National Aeronautics and Space Administration

COURSE CATALOG

2010

Office of the Chief Engineer

The NASA Academy of Program/Project & Engineering Leadership (APPEL)

APPEL MISSION STATEMENT

APPEL is the Agency focal point for enabling individual and team excellence in program/project management and systems engineering through the application of learning strategies, methods, models, and tools.

Office of the Chief Engineer
The Academy of Program/Project & Engineering Leadership

2010 Course Catalog

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GREETINGS FROM THE ACADEMY DIRECTOR

"All that is valuable in human society depends upon the opportunity for development accorded the individual." – Albert Einstein

The Academy of Program/Project and Engineering Leadership (APPEL) has roots in the development of the program and project management workforce since the early 1990s. From the start, the foundation of our professional development has been based on NASA standards, competencies, and learning from real experiences.

Today, the Academy has expanded its focus to include the entire programmatic and engineering workforce in an integrated and collaborative manner. Furthermore, the majority of APPEL professional development resources go directly to mission-driven engineering and project teams. This targeting of mission-specific team learning is reinforced by a vast array of courses, workshops, and forums for individual and group learning. Through this approach, APPEL strives to provide the leadership, advice, direction, and support for the development and learning of the NASA program/project management and engineering community.

The catalog you are reading is intended to be a road map for your professional development. The APPEL curriculum lies at the heart of our approach to building project management and engineering capability at NASA. APPEL offers a mature curriculum that employs state-of-the-art methodologies based on leading empirical research and the latest developments in the aerospace and knowledge management industries. The aim of our curriculum is to enable each and every member of NASA's technical workforce to develop both the technical skills and the leadership abilities necessary to respond with speed and vision to a constantly changing landscape. A new overall curriculum structure for APPEL has been developed that will help us meet this vision and provide a defined path for project managers and engineers to progress. The new core curriculum comprises four levels of APPEL project management and systems engineering programs: Foundations of Aerospace at NASA, Project Management and Systems Engineering, Advanced Project Management and Advanced Systems Engineering, and the Executive Program. The core program will be augmented with elective course offerings that provide further depth of knowledge and development.

In short, the programs described in this catalog are a central part of APPEL's effort to set the standard for the professional development of NASA's technical workforce in order to advance the mission of the agency in its service of our nation. I am confident that your investment of time and effort in APPEL's programs will yield multiple rewards over the course of your career, and I encourage you to make the most of the Academy's rich opportunities for learning and professional development.

Dr. Ed Hoffman

NASA Academy Director

http://appel.nasa.gov

WHO WE ARE
AND WHAT WE DO

ACADEMY OF PROGRAM / PROJECT & ENGINEERING LEADERSHIP

APPEL

WHO WE ARE

The Academy of Program/Project and Engineering Leadership (APPEL) is the central source of training for program/project managers and systems engineers at NASA. We are actively engaged in promoting career and professional development and providing a wealth of information and resources to our technical workforce. APPEL builds NASA's capacity for teamwork, leadership, process utilization, and knowledge through customized programs to meet the specific needs of individuals, teams, and communities of learners. Our products and services are designed to address the competencies required for project management and systems engineering across four levels of career development from team member to program manager or chief engineer. The Academy provides these products and services through four business lines: Curriculum, Knowledge Sharing, Performance Enhancement, and Research and Advanced Concepts.

WHAT WE DO

Our Curriculum

Curriculum lies at the heart of the Academy's approach to building program/project management and engineering capability at NASA. The courses are designed using project management and systems engineering competency models and focus on what the participants will need to enhance their own capabilities, knowledge, and skills. We use best practices and NASA subject-matter experts to ensure the best training available is provided to NASA's practitioners. In addition, an integral component of the courses is pre- and post-assessments, which are designed to help practitioners identify their own strengths, the depth of their knowledge, any knowledge gaps, and knowledge gain. APPEL offers a curriculum with a world-class reputation that develops both technical skills and the leadership ability necessary to respond with speed and vision to a constantly changing landscape.

The curriculum consists of a core curriculum and a wide array of in-depth courses. The courses combine with outside-the-classroom development experiences to reinforce learning and provide an additional means of obtaining requisite skills.

Core Curriculum

The core curriculum provides fundamental knowledge for NASA's technical workforce. The completion of the core courses in a logical sequence is necessary to ensure that the appropriate level of knowledge is available for performance at a particular time in an individual's career and that later courses build on knowledge gained from earlier courses. Dates and locations can be found on the Agency master schedule.

In-Depth Courses

The Academy sponsors in-depth courses in program/project management, systems engineering, design and manufacturing, communications, and leadership; courses related to NASA's mission and vision; as well as other experiential learning activities. These courses are intended to provide in-depth, detailed, and supplemental development for achieving current and future job requirements and augment the knowledge and skills gained in the core curriculum. In-depth courses are made available to the NASA centers but students are not limited to attending courses at their home centers. Dates and locations can also be found on the Agency master schedule.

Outside the Classroom

As an integral part of the APPEL curriculum, participants will be exposed to experiences outside the classroom as a way of sustaining their continuous professional growth. APPEL provides career-development opportunities that guide the Agency's program and project managers and systems engineers through a sequence of professional experiences, courses, and other strategies that support individual and team development. Participants will have the opportunity to assess their development and take advantage of other APPEL services such as the following:

- Participation in knowledge-sharing activities
- Leadership assessment and coaching (individual and team)
- Access to APPEL publications
- Participation in the APPEL Masters Forum or the APPEL Project Management Challenge
- Project life-cycle and technical assistance, including access to expert practitioners

In addition to classroom training and other development strategies, APPEL appreciates the importance of on-the-job learning experiences, which can come in the form of job assignments or learning from mentors, supervisors, and other senior personnel. APPEL believes that the most successful participants will be those who use a combination of development activities to enhance their personal growth. We encourage participants to work with their supervisors and managers to identify appropriate, informal, on-the-job learning experiences that will positively reinforce classroom learning.

NEW HANDS-ON LEARNING OPPORTUNITIES

Systems Engineering Leadership Development Program (SELDP)

The SELDP, an agencywide leadership-development program, identifies high-potential systems engineers who are expected to lead higher-level or more complex efforts in the near future. The comprehensive program provides development in the form of assignments outside the home center, technical and leadership training, and coaching and mentoring. Program participants take part in a twelve-month developmental program that focuses on developing and/or improving specific leadership behaviors and technical capabilities.

Participant selection involves identifying individuals who have proven technical/discipline capability and who have demonstrated key leadership capabilities and behaviors. The competitive process ensures that the most qualified individuals are selected for this opportunity at the right time in their careers when the learning will have the greatest impact. Individuals must be nominated by their center director and center engineering director for this program. Visit http://www.nasa.gov/offices/oce/appel/seldp/index.html for more information.

Hands-On Project Experience (HOPE)

APPEL is partnering with the Science Mission Directorate to offer project HOPE, which provides hands-on learning opportunities as teams undertake flight hardware design, development, and flight. These learning experiences build individual capabilities in a team setting.

The initial project, TRaiNED (Terrain-Relative Navigation and Employee Development), is now under way at the Jet Propulsion Laboratory. It will enhance the technical, leadership, and project skills of NASA scientists, engineers, and project support personnel as they build and launch a sounding rocket. The program provides mentoring, training, and experiential learning experiences

through all phases in a project's life cycle where team members assume project roles new to them.

TRaiNED provides experience in proposal development, development of a scientific investigation, payload integration and testing, integration of the payload with the launch vehicle, flight operations (including data collection and analysis), and project management. This is the first in a series of HOPE projects planned in the years ahead. Look for more information in *ASK Magazine*.

WHAT COURSES TO TAKE AND WHEN

DEVELOPMENT PLANNING MATRIX				
	Level 1	Level 2	Level 3	Level 4
LEVELS OF PROJECT LEADERSHIP	Team Practitioners/ Technical Engineers	Subsystem Leads	Project Managers/ Project Systems Engineers	Program Managers/Project Systems or Chief Engineer
APPEL CORE COURSES	Foundations of Aerospace at NASA	Project Mgmt and Systems Engineering	Advanced Project Mgmt and Advanced Systems Engineering	Executive
IN-DEPTH COURSES are offered in various topic areas. These are guidelines as to when in an individual's career a course can be taken. Individuals should attend courses to enhance competencies in current positions or for future development requirements.	Project Management			
	• Beyond EVM Basics • Beyond Scheduling Basics • EVM Overview • NASA's Budgeting Process • Project Planning Analysis & Control • Risk Management • Understanding EVM • Understanding Project Scheduling	• Assessing Project Performance • Advanced EVM • Integrating EVM with Acquisition • Continuous Risk Mgmt • Management of Space Technology • Project Acquisition Workshop • Scheduling & Cost Control	• Integrating Cost and Schedule • International Project Management (course can be taken by anyone in a role that deals with IPM issues) • Passing the PMP Examination	
	Systems Engineering			
	• Fundamentals of Systems Engineering • Life Cycle, Processes, and Systems Engineering • Requirements Development and Management	• Concept Exploration and Systems Architecture • Decision Analysis • Developing and Implementing SEMP • Earth, Moon, and Mars • Software Engineering Management 301 • Space System Development: Lessons Learned • Space Systems V&V • Transition, Product Delivery, and Mission Ops		

IN-DEPTH COURSES (Continued)	Design and Manufacturing and Innovation			
		• Design for Manufacturability and Assembly • Innovative Design for Engineering Applications • Seven Axioms of Good Engineering		
	Communication and Leadership			
	• Communicating Technical Issues • Negotiations • Team Membership	• Team Leadership	• Leading Complex Projects	• Consider Agency Leadership Courses offered by OHCM.
	Technical—General			
	• Introduction to Aeronautics	• Mars Mission System Design • Science Mission Systems Design and Ops Course/Lab • Space Launch Transportation Systems		• Principal Investigator Forum
Developmental Work Assignments: (To Be Determined by Centers)				
Examples of Knowledge-Sharing Activities				
These are only examples. Each Center should identify those experiences specific to Center needs.	• Obtain a mentor • Attend a technical conference • Demonstrate working knowledge of Agency policy documents • Join national & international affiliations or technical bodies (i.e., INCOSE, PMI)	• Write and present a technical paper • Attend the Masters Forum, PM Challenge, or other non-NASA conferences	• Write a technical paper and present it at the Master's Forum, PM Challenge or external NASA conference • Study case studies	• Become a mentor • Conduct storytelling sessions • Instruct or become a guest speaker at APPEL courses • Write an article in *ASK Magazine*

COURSE DESCRIPTIONS

ACADEMY OF PROGRAM / PROJECT & ENGINEERING LEADERSHIP

APPEL

FOUNDATIONS OF AEROSPACE AT NASA (FOU)

AUDIENCE

This course is designed for all NASA employees to educate them about NASA's strategic direction, its missions, governance structures, technical guidelines, and mission directorate programs and projects as well as NASA's past, present and future.

GOAL

The goal of this two-week learning experience is to immerse participants into the meaning of working at NASA and the principles of technical excellence. This aerospace foundations course provides the big picture overview of NASA, its Governance model and operations. The NASA leadership and various technical experts will provide insights into the organization and inner-workings of the agency.

LEARNING OUTCOMES

You will gain an understanding of the basics of NASA's aerospace mission and systems, as well as the fundamentals of aeronautics. You will better understand the NASA organization (including center activities), key programs and projects, and the Agency's vision for exploration. You will explore the characteristics of effective teams and discover the value of effective technical communication and leadership. Additionally, you will be introduced to technical career development resources at NASA, particularly programs and activities sponsored by the Academy of Program/Project and Engineering Leadership.

LEARNING METHODS

Learning will be accomplished through the use of lectures, videos, animations, and group exercises. A special aspect of the course includes discussions and activities with NASA leadership (from Headquarters and the centers), astronauts, and other noted NASA individuals. Learning activities include pre- and post-class assignments and reports.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Explain NASA's strategic goals and objectives as an agency, including its mission, and governance model.
- Describe the "big picture" of NASA, the agency, and how the infrastructure works.
- Describe the basics of NASA's space mission and systems, including aeronautics and astronautics concepts.
- Demonstrate skills necessary for effective technical communication and teamwork.
- Identify specific space exploration programs and projects and demonstrate the importance of space exploration to America.
- Explain the concept of systems thinking and associated trades.
- Explain trends in the space industry, space missions and systems.
- Explain the fundamentals of orbits, maneuvering in space, interplanetary travels and the space environment.
- Describe key aspects of payload and spacecraft design, launch systems, and space system operations.

ATTENDANCE

Enrollment and participation in this course is by Center or organization nomination only. Please contact your Center Training and Development Officers and APPEL Coordinators for more information on the nomination process.

