. The IA is conducted by a team comprised of highly knowledgeable specialists from organizations outside of the advocacy chain of the program/project.

F.3.2 Content

a. Provides the NASA PMC with an indepth, independent validation of the advanced concepts, program or projectís requirements, performance, design integrity, system/subsystem trades, LCC, realism of schedule, risks and risk mitigation approaches, and technology issues.

b. Provides suggestions of alternative system and/or subsystem design approaches which offer potential for reduced costs and risks or improved system performance.

F.3.3 Outcome

The results of the IA are used in support of the NASA PMC in its deliberative process for developing recommendations regarding the following:

a. Continuing further formulation of the program or project.

b. Program/project budget decisions.

F.4 External Independent Readiness Reviews (EIRR)

F.4.1 Purpose

EIRRís are performed in support of the EAAís oversight of approved programs and projects. The EIRRís are conducted by a team of highly knowledgeable specialists from organizations outside of the advocacy chain of the project. In addition, the EIRR team is generally from organizations outside of NASA. This approach allows for access to a larger pool of resources with potentially more focused skills, raises confidence of NASA Senior Management, elevates and obtains attention to issues, and highlights lessons learned from other programs.

F.4.2 Content

The requirement for EIRRís shall be documented in the Program Plan. The program manager will flow down the requirement for an EIRR to the Project Manager via the Project Plan and negotiate with customers to minimize the number of independent reviews on a project.

F.4.3 Outcome

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