> *"I learned more than I ever thought I would about everything that needs to be understood to be able to travel in space."*

PROJECT MANAGEMENT AND SYSTEMS ENGINEERING (PM&SE)

AUDIENCE

This course is designed for NASA project practitioners and systems engineers prior to or in the first year of entry into project, systems engineering or supervisory positions.

GOAL

This two-week course is intended to enhance proficiency in applying PM and SE processes/practices over the project life cycle. This course focuses on defining and implementing system projects and provides valuable insight for managing and leading project and technical teams.

LEARNING METHODS

Learning will be accomplished using lectures, individual and group activities, and case studies. Learning activities include pre- and post-class assignments and reports.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Perform tasks that demonstrate an understanding of the project life cycle using PM and SE best practices and processes.
- Develop a project schedule and use the WBS to develop a network diagram.
- Identify contract types and understand contract management and procurement processes from start to finish.
- Apply the NASA paradigm to rank and prioritize risks.
- Describe EVM guidelines and perform technical and programmatic activities to control costs, schedule and technical content.

ATTENDANCE

Enrollment and participation in this course is by Center or organization nomination only. Please contact your Center Training and Development Officers and APPEL Coordinators for more information on the nomination process.

RECOMMENDED PREREQUISITES

Foundations of Aerospace at NASA or equivalent knowledge.

NOTES

This course is registered by the Project Management Institute (PMI) for 79 Professional Development Units (PDUs). PMI Course ID: PMSEA01

ADVANCED PROJECT MANAGEMENT AND ADVANCED SYSTEMS ENGINEERING (APM&ASE)

AUDIENCE

This course is designed as graduate-level seminar for experienced project managers (PMs) and systems engineers (SEs).

GOAL

This four-day course focuses on advanced concepts of project management and systems engineering and their integration in the management of all phases and facets of the project life cycle. This participant-driven course uses a case study approach to examine such topics as system architecting, performance, risk, cost, schedule, reliability and operability, as well as stakeholder management and acquisition strategies.

The structured facilitation provides the context that frames advanced project management and systems engineering concepts used to describe practices, approaches and issues. The participants will compare, differentiate, and discuss similarities, differences, and applications in order to draw conclusions on how to apply these concepts in their organization. This course equips you with the knowledge necessary to realize successful project solutions, leveraging the unique roles and responsibilities of the project managers and the systems engineers put forth in NPRs 7120.5D and 7123.1A.

LEARNING METHODS

Learning will be accomplished primarily through facilitated and structured class discussion on advanced systems engineering and project management topics, although introductory lectures on the key course topics will preface each of the sessions. Utilizing NASA and industry case studies, attendees then practice the 'how-to' of the principles through analyzing situations and applying concepts from the course to real project scenario exercises and illustrative examples. These practical exercises, complemented by the facilitated knowledge sharing that elicits senior level project experiences, provide opportunities to consider and apply new techniques and decision processes required in real world NASA project environments.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Lead integration of project management and systems engineering functions and personnel to balance performance, risk, cost, schedule, reliability and operability through all life-cycle phases per NASA policy guidelines.
- Apply techniques for coping with multiple stakeholders, complex approval situations and teams drawn from across NASA.
- Lead the development of a system architecture compatible with the performance requirements and the organizations involved with that system, acceptable levels of risk and suitable for the NASA mission to be performed.
- Direct the identification of system functional boundaries including multiple interfaces, segmenting the architecture into functions and conducting functional analysis on all of the segments.
- Recommend efficient acquisition strategies, lead their implementation, and monitor their effectiveness.

> *"This course was more about learning from the experiences of others and applying them to our situations … not just flipping charts."*

ATTENDANCE

Enrollment and participation in this course is by Center or organization nomination only. Please contact your Center Training and Development Officers and APPEL Coordinators for more information on the nomination process.

RECOMMENDED PREREQUISITES

Project Management & Systems Engineering (PM&SE) or equivalent knowledge

NOTES

This course is registered by the Project Management Institute (PMI) for 79 Professional Development Units (PDUs). PMI Course ID: PMSEA01

EXECUTIVE PROGRAM (EXEC)

AUDIENCE

This course is designed for the NASA program management community comprised of Agency officials serving in positions having major responsibilities for program management, as well as individuals serving as program managers, program chief engineers, program scientist and senior executives leading key technical and support functions such as engineering, science, budget, procurement, and safety and mission assurance.

GOAL

This five-day course supplements the participants' project management and systems engineering knowledge and skills as needed to achieve successful executive leadership and management of programs and key program support functions.

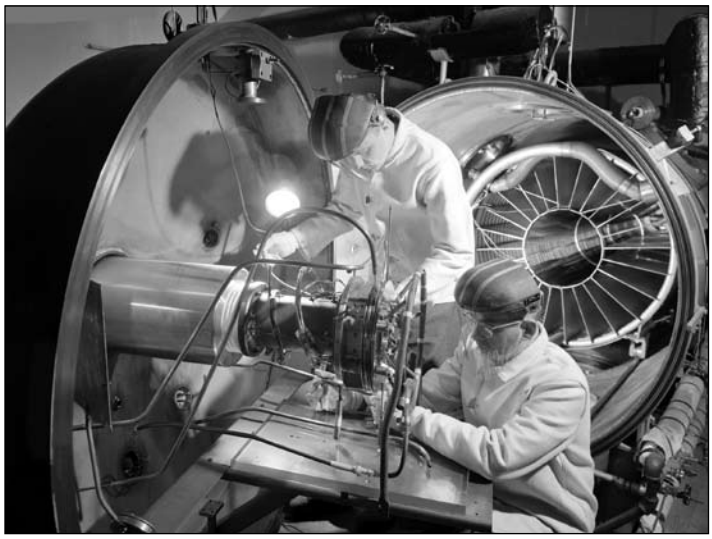
LEARNING METHODS

Learning methods include a variety of lectures, case studies and lessons learned. Sessions are primarily conducted by current or retired high-level NASA officials with a significant number having also served in private industry.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Explain how to manage a team effectively under the Agency strategic management and governance systems and within the Agency internal and external environments;



- Develop knowledge and skills in leading and managing the PGM processes of program formulation, approval and oversight; and
- Develop leadership and collaboration skills in advocating programs, working across organizational boundaries, and resolving conflict and solving problems.
- Perform effectively and efficiently in accordance with the NASA governance model and strategic direction, and within the Agency internal and external environments;
- Lead and manage the programmatic processes and functions for program formulation, approval, implementation and review; and
- Effectively and efficiently advocate programs, facilitate collaboration among organizations with diverse interests and cultures, and resolve conflicts in the Agency environment.

PREREQUISITES

The participants must have extensive project management and systems engineering experience and training up to and including the Advanced Project Management and Advanced Systems Engineering course (APM&ASE) level of the APPEL Core Curriculum or equivalent and be nominated by their Headquarters Mission Director or their center director and selected by the Agency Administrator.

ADVANCED EARNED VALUE MANAGEMENT TECHNIQUES: RECOGNIZING GAMING, ABUSE, AND DATA MANIPULATION (APPEL-AEVMT)

AUDIENCE

This course is designed for project managers who are responsible for reviewing the cost, schedule and technical performance reporting of subordinates and contractors.

GOAL

This one-day course provides an understanding of gaming, abuse and manipulation of Earned Value Management (EVM) and schedule management data building upon an intermediate understanding of EVM and scheduling.

LEARNING METHODS

Lectures, discussions, case studies, demonstrations, and exercises will present key concepts regarding advanced EVM techniques.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify irregularities in EVM and schedule data
- Interface in an informed manner with contractors and subordinates about faulty performance reporting
- Develop action plans to correct erroneous reporting
- Explain the role of EVM in contractors' performance evaluation/award fee process
- Develop strategies to build a good EVM working relationship between the government and contractor

NOTES

This course is registered by the Project Management Institute (PMI) for 39 Professional Development Units (PDUs). PMI Course ID: APMSE03

ASSESSING PROJECT PERFORMANCE (APPEL-APP)

AUDIENCE

This course is designed for project managers, subsystem managers, and other project team members who are responsible for meeting project commitments, and who would benefit from an understanding of integrated project performance assessment techniques.

GOAL

This two-day course is designed to help participants manage and make informed decisions from the volumes of data about project performance such as earned value, risk matrices, critical path, slack, estimates to complete, cost variances, configuration changes, contract modifications, award fee scores, technical performance measures, and others.

LEARNING METHODS

Lectures and discussions are combined with case studies, demonstrations, and exercises to maximize the learning experience.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand the importance of project performance assessment
- Apply performance assessment methodologies using existing project data
- Interpret the significance of the project performance assessment results
- More fully synthesize project performance data from multiple sources into a cohesive assessment of past, present and future performance of the project

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: APP006

> *"BEVMB helped me understand how to read earned-value reports and what they actually represent."*

BEYOND EVM BASICS: BASELINE CONTROL, RISK CONSIDERATIONS AND PERFORMANCE INDICATORS (APPEL-BEVMB)

AUDIENCE

This course is designed for project team members who are responsible for the cost, schedule, and technical performance of project work scope.

GOAL

This two-day course will provide an understanding of how to control baseline changes, integrate risk management with EVM, and analyze performance indicators and flags that build upon the basic understanding of the Performance Measurement Baseline (PMB), cost and schedule variances and indices, and determining an Estimate at Completion (EAC).

LEARNING METHODS

Lectures, case studies, discussion, demonstrations, and exercises will present key concepts regarding the EVM process.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand how to control changes to the Performance Measurement Baseline
- Understand how to make risk-informed decisions about Management Reserve and Schedule Reserve usage
- Understand the role of quantitative cost and schedule risk analysis in developing risk-adjusted baselines
- Recognize and respond to warning signs from the contractor's EVM data
- Understand how common EVM analysis traps could compromise effective decision making
- Develop pertinent EVM metrics and reporting for senior management

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: BEVM07

BEYOND SCHEDULING BASICS: ANALYSIS, CONTROL, AND RESERVE PLANNING (APPEL-BSB)

AUDIENCE

This course is designed for project team members who are responsible for planning, controlling and analyzing cost, schedule and technical performance of an activity, project, or contract.

GOAL

This one-day course builds upon the foundational processes of activity definition, activity sequencing, activity duration estimating, schedule development, schedule status accounting and data maintenance, and schedule performance reporting by examining the more advanced topics of schedule analysis, schedule control (baseline revisions, replanning, and workaround planning), and schedule reserve planning.

LEARNING METHODS

Lectures and discussions are combined with case studies, demonstrations, and exercises to maximize the learning experience.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand ways to assess when a project is likely to finish
- Determine if the schedule is realistic
- Gauge the significance of past schedule performance and trends
- Evaluate the effect of changes on the baseline and current operating schedules
- Assess the adequacy of schedule reserve and slack
- Identify risk in the schedule
- Understand how to control the schedule (including methods to accelerate the schedule or get back on track if behind plan)
- Understand the differences between schedule baselines, re-baselines, revisions, replans, and work around plans

NOTES

This course is registered by the Project Management Institute (PMI) for 7 Professional Development Units (PDUs). PMI Course ID: BSB008

COMMUNICATING TECHNICAL ISSUES (APPEL-CTI)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel working on or leading project teams.

GOAL

This two-day workshop provides the foundation for communicating technical information to a varied audience and demonstrates effective methods and strategies for presenting technical issues.

LEARNING METHODS

This course provides hands-on experience in effectively communicating complex, technical information to different audiences, both those familiar with and those unfamiliar with the topic. Individual and small-group learning exercises will help you develop key communications competencies. In a laboratory setting, you will structure and conduct presentations/meetings with stakeholders and project team members and establish a set of effective e-mail practices to use within a project.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe a basic communications model and apply it to different settings where technical information is required
- Determine the information and communications needs of diverse groups (e.g., project stakeholders, team members, review teams)
- Design and deliver technical communications using different media (e.g., meetings, presentations, e-mail).
- Present (in oral and written form) complex, technical material that is carefully tailored to specific audiences and that facilitates understanding
- Solicit feedback and information as you present technical concepts and reports

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: CTI009

CONCEPT EXPLORATION AND SYSTEM ARCHITECTING (APPEL-CESA)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel.

GOAL

This four-and-a-half-day workshop introduces participants to the primary processes and tools for successfully performing up-front system engineering analysis. Participants learn how to define proper system scope, acceptance criteria, create context diagrams and develop use case scenarios, and synthesize a first level logical architecture for the system to help meet customer objectives, requirements and constraints. In addition, participants are introduced to the fundamentals of life-cycle cost analysis as well as risk management and other program issues.

LEARNING METHODS

The learning methods include the use of lectures, discussions, group exercises, and other activities, including actual system engineering problems of all types with emphasis on NASA missions and systems.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand the rational for and the value of systems engineering concepts and principles
- Define various systems engineering related terms and explain the systems engineering process
- Describe the system life cycle and various systems engineering life-cycle models, phase gates, reviews, standards
- Apply the systems engineering process and principles from the identification of a customer or other stakeholder need through a System Requirements Review (SRR)

NOTES

- Please note that this APPEL course is based on the Stevens Institute of Technology's "Fundamentals of Systems Engineering course (SYS 625)."
- This course is registered by the Project Management Institute (PMI) for 36 Professional Development Units (PDUs). PMI Course ID: CESA30

CONTINUOUS RISK MANAGEMENT (APPEL-CRM)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This three-day course covers planning and control of risk factors; the recognition and reporting of all risk components such as technical, cost, schedule, safety, ITAR, environmental, etc.; and application of methods and techniques to assess, mitigate, and balance risks at each level of the program/project.

LEARNING METHODS

This course design uses current NASA project examples being worked by the facilitators in addition to ongoing risks identified by class participants to provide hands-on experiences in management of program/project risks. Multi-media presentations, lectures, interactive discussions and small team workgroups will enhance your learning of risk management.

SPECIFIC OBJECTIVES

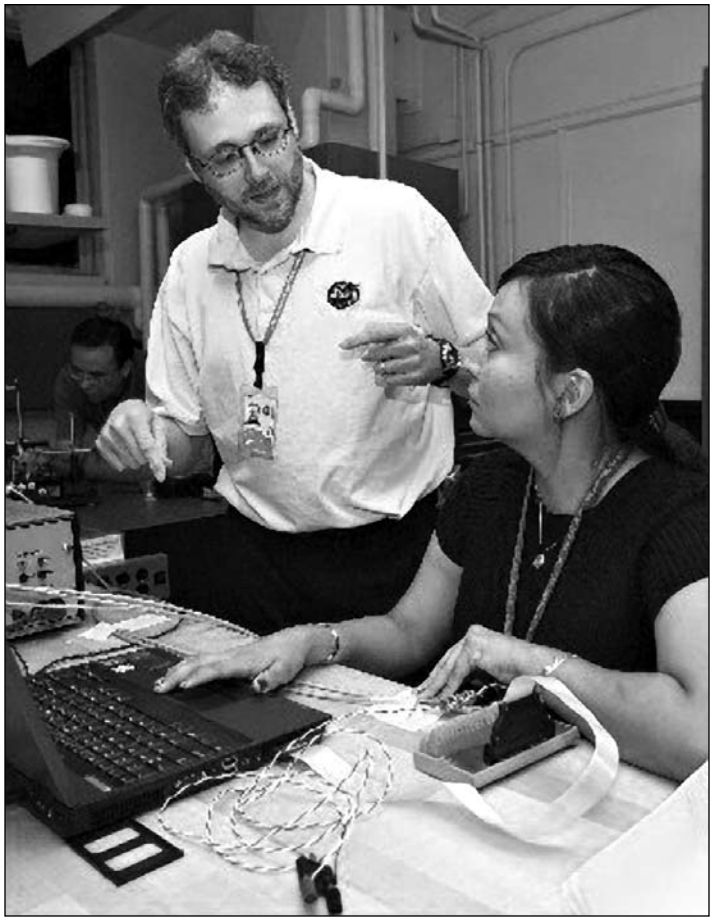
The course is designed to integrate two complementary processes in the form of risk management; risk-informed decision making (RIDM), and continuous risk management (CRM).

Upon completion of this course, participants will be able to:

- Establish and implement a risk management process, integrating discipline inputs and utilizing risk analysis methods and techniques to develop specific mitigation actions
- Evaluate program/project decisions and identify appropriate risk alternatives for each decision
- Establish an effective risk review process and establish appropriate membership along with roles and responsibilities of a program/project Risk Management Board
- Determine the impact of specific risks to project objectives and define documentation and reporting characteristics.
- Determine when specific qualitative and quantitative risk identification methods and techniques should be applied to program/project activities
- Define, document and describe the advantage, use, and application of database tools for the capture, tracking, and reporting of risks
- Systematically capture issues and develop them through the process from writing risk statements, classifying the impact against program/project risk attributes, determining the cost of the risk to the cost of the mitigation, and defining the return on investment from a prioritized list of proposed mitigation actions
- Develop and implement strategies to mitigate or eliminate risks and develop a contingency plan

NOTES

This course is registered by the Project Management Institute (PMI) for 23 Professional Development Units (PDUs). PMI Course ID: CRM010



DECISION ANALYSIS (APPEL-DA)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel involved in project teams or small projects.

GOAL

This two-day course is designed to provide the tools necessary to improve the quality of a factually based decision-making process for resolving technical issues at NASA.

LEARNING METHODS

Case studies, small group applications, and informed discussions with knowledgeable resources will serve as the basis for course activities.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify Decision Analysis relationship to NPR-7123.1A, NASA Systems Engineering Processes and Requirements, including role of SEMP
- Recognize factors contributing to successful and unsuccessful decision-making
- Apply a standard process for decision-making
- Identify which technical issues are subject to formal evaluation, and discern the differences between a well-framed problem and a poorly framed one
- Define the criteria used for evaluation, and identify alternative solutions to address decision issues
- Select evaluation methods and tools, and evaluate alternative solutions with respect to evaluation criteria
- Make a decision, document, and evaluate decision impact

DESIGN FOR MANUFACTURABILITY AND ASSEMBLY (APPEL-DMA)

AUDIENCE

This three-day course is designed for the NASA technical workforce (e.g., CogEs, PEMs, Designers) involved in the design, manufacture and assembly of hardware in support of NASA's major programs.

GOAL

This course provides key technological information on manufacturing processes that are of strategic interest to NASA. This knowledge is presented in a Design For X (DFX) format where X can be manufacturability, assembly, serviceability, or other technological needs. As in any DFX process students are shown the need for early involvement of key stakeholders in the design process.

This course brings together more than fifty years of manufacturing/academic expertise to provide the insight and direction to design mechanisms, devices, and structures that can be produced with the correct design objective.

LEARNING METHODS

Videos of pertinent manufacturing processes, case studies, in-class demonstrations, and exercises will supplement a standard lecture-based presentation.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Apply a concurrent engineering design process that includes Design for Manufacture early in the product realization process
- Select between several competing manufacturing processes
- Explain the science and physics of machining
- Describe Geometric, Dimensioning and Tolerancing (GDT) concepts and practices and how they can open the tolerance envelope for manufacturing
- Explain general manufacturability guidelines for machining operations
- Describe additional knowledge sources about the design for manufacture process
- Apply an intuitive understanding of how the manufacturing process works
- Explain typical tolerances, surface finishes, and process times that are easily achievable and those that are achievable only with significant extra effort
- Determine the major cost, schedule, and quality drivers
- Explain typical design rules and the reasons for them

DEVELOPING AND IMPLEMENTING A SYSTEMS ENGINEERING MANAGEMENT PLAN (APPEL-SEMP)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This three-day course introduces participants to the processes that support planning, development and execution of a Systems Engineering Management Plan (SEMP). Participants learn how to create a SEMP in compliance with NASA standards. In addition, they learn how technical planning complements the project planning to create the next-level guidance for a technical team. They learn how to schedule technical reviews, systems engineering activities, technology insertion, and detailed technical activities. They learn the importance of technical management in the execution of any project, and how to use technical leadership to keep a project on track.

LEARNING METHODS

Learning is accomplished through the use of lectures, discussions, group exercises, and other activities, including case studies involving the planning, development, monitoring and assessment of systems engineering activities using a SEMP with emphasis on NASA missions and systems.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe the importance of technical planning and technical management
- Describe how the technical plan coordinates with a project plan
- Document a technical plan in a NASA-compliant Systems Engineering Management Plan (SEMP)
- Explain the NASA established (SE NPR 7123.1A and 7120.5D) steps to create a technical plan
- Define the technical work necessary and sufficient to complete a project
- Describe the characteristics and elements of a good technical plan
- Describe the flow of systems engineering activities that guide a project
- Select appropriate technical reviews, metrics and measurements to assess project progress
- Explain how to use the SEMP to control scope during project execution

NOTES

This course is registered by the Project Management Institute (PMI) for 23 Professional Development Units (PDUs). PMI Course ID: SEMP11

EARNED VALUE MANAGEMENT OVERVIEW (APPEL-EVMO)

AUDIENCE

This course is designed for project team members who need a top-level understanding of Earned Value Management concepts.

GOAL

This six-hour course will provide a high-level understanding of Earned Value Management (EVM) concepts as well as how to analyze the EVM data.

LEARNING METHODS

Lectures, discussions, case studies, and group exercises will present key concepts regarding the EVM process.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand basic EVM concepts and terminology and how to interpret EVM reports and graphs
- Understand the governing requirements for EVM on NASA projects
- Recognize the various methods of assessing earned value
- Understand how to use performance indices and factors to calculate estimates of the final cost
- Understand how to apply basic EVM concepts to project work—even projects without an EVM requirement

NOTES

This course is registered by the Project Management Institute (PMI) for 7 Professional Development Units (PDUs). PMI Course ID: EVM012

EARTH, MOON, AND MARS (APPEL-EMM)

AUDIENCE

This course is designed for NASA engineers, scientists, and project personnel who are interested in understanding the systems and geological events that shape Earth and how to apply this analysis to understanding the moon, mars, and other planetary bodies.

GOAL

In an engaging hands-on three-day workshop, participants will learn about the remarkable discoveries of how these planetary bodies formed and the kinds of geologic processes that continue to operate on them today. Participants will also learn of the unique geologic challenges that the Moon and Mars pose to future exploration.

LEARNING METHODS

Interactive lectures, small-group applications, and informed discussions with knowledgeable resources will serve as the basis for course activities. The course will begin with a study of how the Earth "works"—how competing processes continue to battle over Earth's surface, weathering and eroding rock as fast tectonic processes can create it.

Participants will get an opportunity to examine the current ideas about the structure, dynamics and composition of the moon and Mars. The evidence comes from meteorites, satellite remote sensing, and previous NASA missions (manned and unmanned) to their surfaces. These lessons are directly applicable to identifying the signatures of ancient life that might still remain on Mars.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe the systems that continue to shape our planet and how they impact life on Earth (energy sources, water availability, climate change, and natural hazards)
- Explain the important influences that life exerts in changing Earth's surface as well as how these processes can apply to other planetary surfaces
- Debate hypotheses about the formation and history of Earth, moon, Mars, and other planetary bodies
- Identify the forces that continue to change Earth, moon, and Mars, as well as the geological conditions that human's will face as they continue to explore them
- Describe how planetary compositions may affect Lunar and Martian vehicles and landing gears

> *"I had no idea how much is known about the history and processes that have shaped the Earth. I have a much better understanding of how NASA missions have and can in the future contribute to this knowledge."*

EXPLORATION SYSTEMS AND SPACE OPERATIONS (APPEL-EXPO)

AUDIENCE

This course is designed for NASA's technical workforce, including engineers, systems engineers and project personnel involved in creating overall mission architectures, detailed design and the operation of systems.

GOAL

This three-day workshop focuses on creating a phased, conceptual design for complete Earth-orbiting, lunar, and Mars manned missions. It provides an overview of human space exploration including the vision for the future, objectives and strategies, as well as a view of upcoming technologies and missions.

LEARNING METHODS

An integrated example of a Lunar Base Mission to illustrate each of the design areas is used throughout the course. This example enables hands-on, practical experience in applying the information and tools provided. The course involves real-world design exercises aimed at helping you apply the techniques and guidelines presented once you return to work. All participants receive a complete set of course Notes and the authoritative text *Human Spaceflight* by Giffen and Pranke.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Interpret and convert space mission objectives, requirements, and constraints into visible and cost-effective operations concepts
- Develop and apply hazards and mitigation techniques
- Explain the physiology of space flight, human factors, and psychological aspects
- Describe a process-oriented approach for creating cost-effective space missions
- Describe the key functions that must be performed for mission operations
- Apply effective methodology for translating space mission objectives, requirements, and designs into viable and cost-effective operations concepts
- Explain the interrelationships and trade-offs between system design and mission operation

FUNDAMENTALS OF SYSTEMS ENGINEERING (APPEL-FSE)

AUDIENCE

This course is designed for junior to mid-career NASA systems engineers, functional engineers, project managers, integrated product team members, and business managers.

GOAL

This course introduces the methods and techniques for a structured systems development process that proceeds from requirements to concept to production to operation and is based upon NASA policy guidelines, specifically NPR 7123.1A and 7120.5D. The NASA practice of systems engineering is the glue that works across all engineering and project management disciplines to tie customer needs to the right solution. Systems engineering focuses on the interfaces between the people, processes, and products that are often outside the responsibility of any one function or discipline. This course equips your teams with the knowledge necessary to realize successful solutions.

LEARNING METHODS

Learning will be accomplished through lecture and class discussion. Attendees then practice the 'how-to' of the principles through case studies and illustrative examples. Practical exercises provide experience in the techniques and decisions required in a real world environment.

If the hands-on life cycle activity option is selected, the participants will develop and present appropriate artifacts and content based upon a real NASA case study. This activity will be conducted post-course with guidance from the instructor.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Explain the purpose of systems engineering
- Describe the SE process incorporating NASA policy guidelines (NPRs 7123.1A and 7120.5D)
- Summarize the process for system requirements development and management
- Describe the system definition process (concepts and architecting)
- Defend project decisions and trade-off analyses
- Conduct product and project risk analyses and mitigation based upon NASA policies and practices
- Incorporate reliability, availability, and supportability considerations into the design process
- Explain performance measurement needs
- Describe the system implementation process
- Explain verification and validation activities

NOTES

This course is registered by the Project Management Institute (PMI) for 40 Professional Development Units (PDUs). PMI Course ID: FSE031

INNOVATIVE DESIGN FOR ENGINEERING APPLICATIONS (APPEL-IDEA)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel involved in project teams or small projects.

GOAL

This three-day course will introduce participants to the framework of innovation and the design of creative solutions. The course seeks to stimulate and motivate participants to think "outside-the-box" when dealing with design problems. Integrated in-class projects will focus on hardware design, system performance and strategies for lateral ways of approaching technical challenges and solutions. Topics will include design models, design environment and design constraints.

LEARNING METHODS

Classroom exercises and embedded activities are driven by actual Constellation projects and other NASA case studies. For example, a case study on the design of the Orion capsule seat enables the visualization of multidisciplinary teamwork during the early stages of the design process. Hands-on class exercises, lectures, videos, discussions, brainstorming, and group exercises allow participants to apply techniques to specific design problems.

Essential Class Tour:

Specific hardware or mechanical systems familiarization tours have been built into this offering to highlight innovation or creative solutions to technical problems. The "Innovation Tours" will also afford participants the opportunity to engage some of the architects of these design solutions. The IDEAS course integrates practical NASA innovative solutions into APPEL's educational, training and development activities.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe common innovation practices inside and outside NASA
- Demonstrate different modes of thinking in creativity (e.g., physical versus visual problem solving)
- Identify sources for creativity themes such as referential, internal and customers
- Explain the hard and soft sides of innovation and how to create the right environment and atmosphere for creativity
- Demonstrate the methods of designing for the user, including human/bio design, ethnography, and issue identifications
- Describe effective prototyping techniques (fast fail safely to success)
- Explain general guidelines that serve as quick rules of thumb
- Identify tools that help improve reliability, reduce errors and cost, speed manufacturability and assembly (error proofing)
- Explain open innovation or networks and how they are at NASA
- Apply best practices obtained from other NASA designers (reference booklet based on past projects).

NOTES

This course is registered by the Project Management Institute (PMI) for 24 Professional Development Units (PDUs). PMI Course ID: IDEA32

INTEGRATING COST AND SCHEDULE (APPEL-ICS)

AUDIENCE

This course is designed for experienced project managers who are already subsystem leads or managers of small projects and who are preparing to perform as a project manager of a more complex project (multiple distinct subsystems, or other defined services, capabilities, or products) with associated interfaces.

GOAL

This two-day course is geared toward increasing project managers' proficiency in dealing with the cost and schedule aspects of project management.

LEARNING METHODS

Learning will take place through a series of lectures, discussions, exercises, case studies and demonstrations.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand the importance of cost and schedule management to mission success
- Identify the various schedule communication tools and their implications
- Plan and manage within the realities of current Federal budget environment
- Conduct Baseline and Reserve planning through Range estimates
- Explain techniques to effectively communicate cost and schedule
- Discuss how to integrate cost and schedule with Earned Value Management (EVM)
- Illustrate a schedule problem flight project teams might face and formulate possible workaround plans to solve it
- Develop strategies for effectively dealing with complex inter-organizational conflicts
- Develop skills for successful budget justification.
- Assess project performance based on limited cost, schedule and EVM of a project
- Gain insight into evaluating projected final cost of a project
- Communicate project performance status to senior management

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: ICS013

INTEGRATING EVM WITH ACQUISITION (APPEL-IEVMA)

AUDIENCE

This course is designed for project managers and contracting officers who use Earned Value Management (EVM) to monitor the cost, schedule, and technical performance of major contractors responsible for large development contracts.

GOAL

This half-day course provides a high-level understanding of Earned Value Management (EVM) concepts, and the effective integration of EVM with project management and acquisition.

LEARNING METHODS

Lectures, case studies, discussions, and group exercises.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand basic EVM concepts and terminology
- Recognize what mistakes to avoid that would hinder EVM effectiveness
- Understand how to incorporate EVM into acquisition strategy and contract administration.

INTERNATIONAL PROJECT MANAGEMENT (APPEL-IPM)

AUDIENCE

This course is designed for project managers, systems managers, systems engineers and program managers who work on international projects.

GOAL

This five-day course provides project practitioners with an understanding of cultural challenges, legal concerns, and teaming issues that are likely to be encountered working with international partners. The course addresses two distinct facets of successful international project management: technical knowledge and cultural understanding.

LEARNING METHODS

Course materials and discussions provide insights into the characteristics of international teaming that have the potential to make or break a project. The course format features lectures, small group discussion, hands-on practical exercises, and case studies. Instructors are successful NASA project managers from the international arena who discuss their experiences with participants, shedding light on multinational project traps and how to avoid them. Guest lecturers include content experts with international experience and, when available, relevant embassy personnel.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Apply experiential and theoretical knowledge of cultural awareness and leadership
- Manage or support a project that interacts with international partners
- Successfully manage projects involving international elements
- Practice advocacy, partnering, and the "softer" side of cross-cultural relations to be effective in the international arena
- Understand the cultural understanding necessary to manage or participate at any level of an international project team

NOTES

This course is registered by the Project Management Institute (PMI) for 40 Professional Development Units (PDUs). PMI Course ID: IPM014

> *"I learned the different cultural characteristics that should be considered in negotiations."*

INTRODUCTION TO AERONAUTICS (APPEL-I-AERO)

AUDIENCE

This course is designed for anyone interested in a big-picture overview of aeronautics. No technical background is necessary.

GOAL

This four-day course is all about aircraft – how they fly and why they look the way they do. Using design as a common thread, this course provides a solid understanding of the basics of aeronautical engineering, including low- and high-speed aerodynamics, stability and control, structures and materials, propulsion systems, and aircraft performance. Although the focus is clearly on conventional aircraft, discussion will include other air vehicles including airships, helicopters, stealth, hypersonic, unmanned, STOL, and micro-air vehicles. At the end of this course, you will be able to identify and understand the design features of a given aircraft and have a tremendous appreciation for the impact of modifying its design (for example, adding tip tanks).

LEARNING METHODS

Lectures, hands-on exercises, practical examples, and discussions are intertwined to support the lesson objectives. In addition, an off-site visit to a local aircraft museum or airport/aero club reinforces the classroom discussions.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Explain why standard atmosphere is important in the field of aeronautics
- Define lift and drag, explain how lift is generated, and identify the various components of drag
- Explain why an aircraft "stalls" at high angle of attack
- Describe how flow properties change across a shock wave and an expansion wave
- Describe design techniques used to minimize drag due to lift and wave drag
- Explain the significance of (L/D)max and locate (L/D)max on a drag versus velocity graph
- Identify high-lift devices and state their purpose
- Name the aircraft axes, the motion of each, and the conventional control surface(s) that produce each motion as well as describe the pilot's input
- Identify design and operational factors that contribute to achieving pitch stability
- Demonstrate an understanding of the structural considerations of a given aircraft
- Explain how thrust is generated and demonstrate an understanding of the trade-offs associated with aircraft/engine integration
- Identify and explain the impact of six factors (e.g., density altitude) on takeoff and landing performance.

LEADING COMPLEX PROJECTS (APPEL-LCP)

AUDIENCE

This course is designed for experienced project managers who are subsystem leads or managers of small projects and are preparing to perform as a project manager of a more complex project (multiple distinct subsystems, or other defined services, capabilities, or products) with associated interfaces.

GOAL

This three-day course provides participants with key project management concepts, tools, and techniques used to manage complex projects successfully. It also provides insights and tools to measure project complexity and adopt the best techniques for ensuring control of a project and all of its associated elements.

LEARNING METHODS

This course is a progressive, integrated case study that gives you hands-on experience in determining the true level of project complexity, governing the use of complexity to assist rather than hinder progress, and to lead the project team from a new perspective.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Clearly understand how to address variables involved in dealing with complex projects
- Master techniques for accurate work estimating and risk analysis in complex situations
- Develop a plan that provides the right level of control and flexibility for success in complex projects
- Integrate strategic planning techniques to meet NASA requirements for complex projects
- Develop techniques for coping with multiple stakeholders, complex approval situations and teams drawn from across the Agency's organizational boundaries

NOTES

This course is registered by the Project Management Institute (PMI) for 23 Professional Development Units (PDUs). PMI Course ID: LCP015

LIFE CYCLE, PROCESSES AND SYSTEMS ENGINEERING (APPEL-LPSE)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This three-day course introduces systems engineering processes, NASA life-cycle phases, key technical reviews, and systems engineering management techniques. The course helps you realize the value of well-established systems engineering processes and deliverables.

LEARNING METHODS

Lectures, discussions, exercises, and other activities including structured systems engineering processes and management undertakings enhance the learning experience.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Define and demonstrate engineering of systems processes as illustrated in the Systems Engineering NASA Procedural Requirements (NPR) 7123.1A and 7120.5D
- Describe how operations concepts are developed and their impact on the system of interest
- Define system architecture functions and analyze their functional performance
- Define system technical solution options and describe how trade studies are performed
- Map architecture functions to subsystems and define the relationships among the subsystems
- Describe internal and external interface definitions, designs, and changes for products and product components
- Explain the importance of establishing a technical planning process for a given system of interest
- Identify tools used for systems engineering activities

MANAGEMENT OF SPACE TECHNOLOGY PROGRAMS (APPEL-MSTP)

AUDIENCE

This course is designed for NASA project practitioners and systems engineers, technical professionals at the supervisory level, and project leaders.

GOAL

This three-day course examines the dynamics of organizational management at NASA. These dynamics entail political, organizational, and technical factors. The interrelationships among these factors influence program/project management processes and outcomes that determine whether implementation of complex space projects is met with success or failure. Course participants will gain a level of awareness regarding the factors that affect their work environment. From a political standpoint, the ways in which program/project leaders at NASA navigate among accountability practices is scrutinized. The relevant practices encompass: political factors, like cost and schedule; organizational factors, such as program/project standard operating procedures; and technical factors concerning the nature of how complex technology functions, e.g., interactive failure modes.

LEARNING METHODS

Learning will take place through critical analysis of case studies that demonstrate management dynamics relevant to NASA. This is accomplished by distilling from real-life cases the different issues that demonstrate both successes and failures at NASA. The period of time covered in the course spans the history of NASA from the Apollo era to the current Space Exploration Policy.

LEARNING OBJECTIVES

Upon completion of this course, participants will be able to:

- Demonstrate a level of organizational awareness as to how to navigate between the political, organizational, and technical factors that influence management of complex technical projects
- Explain how stakeholder expectations affect the development of space technological systems, namely the problem of optimization of those technical systems
- Describe how political, organizational, and technical factors influence the program/project life cycle
- Explain the organizational variables that impact the management of complex projects, which focuses on high-reliability and high-performance across project development and implementation
- Identify the strengths and weaknesses of operational methods—systems management practices, project management, and systems engineering—as applied to the management of risk, schedule, and cost
- Demonstrate how decision-making structures, involving centralization and decentralization, and organizational cultures impact the planning, organization, and implementation of complex projects, and the capabilities for dealing with complexity
- Describe how political, organizational, and technical accountability practices influence the management of complex projects
- Apply heuristics and strategic planning techniques to address elements of decision-making for complex projects

MARS MISSION AND SYSTEMS DESIGN LAB (APPEL-MMSD)

AUDIENCE

This course is designed for NASA's technical workforce, including engineers, systems engineers and project personnel involved in creating overall mission architectures, detailed design, and the operation of systems.

GOAL

This four-day lab is designed to provide real-life experience of conceptualizing and designing space missions to Mars or the moon. This lab provides an integrated view of space mission design and operations from conceptual design and requirements definition through spacecraft design, development, test, and launch to development of mission operations concepts and ground infrastructure capabilities.

LEARNING METHODS

A variety of learning methods are used including lecture, group discussion, exercises and videos. You will be introduced to various demonstrations using a CD for Satellite Tool Kit with a temporary full-use license. Hands-on exercises introduce you to the Space Mission Analysis and Design Software Tool, specifically tailored to Mars or the moon.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Exercise space systems engineering processes
- Enhance space systems engineering skills—systems engineering management, technical integrity, and technical leadership.
- Integrate all elements of a successful mission
- Establish a process to refine requirements and define parameters to meet mission objectives at acceptable costs and risk
- Use practical application of the information and processes in a non-threatening environment
- Promote system-level thinking

NASA'S BUDGETING PROCESS (APPEL-NBP)

AUDIENCE

This course is designed for project team members who need an introductory course in NASA budget development.

GOAL

This one-day course describes the steps involved in the U.S. government's budgeting process while providing a framework for understanding how NASA project budget requests fit into the Agency's overall budget. The course provides a survey of proper contingency and reserve planning to the budgeting process while reinforcing the importance of carefully tracking costs and obligations against the budget plan and reasons for variations.

LEARNING METHODS

Lectures, discussions, and group exercises will present key concepts regarding the budget process.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand the federal budget process
- Understand how project budget requests fit into the NASA budget picture
- Understand the team member's role in developing the Program Operating Plan (POP)
- Describe the processes for cost estimating
- Identify significant needs and issues in preparing budgets
- Understand the importance of tracking costs and obligations against the budget plan and the reasons for the variances

NOTES

This course is registered by the Project Management Institute (PMI) for 7 Professional Development Units (PDUs). PMI Course ID: NBP016

NEGOTIATIONS (APPEL-NG)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This two-day workshop identifies and develops the negotiating and bargaining skills necessary to successfully execute a win-win negotiation. Thorough instruction is provided on how to develop negotiating skills that promote effective leadership.

LEARNING METHODS

This highly interactive workshop uses a variety of instructional methods. Methods include tailored case studies, interactive facilitation, Q&A sessions, and other nontraditional techniques. You will participate in increasingly demanding negotiations and use impact and influence skills to persuade others to agree in both one-on-one and team exercises.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Achieve creative, mutually satisfactory "win-win" solutions
- Analyze available negotiating tactics and select strategies that can move the situation to your advantage
- Establish and maintain a positive negotiating climate and effectively handle emotional situations
- Overcome impasses by structuring creative options.
- Set desired outcomes, goals, bottom line targets, and alternative outcomes and options
- Understand the difference between positions, interests, and fears
- Overcome your natural reluctance to negotiate and reduce your stress levels in the negotiation process
- Use creativity and value-based negotiating to help achieve successful closure
- Understand how to manage ego and trust issues
- Effectively manage team/staff negotiating situations

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: NEG018

PASSING THE PROJECT MANAGEMENT PROFESSIONAL EXAM (APPEL-PMP)

AUDIENCE

This course is designed for individuals seeking the Project Management Professional certification.

GOAL

This 3.5-day course will acquaint the student with the 44 PMI processes, their inputs, tools, techniques and outputs that comprise approximately 80% of the exam. It will also give the student the opportunity to become acquainted with the significant amount of material on Professional Responsibility and Human Resources that are not covered in the PMBOK.

LEARNING METHODS

The large amount of material to be absorbed requires that the material be presented in a variety of ways. In addition to conventional lecture, the students will act in skits, participate in games, see videos and hear silly but effective jingles, poems, etc. They will take notes using color-coded pens that will match a large colored chart they receive. Whatever the student's preferred learning style, the presentation that will meet their needs.

QUALIFICATIONS FOR THIS COURSE

Interested students are encouraged to contact the instructor (Chris Bart) in advance to determine if they qualify to register for and attend this course.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be eligible to:

- Be guided personally through the application process for the Project Management Institute's PMP examination
- Be counseled in advance to ensure that they are qualified to sit for the 200-question, four-hour PMP exam

PERFORMANCE-BASED STATEMENT OF WORK (APPEL-PBSOW)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This two-day course will show you how to write an effective Performance-Based Statement of Work (PBSOW). You will understand what is meant by performance-based contracting and discover the advantages of this contract methodology.

LEARNING METHODS

Learning is accomplished through instructor-lead sessions using slides and flip charts. Students follow along using a detailed course package that is provided as part of the seminar. Students are encouraged to provide examples and "war stories" from their experiences.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Define and describe performance-based contracts.
- Describe the advantages of PBSOW as opposed to a level-of-effort (LOE) statement of work
- Identify the characteristics of both good and bad performance-based contracts
- Analyze a given situation to establish the necessary requirements
- Write SOW requirements that are clear and measurable
- Demonstrate how to give contractors flexibility and authority while still holding them responsible

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: S20008

PROJECT MANAGEMENT LEADERSHIP LAB (APPEL-PM-LAB)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This four and a half-day course is an intensive experience aimed at building capabilities for managerial effectiveness to achieve project team objectives and to synthesize the project management practices you have learned through practice and study. This laboratory provides a unique opportunity to identify, understand, and practice effective leadership behaviors in a project team setting.

LEARNING METHODS

The Project Leadership Lab is a highly interactive experiential program design. Developed from more than thirty years of applied research and continuous user input and innovation, the program is anchored by a complex computer simulation exploring a project launch— employing multiple decision tree scenarios which activate dynamic variations and realistic outcomes. As part of a small team, you are responsible for implementing a computer simulated project. You and your team collectively confront and resolve an array of problems associated with tasks, vendors, consultants, time, quality, customer interactions, and staff with varying personalities, skills and experience.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Lead in ambiguous, complex environments
- Develop adaptive leadership skills: recognizing when to focus on technical versus adaptive problems
- Develop defensible, flexible plans.
- Employ effective leadership techniques and improve interpersonal effectiveness.
- Manage risks
- Identify complex project trade-off decisions.
- Lead and improve project team performance.

> *The project simulation exercise was the most helpful tool because it allowed you to exercise countermeasures and provided instant feedback.*

NOTES

This course is registered by the Project Management Institute (PMI) for 31 Professional Development Units (PDUs). PMI Course ID: PMLAB19

PROJECT PLANNING, ANALYSIS AND CONTROL (APPEL-PPAC)

AUDIENCE

This course is designed for NASA's new engineers/ fresh-outs.

GOAL

This five-day course offers a foundation in program planning, analysis, and control and provides intensive instruction in project management fundamentals across the entire project life cycle. Course content covers the areas of technical integration of project elements, design and discipline functions, and their associated interactions to balance performance, cost, schedule, reliability, and operability. Proven strategies and practical tools for planning, executing, and controlling a variety of projects are presented.

LEARNING METHODS

Individual and small-group learning exercises will help you develop these skills. You'll master key theories, concepts and practices and put this knowledge to work in the classroom through a comprehensive case study and other practical learning activities.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Define a project, its objectives, and measurement criteria for success
- Estimate project schedules, costs, and resources using a variety of proven methods such as Earned Value Management
- Build a work breakdown structure of project tasks
- Develop a network diagram and calculate the project schedule using PERT/CPM
- Describe project risk identification, risk assessment, and risk mitigation strategies
- Close out a project in a systematic, comprehensive manner

NOTES

This course is registered by the Project Management Institute (PMI) for 33.5 Professional Development Units (PDUs). PMI Course ID: FOU150

PROJECT REVIEW PROCESSES AND STRATEGIES (APPEL-PRPS)

AUDIENCE

This course is designed for experienced project and program managers, subsystem leads, other project team members and for review board members, including Standing Review Board (SRB) participants.

GOAL

This learning activity is intended to demonstrate the planning process, content and techniques necessary to conduct a credible project review or to serve as an effective review board member. It provides exposure to NASA standards, success criteria, lessons learned, tools and experiences for overall project review activities. This course is conducted in two parts: a one-day classroom lecture and exercise activity followed by coached participation in an actual NASA program or project review that may require up to four days' activity.

LEARNING METHODS

This course provides a hands-on program or project review experience under the guidance of a project review coach. Lectures, small group exercises, and interaction with current project teams and review panels amplify the key aspects of the learning activity. Participants will serve as a "shadow review team at an actual NASA review, ask question, write Requests for Action (RFAs) and prepare and present an outbrief to program and/or project leaders, and compare their findings and recommendations with those of the formal review board.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Aid or lead the planning, preparation and presentation of a formal NASA review
- Serve as an effective chair person or member of an SRB or other review board
- Prepare and present appropriate findings and recommendations to the program and/or project leaders following a review
- Develop a list of lessons learned related to project review activity

NOTES

This course is registered by the Project Management Institute (PMI) for 32 Professional Development Units (PDUs). PMI Course ID: PRPS21

REQUIREMENTS DEVELOPMENT AND MANAGEMENT (APPEL-REQ)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This three-day course provides a firm foundation for the development and management of your project's product requirements. This course presents the student with requirement best practices that, when incorporated into your requirement development and management process, will help your project team develop a winning product—one that delivers what is needed, when it is needed, within the projected costs and with the expected quality.

LEARNING METHODS

Lectures, discussion, and individual and small-group learning exercises help you learn how to develop and manage product scope and requirements. Writing exercises and peer reviews reinforce and expand learning.

> *"I gained a better understanding of the different stages of writing good requirements."*

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify the benefits of defining scope at the beginning of your product development process
- Identify and describe the importance of drivers and constraints
- Develop and describe the importance of operational concepts
- Demonstrate the importance of validating and baselining product scope
- Identify the characteristics of good and well-written requirements
- Explain the levels of requirements, how requirements are linked, and the iterative nature of requirement decomposition
- Explain the importance of allocation and how to allocate requirements
- Identify types of requirements that must be defined and write good requirements
- Describe the processes, activities, and tools that are used to manage requirements throughout the product life cycle
- Describe management's role in requirements management activities
- Explain how and why a requirement development and management process needs to be defined and followed

NOTES

This course is registered by the Project Management Institute (PMI) for 21 Professional Development Units (PDUs). PMI Course ID: S30012

REQUIREMENTS DEVELOPMENT AND MANAGEMENT—TEAM (APPEL-REQ-T)

AUDIENCE

This course is designed to meet the needs of intact project teams including project managers, systems engineers, users, customers, developers, testers and other relevant stakeholders. Anyone involved in the development or review or management of project scope and system/product requirements for a project will benefit from this training. The seminar is applicable to projects large and small as well as hardware and software projects of all sizes.

GOAL

This three-day course provides your project team just-in-time-training for the development and management of your project's product scope and requirements. During this course, the project's existing scope and requirements documentation are reviewed and used to allow participants to determine which areas need improvement and further work. The resulting effort is improved project scope, requirements, action items and better communication between team members. This course will help your project team apply requirement engineering best practices which are needed to develop a winning product—one that delivers what is needed, when it is needed, within the projected costs and with the expected quality.

LEARNING METHODS

Lectures, discussion, and individual and small-group learning exercises will help your project team learn how to develop and manage your project's product scope and requirements. Exercises are included based on the project's existing requirements allowing attendees to improve their project's requirements as part of the seminar.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Define your project's product need, goals, and objectives
- Identify drivers and constraints
- Develop and document operational concepts
- Identify and define your products external interfaces
- Demonstrate the importance of validating and baselining product scope
- Identify the characteristics of good and well-written requirements
- Write requirements at the correct level and to link requirements
- Correctly allocate requirements
- Identify types of requirements that must be defined
- Apply continuous and discrete requirement validation activities to remove requirement defects

RISK MANAGEMENT (APPEL-RM)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This one-day course enhances knowledge of NASA's approach to managing risk and demonstrates the impact risks have on meeting program and project objectives. It provides practical knowledge on how to identify risks before problems arise and develops the relationship between decisions and risk. The course also includes discussions on how to develop risk statements and describes potential mitigation options.

LEARNING METHODS

Multi-media presentations, lectures, interactive discussions, use of current program/project examples, and case studies will enhance your learning of risk management.

SPECIFIC OBJECTIVES

The course is designed to integrate two complementary process in the form of risk management; risk-informed decision making (RIDM) and continuous risk management (CRM).

Upon completion of this course, participants will be able to:

- Define NASA's risk management process
- Apply the NASA paradigm to rank and prioritize risks
- Define where risks come from and the issues and concerns that lead to risks
- Understand the relationships between project decisions and project risks
- Explain individual roles and responsibilities for identification and management of risks
- Use various tools and techniques for identifying, documenting, and communicating risks
- Discuss the relationship between risk magnitude and individual perspective on the organization
- Explain trending and tracking approaches and the use of metrics
- Develop skills/competencies in how to utilize the NASA Risk Management Process
- Write acceptable statements of risks
- Implement mitigation plans

NOTES

This course is registered by the Project Management Institute (PMI) for 7 Professional Development Units (PDUs). PMI Course ID: RM022

SCHEDULING AND COST CONTROL (APPEL-SCC)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This four-day course focuses on managing project constraints including limits on time, human resources, materials, budget, and specifications. It also helps participants to develop effective measures for scheduling and controlling projects as they put the tools of project management to work.

LEARNING METHODS

You will get hands-on experiences practicing your skills in building project requirements and the work breakdown structure. Individual and small-group exercises feature scenarios that hone your competencies/skills, and a comprehensive tool kit provides practical field guidance.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify documentation needed to provide inputs to scheduling and cost control activities
- Use the work breakdown structure to develop a network diagram
- Calculate schedules using PERT/CPM
- Identify, assign, and tabulate resource requirements
- Predict costs and work time using specific levels and estimate types

- Plan for contingencies and anticipate variations
- Predict future project performance based on historical data
- Monitor changes and close out projects on time

NOTES

This course is registered by the Project Management Institute (PMI) for 31 Professional Development Units (PDUs). PMI Course ID: SCC023

SCIENCE MISSION SYSTEMS DESIGN AND OPERATIONS (APPEL-SMSDO)

AUDIENCE

This course is designed for NASA's technical workforce, including engineers, systems engineers and project personnel involved in creating overall mission architectures, detailed design and the operation of systems.

GOAL

This three-day course provides an integrated view of space science mission design and operations from conceptual design and requirements definition, through spacecraft design, development, and test, to development of mission operations concepts and ground infrastructure capabilities.

LEARNING METHODS

Learning will be enhanced through lectures, group discussions, videos, demonstrations and multiple team activities applying previous material to a NASA mission.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Define the components and systems of a robotic space mission
- Describe an integrated view of space science mission design and operations
- Describe the interrelationships between systems design and mission operations
- Describe a process-oriented approach for creating cost-effective space missions
- Apply effective methodologies for translating space mission objectives, requirements, and designs into viable and economical operations concepts
- Demonstrate practical, detailed ideas and tools to analyze and design space segment support for unmanned missions, including architecture and configuration, payloads, and vehicle subsystems

SCIENCE MISSION SYSTEMS DESIGN AND OPERATIONS LAB (APPEL-SMSDO LAB)

AUDIENCE

This course is designed for NASA's technical workforce, including engineers, systems engineers and project personnel involved in creating overall mission architectures, detailed design and the operation of systems.

GOAL

This four-day lab is designed to provide real-life experience for conceptualizing and designing space missions. The lab provides an integrated view of space mission design and operations, from conceptual design and requirements definition through spacecraft design, development, test and launch, to mission operations concepts and ground infrastructure design.

LEARNING METHODS

You will be given a bona fide, real-life mission objective and divided into competing groups or teams to conceptually design a mission to meet the objectives at an acceptable life-cycle cost. Other learning methods include lectures, group discussions, demonstrations, and videos. All participants receive a complete set of course Notes, the authoritative text *Space Mission Analysis and Design* by Larson and Wertz, and an integrated software tool for performing detailed space mission design.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe and apply an integrated approach to space mission design and operations
- Develop mission concepts and supporting architectures to meet specific mission objectives
- Develop effective techniques for providing customers and stakeholders with space mission concepts and architecture in the most cost-effective manner possible
- Apply an effective methodology for translating space mission objectives, requirements, and designs into viable and cost-effective operations concepts

SEVEN AXIOMS OF GOOD ENGINEERING (APPEL-SAGE) A CASE STUDY COURSE: LEARNING FROM FAILURE

AUDIENCE

This course is designed for NASA engineers and project personnel who are interested in understanding the role of case studies and engineering failures in critical thinking, the design process, and how to avoid classical design errors, among others.

GOAL

The purpose of SAGE is to promote good engineering design and project management decision making via the study and discussion of case studies. Such discussions will promote critical thinking and will improve decision making among NASA engineers, technologists, program managers, and scientists.

LEARNING METHODS

The course is primarily taught using a case study format. Participants are given the opportunity to create their own design corollaries and case studies based on their own experiences and present their cases in light of the engineering axioms learned.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Demonstrate the value of case studies in critical thinking
- Identify and explain the seven classical types of design errors and how to avoid them
- Explain the importance of non-analytical aspects involved in the design process
- Integrate design data into design knowledge
- Extract key decision-making aspects associated with the engineering process from case studies
- Explain how to incorporate lessons learned into everyday design processes

CASE STUDIES USED IN SAGE

- GE Rotary Compressor Failure
- Space Shuttle *Columbia* RCC Strike
- Assessment of PowerPoint as a Communication Tool in the Engineering Design Process

- Apollo LOX Tank
- Pioneer 10 Spacecraft
- Recurring Mistakes in Suspension Bridge Design
- Hubble Space Telescope Primary Mirror
- Navy Mark 14 Magnetic Imploder Malfunction
- Kansas City Hyatt Regency Walkway Collapse
- Ocean Ranger Sinking
- Three-Mile Island Partial Meltdown

NOTES

This course is registered by the Project Management Institute (PMI) for 24 Professional Development Units (PDUs). PMI Course ID: SAGE33

SOFTWARE ENGINEERING MANAGEMENT 301 (APPEL-SWE-301)

AUDIENCE

This course is designed for novice and intermediate-level software project managers. Those involved in or supporting project management will improve their understanding of project management activities.

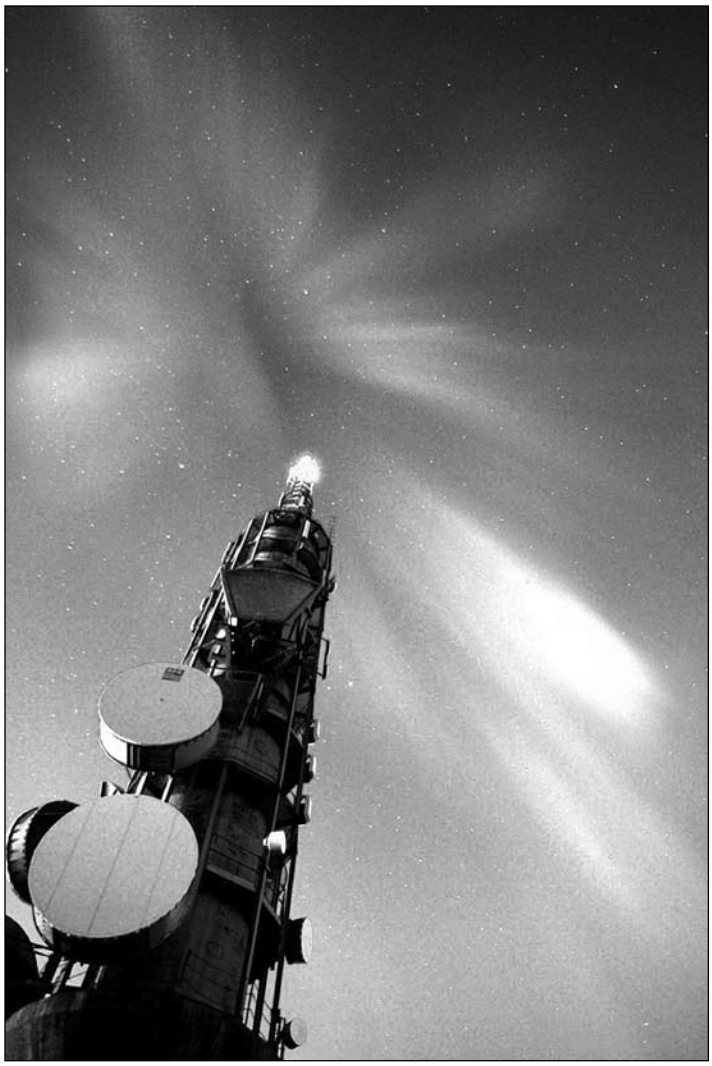
GOAL

This course will introduce participants to software engineering management techniques, including project monitoring, control, and measurement. Participants will also learn strategies for products and services acquisition as well as how to manage stakeholder relationships.

LEARNING METHODS

The course is an intensive 5.5-day, residential class beginning at 5:00 p.m. on Sunday afternoon. It includes classroom lectures and group workshops that allow the application of skills learned. Several workshops include evening work. All class sessions and workshops are mandatory and participants are expected to attend all sessions to receive credit for participation.

Learning is accomplished through lecture, class discussion, and participation in workshops that include role playing. The class participants will be divided into four project teams that will plan a project and respond to feedback and changes that occur over various phases of the project life cycle. Each participant will serve as project manager for the team in at least one of the workshops. All team members will practice the



management skills during each workshop and interact with senior management and customer representatives.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Plan a software project
- Apply progress monitoring and controlling techniques, including the concepts of earned value
- Explain how to find NASA polices, standards, and directives
- Explain the requirements documented in NPR 7150.2
- Develop a software build strategy based on project management considerations
- Manage stakeholder relationships and apply negotiation techniques
- Respond effectively to customer changes during the software development life cycle

SPACE LAUNCH AND TRANSPORTATION SYSTEMS (APPEL-SLTS)

AUDIENCE

This course is designed for NASA's technical workforce, including engineers, systems engineers and project personnel involved in creating overall mission architectures, detailed design and the operation of systems.

GOAL

This three-day course is intended to provide practical, detailed approaches and tools to analyze and design manned and unmanned and reusable and expendable launch vehicles for Earth and other planets. This includes architecture and configuration, payloads and vehicle subsystems.

LEARNING METHODS

Lecture, discussion, group exercises, videos, and physical examples will increase your understanding of space launch and transportation systems.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify practical tools and processes for the analysis and design of manned and unmanned, reusable and expendable vehicles for Earth and other planets
- Describe a process-oriented approach for creating cost-effective space launch and transportation systems to meet broad, often poorly defined requirements
- Apply effective methodologies for translating SLTS objectives, requirements, and designs into viable and economical operations concepts
- Explain the components of space launch and transportation systems design and operations
- Define the parameters for evaluating the life-cycle cost of space launch and transportation systems
- Identify technical risks and mitigate them in the most cost-effective manner while maintaining the technical integrity of the vehicle(s) and infrastructure
- Describe launch operations functions that must be performed
- Describe the interrelationships and trade-offs between system design and mission operations

SPACE SYSTEM DEVELOPMENT: LESSONS LEARNED (APPEL-SSD)

AUDIENCE

Engineering staff, technical managers, and program/project managers engaged in developing aerospace and similar high-tech systems and those responsible for the oversight of these activities.

GOAL

This two-day lessons-learned course examines the root causes of aerospace mishaps and the lessons that can be derived from those historical incidents. Majority of space mishaps can be traced to easily recognized, preventable root causes. Implementing specific strategies and project principles is the best means of prevention. This message is highlighted throughout the course.

> *"After taking this course, I will be better able to take a step back and objectively view the mission for potential issues."*

LEARNING METHODS

Learning will take place through critical analysis of actual events. This course is facilitated by two experienced former NASA employees with space system development experience as well as firsthand analysis experience of more than thirty-five NASA mishaps and near-misses.

There will be a detailed look at the *Challenger* accident and the Normalization of Deviance" concept presented in Dianne Vaughan's book, *The* Challenger *Launch Decision—Risky Technology, Culture, and Deviance at NASA*. Ms. Vaughan demonstrates how a series of discrete decision points—at which system behaviors deviating from established norms were rationalized and accepted—led to the Challenger disaster. Many archival photographs and videos are included in the presentation.

SPECIFIC OBJECTIVES

Upon completion of this course, participants should be able to:

- Demonstrate how normalization of deviance can affect decision points
- Identify systems-specific lessons from selected historical cases treated
- Translate extracted lessons into concrete strategies for eliminating root causes of problems

SPACE SYSTEM VERIFICATION AND VALIDATION (APPEL-SSVV)

AUDIENCE

This course is designed for NASA's technical workforce, including engineers, systems engineers and project personnel involved in creating overall mission architectures, detailed design and the operation of systems.

GOAL

This three-day course demonstrates the processes, information, and tools necessary to implement a credible verification, integration and test program. It provides exposure to NASA and Department of Defense (DoD) standards, lessons learned, tools, and experiences in validation and verification.

LEARNING METHODS

This course provides a hands-on system validation and verification learning laboratory. Lectures, small group exercises, and videos will also enhance your learning experience. Participants plan test campaigns, execute tests, integrate subsystems and conduct test reviews using a unique desktop satellite called Eyasat.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Explain the end-to-end SE process and how it applies to system (and lower level) requirements definition, allocation, validation, and verification
- Describe the purpose and scope of key documents required in the validation and verification processes, and describe typical errors committed
- Describe various methods of verification, determine when they are appropriate, and how they are used as part of a verification plan
- Determine appropriate circumstances and applicability of verification methods to prototype and protoflight systems
- Describe capabilities of various automated requirements tracking tools (e.g., CORE and DOORS) and their applicability to the validation and verification process
- Develop, evaluate, and implement a master verification plan for a space system including hardware, software and associated ground support equipment (GSE)
- Apply processes and techniques in a hands-on workshop associated with a system of interest
- Highlight applicable NASA, ECCS, DoD, and Industry Standards and lessons learned to support system verification decisions and activities

TEAM LEADERSHIP (APPEL-TL)

AUDIENCE

This course is designed for NASA's technical and administrative workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This three-day workshop is aimed at building your capabilities for managing and facilitating team processes necessary to achieve successful team performance. Concepts, processes, and practices for developing and managing superior teams are shared and opportunities to practice and sharpen team leadership skills/competencies are part of the course content.

LEARNING METHODS

This workshop provides a venue for learning new concepts and for sharing your successful and unsuccessful strategies for leading teams. Role-playing, and small group activities reinforce learning. Lecture and both small and large group discussions allow you to share your own experiences and benefit from the experiences of others.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Distinguish between leadership and management functions within project teams
- Adjust leadership style to meet the demands and requirements of different situations and groups
- Define and implement open and integrated communication approaches within and between teams to improve the interaction of the team members, increase buy-in, and enhance performance.
- Build a cohesive team and establish common standards for performance and quality
- Motivate team members to pull together to accomplish goals
- Systematically solve problems and resolve conflicts within the team
- Ensure that agreed-upon plans are implemented
- Capture and apply lessons learned and best practices

NOTES

This course is registered by the Project Management Institute (PMI) for 19 Professional Development Units (PDUs). PMI Course ID: TL0024

TEAM MEMBERSHIP (APPEL-TM)

AUDIENCE

This course is designed for NASA's new engineers/ fresh-outs.

GOAL

This two-day workshop provides information on team dynamics, processes, roles/responsibilities, and other practical information for working effectively within a team environment. You will learn the strategies of how to be an effective member of a team and have opportunities to put these strategies into practice.

LEARNING METHODS

This course combines lectures and discussions to present the key concepts and proven practices that increase team collaboration. Individual and small-group learning exercises are used. Additionally, you will put this knowledge to work by participating in role-playing activities and other practical and stimulating learning experiences.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Recognize the importance of teamwork and participating in team activities at NASA
- Define and describe different roles and responsibilities of team members on a project team and how they impact team performance
- Identify and practice the characteristics of a superior NASA project team
- Use an understanding of group dynamics to be an effective NASA team member
- Apply team processes including collaborative decision-making, problem-solving methods, and conflict resolution approaches within or among teams
- Appreciate being open to diverse viewpoints to achieve team success

TECHNICAL WRITING FOR ENGINEERS (APPEL-TW)

AUDIENCE

This course is designed for NASA's new and experienced engineers.

GOAL

This one-day workshop provides intensive instruction in technical writing to assist you in improving your technical communication skills, allowing you to effectively communicate technical/project information to different audiences.

LEARNING METHODS

Lectures and discussions will present key theories, concepts, and proven practices related to technical writing. You will participate in individual and small-group learning exercises to help develop your skills and competencies. Additionally, you will put this knowledge to work by writing technical/project reports such as technical assessments, technical evaluations, and work-in-progress status reports.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Identify and explain the purpose of different types of technical reports
- Determine specific components and formats of technical reports
- Analyze the audience
- Organize and structure a technical report
- Write effective headings, factual information/detail, and technical content
- Create clear figures/tables
- Avoid the common pitfalls of writing technical reports

TRANSITION, PRODUCT DELIVERY AND MISSION OPERATIONS (APPEL-TPDMO)

AUDIENCE

This course is designed for NASA's technical workforce, including systems engineers and project personnel developing the competencies required to succeed as a leader of a project team, functional team, or small project.

GOAL

This four-day course is intended to demonstrate the processes, procedures, and strategies necessary to implement effective product development, transition, delivery, and operations.

LEARNING METHODS

Learning will be through lectures, discussions, group exercises and activities such as actual product development, transition, and discussion of operations problems of all types (with emphasis on NASA missions systems).

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Describe the enabling processes for product development or acquisition
- Describe the various activities/strategies that support effective product implementation
- Describe how enabling product readiness is evaluated
- Identify the importance of validating lower level procured products and preparing the environment for integration
- Develop a plan for product integration
- Identify the "active ingredients" of product integration documentation
- Describe product verification and validation processes and how the outcomes are analyzed and reported, including all the support documentation
- Identify the various documentation that supports product transition
- Identify product transition processes, procedures, and enabling product needs
- Explain the importance of operations planning and execution
- Identify the processes for product operations

UNDERSTANDING EARNED VALUE MANAGEMENT (APPEL-UEVM)

AUDIENCE

This course is designed for project team members who are responsible for planning, controlling, and analyzing cost, schedule and technical performance of an activity, project, or contract.

GOAL

This two-day course will provide an understanding of how to get up and running with Earned Value Management (EVM) by establishing the Performance Measurement Baseline (PMB), assessing earned value, analyzing cost and schedule variances, and determining an Estimate at Completion (EAC) of the project's or contract's final cost and schedule.

LEARNING METHODS

Lectures, discussions, case studies, demonstrations, and group exercises will present key concepts regarding the EVM process.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand basic EVM concepts and terminology and how to develop an EVM baseline
- Use EVM data to forecast the project's or contract's final cost at completion
- Develop Work Packages using generally accepted earned value methods for discrete effort, apportioned effort, and level of effort
- Measure earned value at the work package level
- Understand the principles involved in establishing a PMB to include the role of WBS in defining scope; value of developing a responsibility assignment matrix; importance of the integrated master schedule; and the significance of tying the budget to the schedule with the WBS
- Recognize the significance of variances from the baseline

NOTES

This course is registered by the Project Management Institute (PMI) for 15 Professional Development Units (PDUs). PMI Course ID: UEVM25

UNDERSTANDING PROJECT SCHEDULING (APPEL-UPS)

AUDIENCE

This course is designed for project team members who are responsible for planning, controlling and analyzing cost, schedule and technical performance of an activity, project, or contract.

GOAL

This one-day provides a foundation in how to develop, update and maintain a project schedule and includes an overview of the key steps involved including: activity definition, activity sequencing, activity duration estimating, schedule development, schedule status accounting and data maintenance, and schedule performance reporting.

LEARNING METHODS

Lectures and discussions are combined with case studies, demonstrations, and exercises to maximize the learning experience.

SPECIFIC OBJECTIVES

Upon completion of this course, participants will be able to:

- Understand the purpose and benefits of the project schedule
- Understand basic scheduling concepts and terminology
- Understand how to identify activities, define project logic, estimate activity duration, and calculate "early" and "late" start and finish dates for the project's activities to establish the schedule baseline
- Understand the significance of the critical path, total slack and schedule reserve
- Recognize various schedule reports and formats

NOTES

This course is registered by the Project Management Institute (PMI) for 7 Professional Development Units (PDUs). PMI Course ID: UPS26

HOW TO REGISTER FOR APPEL-SPONSORED PROGRAMS

Please complete your self-registration for the Academy of Program/Project and Engineering Leadership (APPEL) courses through the SATERN online approval process. The implementation of an agencywide standard process through one system for all APPEL courses helps to improve consistency and efficiency in training operations and administration. The self-registration process in SATERN replaces other nomination forms previously available for APPEL. All employees requesting APPEL courses need to log in to SATERN to start the self-registration process.

Please note that an estimate of travel and per diem expenses must be provided by the learner when registering for APPEL courses. Travel and per diem information is required for reporting to the Office of Personnel Management and it should be included in the comments section for review. If this information is not included, the request will be denied and the employee will be required to re-register.

HOW TO REGISTER

To view a step-by-step guide on how to register for APPEL and LMD courses, please visit the SATERN informational Web site at https://saterninfo.nasa.gov/guides_aids.html.

To access SATERN, please go to: https://nasastg.gpehosting.com/elms/learner/login.jsp.

If you need further information on a course or regarding registration, please contact your center's APPEL Training Point of Contact. For a complete list of APPEL Center POCs and their contact information, please go to http://www.nasa.gov/offices/oce/appel/curriculum/532.html

DEVELOPING COMPETENCIES FOR SUCCESS

PROJECT MANAGEMENT AND SYSTEMS ENGINEERING COMPETENCY FRAMEWORK

The APPEL developmental framework is based on a rigorous set of competencies that practitioners should have in order to perform their jobs. These competencies were derived from many sources, including extensive interviews with several hundred highly successful project managers and systems engineers at NASA. The resulting competencies were vetted with both internal and external organizations to ensure completeness and accuracy. Since the competencies form the foundation of the development program, they are under configuration control and are reviewed and updated as appropriate. The latest update was done in June 2009.

A key step for NASA's technical practitioners is to understand the requirements of their roles and the related competencies. APPEL seeks to help practitioners refine their competencies in order to reach the highest level of performance. The diagram below contains a list of the required competencies for both project management and systems engineering professionals at NASA. As shown below, the framework consists of five project management competency areas, three systems engineering competency areas, and five competency areas common to both the project management and systems engineering communities.

The competency areas describe, in broad terms, what is expected of project management and systems engineering personnel in terms of particular components or functions of the job. There are underlying competencies within each major competency area that provide examples of the knowledge, skills, and behaviors that PMs and SEs are expected to possess and/or perform at different levels of job responsibilities. Performance-level descriptions for each competency can be found on the APPEL Web site at http://www.nasa.gov/offices/oce/appel/pm-development/pm_se_competencies.html.

To further support individuals as they work to identify their appropriate development activities, APPEL provides a Course Competency Matrix, beginning on the next page. This tool can be used as a guide in the selection of courses based on competency development and individual learning needs. In addition to competencies, the matrix includes other course elements that may be of interest to individuals considering a particular course. The table represents a snapshot of all APPEL courses, including the course duration, audience, and goal for each course.

APPEL COURSE COMPETENCY MATRIX (CORE)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-FOU (10 days)	APPEL-1CC-Foundations of Aerospace at NASA	Immerses new NASA hires into the meaning of working at NASA and makes them aware of the principles of technical excellence; provides them with the big picture overview of NASA, its Governance model and operations, as well as, communication and team participation skills and basic concepts of aeronautics and astronautics.	• Agency Structure and Internal Goals • Communication/Decision Making • Team Dynamics • Aeronautics and Astronautics Concepts and Terminology • Aircraft Design Fundamentals • Trends in the Space Industry • Fundamentals of orbits, interplanetary travels and the space environment • Overall Space system design and operations • Basic aeronautics concepts • Fundamentals of aircraft design • NASA PM&SE Policies and Procedures
APPEL-PM&SE (10 days)	APPEL-2CC-Project Management and Systems Engineering	Enhances proficiency in applying project management and systems engineering processes/practices over the project life cycle.	• Requirements Development • Logical Decomposition • Design Solution • Technical Requirements Definition • Requirements Management • Stakeholder Expectation Definition and Management • Technical Planning • Product Integration • Product Verification • Product Validation • Product Transition • Operations • Resource Management • Contract Management • Acquisition Strategies and Procurement • Risk Management • Project Planning • Cost Estimating • Project Control • Project Review and Evaluation • Earned Value Management • NASA PM & SE Policies and Procedures

APPEL COURSE COMPETENCY MATRIX (CORE)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-APM&ASE (4 days)	APPEL-3CC-Advanced Project Management and Advanced Systems Engineering	Focuses on critical elements of leading and managing a project life cycle in a complex and dynamic environment to include formulation and implementation of integrated systems and organization architectures, acquisition strategy within an environment of multiple and complex interfaces, extensive review and oversight, and approaches to identify and mitigate technical and other risks such as changing requirements and unanticipated budget reductions.	• PM & SE Integration • Project Planning • Risk Management • Stakeholder Management • Project Control • Leadership • Communication and Decision Making • System Architecture • Acquisition Strategies and Management • System Design
APPEL EXEC (5 days)	APPEL-4CC-Executive Program	This five-day course is designed to develop a cadre of highly qualified NASA leaders to position them for current or future executive leadership roles. The course is intended to transfer invaluable knowledge through the discussion and analysis of past executive decisions relative to high visibility NASA programs and projects.	• Knowledge Capture and Transfer • Knowledge Sharing • Mentoring and Coaching • Communications/Decision Making • Leadership

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-AEVMT (1 day)	Advanced Earned Value Management Techniques	Provides an understanding of gaming, abuse and manipulation of Earned Value Management (EVM) and Schedule Management data building upon an intermediate understanding of EVM and scheduling.	Budget and Full Cost Management
APPEL-APP (2 days)	Assessing Project Performance	Assists in learning how to manage and make informed decisions from the volumes of data about project performance such as: Earned Value, risk matrices, critical path, slack, Estimates To Complete, Cost Variances, configuration changes, contract modifications, award fee scores, Technical Performance Measures, and others.	• Budget and Full Cost Management • Tracking/Trending of Project Performance
APPEL-BEVMB (2 days)	Beyond Earned Value Management Basics	Provides an understanding of how to control baseline changes, integrate risk management with EVM, and analyze performance indicators and flags that build upon the basic understanding of the Performance Measurement Baseline (PMB), cost and schedule variances and indices, and determining an Estimate At Completion (EAC).	• Budget and Full Cost Management • Project Control
APPEL BSB (1 day)	Beyond Scheduling Basics	Builds upon the foundational processes of activity definition, activity sequencing, activity duration estimating, schedule development, schedule status accounting and data maintenance, and schedule performance reporting by examining the more advanced topics of schedule analysis, schedule control (baseline revisions, re-planning, and workaround planning), and schedule reserve planning.	• Project Control • Tracking/Trending of Project Performance

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-CTI (2 days)	Communicating Technical Issues	Provides the foundation for communicating technical information to a varied audience and demonstrates effective methods and strategies for presenting technical issues.	• Communication/Decision Making • Stakeholder Management
APPEL-CESA (4.5 days)	Concept Exploration and System Architecting	Introduces primary processes and tools for doing up-front system engineering analysis (e.g., proper system scope, context diagrams, fundamentals of life-cycle cost analysis, risk management, transition from requirements definition to system architecting).	• Mission Needs Statement • Stakeholder Management • System Architecture • Technical Requirements Definition
APPEL-CRM (3 days)	Continuous Risk Management	Provides hands-on experience in risk management planning and control with respect to technical, cost, and schedule performance, as well as techniques to assess, mitigate, and balance risks at the subsystem/system level.	• Technical Risk Management • Stakeholder Management
APPEL-DA (2 days)	Decision Analysis	Provides tools necessary to improve the quality of a factually based decision making process for resolving technical issues at NASA.	• Technical Decision Analysis • Systems Engineering • Communication and Decision Making
APPEL-DMA (3 days)	Design for Manufacturability and Assembly	This is a course in Design for Manufacture (DFM). This course will provide students with the skills and insight necessary to design mechanisms, devices, and structural that can be produced quickly, at high quality, and cost effectively.	• Typical tolerances, surface finishes, and process times • Design rules • Cost drivers
APPEL-SEMP (3 days)	Developing and Implementing a Systems Engineering Management Plan	Introduces Systems Engineering Management Plan (SEMP) processes, highlights how systems engineering deliverables are planned and managed, and addresses systems engineering technical reviews.	• Project Planning • Systems Engineering Management
APPEL-EVMO (1 day)	Earned Value Management Overview	Provides a high-level understanding of Earned Value (EVM) concepts as well as how to analyze the EVM data.	Budget and Full Cost Management

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-EMM (3 days)	Earth, Moon, and Mars	Introduces the remarkable discoveries of how these planetary bodies formed and the kinds of geologic processes that continue to operate on them today. Participants will also learn of the unique geologic challenges that the Moon and Mars pose to future exploration.	• Earth's Geology and Its Relationship with Other Planets • Science of the Solar System • Planetary Bodies, Compositions, their Geological Processes and Systems • Lunar and Martian Geology and its Impact on Exploration Vehicle Design
APPEL-EXPO (5 days)	Exploration Systems and Space Operations	Focuses on creating a phased, conceptual design for complete Earth-Orbiting, Lunar, and Mars manned missions; provides an overview of human space exploration.	Manned Space Missions: • Agency Structure and Goals • System Architecture • Mission Design • Operations
APPEL-FSE (5 days)	Fundamentals of Systems Engineering	This course introduces the methods and techniques for a structured systems development process that proceeds from requirements to concept to production to operation and is based upon NASA policy guidelines, specifically NPR 7123.1A and 7120.5D.	• Purpose of Systems Engineering • SE process incorporating NASA policy guidelines (NPRs 7123.1A and 7120.5D) • System definition process (concepts and architecting) • Incorporating reliability, availability and supportability considerations into the design process • System implementation process
APPEL-IDEA (3 days)	Innovative Design for Engineering Applications	Introduces participants to several methods and tools for generating, developing, and evaluating innovative ideas. The course provides integrated in-class projects focusing on hardware design and system performance.	• Product design process, internal and external constraints • Mind maps, Individual and group brainstorming methods • User-centered design and information design
APPEL-ICS (2 days)	Integrating Cost and Schedule	Geared towards increasing project managers' proficiency in dealing with the cost and schedule aspects of project management.	• Project Control • Tracking/Trending of Project Performance • Budget and Full Cost Management • Communication and Decision Making
APPEL-IEVMA (½ day)	Integrating EVM with Acquisition.	This half-day course provides a high-level understanding of Earned Value Management (EVM) concepts, and the effective integration of EVM with project management and acquisition.	• Budget and Full Cost Management • Acquisition Management • Contract Management

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-IPM (5 days)	International Project Management	Provides an understanding of cultural challenges, legal concerns, and teaming issues that are likely to be encountered working with international partners. The course addresses two distinct facets of successful international project management: technical knowledge and cultural understanding.	International Standards and Political Implications
APPEL-I-AERO (4 days)	Introduction to Aeronautics	Provides overall "big picture" and basics of aeronautical engineering and the give-and-take inherent to aircraft design; includes an overview of the vision, strategic direction, and active programs of the aeronautics research mission directorate.	Aeronautics: • Aircraft Design Fundamentals • Stability and Control • Aircraft aerodynamics • Aircraft performance • Propulsion Systems
APPEL-LCP (3 days)	Leading Complex Projects	Provides participants with key project management concepts, tools, and techniques used to manage complex projects successfully. It also provides insight on how to measure project complexity and adopt the best techniques for ensuring control of the project and all of its associated elements.	• Risk Management • Project Planning • Stakeholder Management • Tracking/Trending of Project Performance • Project Control • Leadership • Communication and Decision Making
APPEL-LPSE (3 days)	Life Cycle, Processes, and Systems Engineering	Introduces systems engineering processes, NASA life-cycle phases, key technical reviews, and systems engineering management techniques.	• Project Planning • NASA PM/SE Procedures and Guidelines • Systems Engineering
APPEL-MSTP (3 days)	Management of Space Technology Programs	Participants will learn how NASA project practitioners and systems engineers dealing with systems integration work navigate between the development of complex space technology to achieve technical excellence and specific operational methods, namely systems management practices, project management, and systems engineering, is explored.	• Stakeholder expectations and management. • Complexity and the problem of "optimization" of technical systems • Organizational governance structures dealing with decentralized decision-making and centralized authority patterns • "Normalization of deviance" and complex technical systems. • Politics, organizations, and technology life cycle development.

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-MMSD (4 days)	Mars Mission System Design	Cultivates a better understanding of the overall space mission design process as it applies to Mars-orbiting missions including technical processes and tools.	Mars Orbiting Mission Lab: • Systems Engineering • System Architecture • Mission Design • Operations
APPEL-NBP (1 day)	NASA's Budgeting Process	Details steps of NASA's budgeting process and accounting and financial management techniques; focuses on project budget formulation, execution, and how to manage against the project operating plan.	• Budget and Full Cost Management • Agency Structure and Internal Goals • NASA PM Procedures and Guidelines
APPEL-NG (2 days)		Identifies and develops the negotiating and bargaining skills to successfully execute a win-win negotiation in a variety of technical/professional and personal situations.	• Acquisitions Management • Contract Management • Leadership • Team Dynamics and Management
APPEL PMP (3.5 days)	Passing the PMP Examination	Acquaints students with the 44 PMI processes, their inputs, tools, techniques and outputs that comprise approximately 80% of the exam. It will also give the student the opportunity to become acquainted with the significant amount of material on Professional Responsibility and Human Resources that are not covered in the PMBOK.	Addresses competencies under the following competency areas relative to the PMP exam: • Project Conceptualization • Resource Management • Project Implementation • Delivery, Operation, and Closeout • Program Control and Evaluation • Human Capital Management • Safety and Mission Assurance • Professional & Leadership Development • Knowledge Management
APPEL-PBSOW (2 days)	Performance-Based Statement of Work	Shows participants how to write effective Performance-Based Statement of Work (PBSOW). Participants learn how to do the three step-based analyses necessary to scope and write performance-based contracts. Also, provides an overview of the acquisition process and where the statement of work fits in the process.	Acquisition Management

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-PM-LAB (4.5 days)	Project Management Leadership Laboratory	Provides an intensive experience to build effective management capabilities in order to achieve project team objectives: synthesizes project management practices learned earlier through practice and study. Through a simulation environment,, this laboratory provides a unique opportunity to identify, understand, and practice effective leadership behaviors in a project team setting.	• Project Proposal • Requirements Development • Project Planning • Cost Estimating • Risk Management • Budget and Full Cost Management • Systems Engineering • Contract Management • Project Control • Team Dynamics and Management • Mentoring and Coaching • Leadership
APPEL-PPAC (5 days)	Project Planning Analysis and Control	Offers program planning, analysis, and control foundation; provides intensive instruction in PM fundamentals across entire life cycle; covers technical integration of project elements, design and discipline functions, and associated interactions to balance performance, cost, schedule, reliability, operability.	• Budget and Full Cost Management • Project Control • Requirements Development • Project Planning • Risk Management
APPEL-PRPS (Varies on project)	Project Review Processes and Strategies	Demonstrates the planning process, content and techniques necessary to conduct a credible project review and provides exposure to NASA standards, success criteria, lessons-learned, tools and experiences for overall project review activities.	Project Review and Evaluation
APPEL-REQ (3 days)	Requirements Development and Management	Provides a firm foundation for the development and management of project requirements.	• Requirements Development • Logical Decomposition • Requirements Management
APPEL-REQ-T (3 days)	Requirements Development and Management-Team	Provides project team just-in-time-training for the development and management of your project's product scope and requirements. During this course, the project's existing scope and requirements documentation are reviewed and used to allow participants to determine which areas need improvement and further work.	• Requirements Development • Requirements Management

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-RM (1 day)	Foundations of Risk Management	Enhances knowledge of risk and its impact; provides practical knowledge on how to identify risks and techniques for risk mitigation.	• Technical Risk Management • Risk Management
APPEL-SCC (4 days)	Scheduling and Cost Control	Focuses on managing project constraints: limits on time, human resources, materials, budget, and specifications; helps practitioners apply effective measures and tools for scheduling and controlling projects.	• Project Planning • Cost Estimating • Project Control • Project Review and Evaluation • Budget and Full Cost Management • NASA PM Procedure and Guidelines
APPEL-SAGE (3 days)	Seven Axioms of Good Engineering – A Case Study Course: Learning from Failure	Utilizes real-life case studies and historical engineering failures to derive seven fundamental engineering axioms. Promotes good engineering design and project management decision making via the study and discussion of case studies. Such discussions promote critical thinking and will improve decision making among NASA engineers, technologists, program managers, and scientists.	• Engineering Design Principles • Technical Decision-Making • Non-analytical aspects of design • Critical Thinking • Assessment of high-risk technologies
APPEL-SMSDO (5 days)	Science Mission Systems Design and Operations	Offers integrated overview of NASA's Science Mission Directorate including its organization, future vision, science objectives and strategies, upcoming technologies, and space science mission design and operations.	Unmanned Space Missions: • Agency Structure and Goals • System Architecture • Mission Design • Operations
APPEL-SMSDO-LAB (4 days)	Science Mission Systems Design and Operations Lab	Provides real-life experience of how missions and space systems are conceptualized and designed: an integrated view of space mission design and operations-conceptual design, requirements definition, spacecraft design, development, test and launch, mission operations concepts and ground infrastructure design.	Unmanned Space Missions Lab: • Systems Engineering • System Architecture • Mission Design • Operations

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-SWE-301 (5.5 days)	Software Engineering Management	This course will introduce participants to software engineering management techniques, including project monitoring, control, and measurement..	• Software Engineering Project Management • Project Planning, Monitoring, Control and Measurement • Products and Services Acquisition Strategies • Stakeholder Relationships Management and Negotiations Techniques • Change Management
APPEL-SLTS (3 days)	Space Launch and Transportation Systems	Provides practical, detailed approaches and tools to analyze and design manned and unmanned, reusable and expendable launch vehicles for Earth and other planets; includes architecture and configuration, payloads, and vehicle subsystems.	Launch Vehicles: • System Architecture • Mission Design • Operations
APPEL-SSD (2 days)	Space System Development: Lessons Learned	Via lessons learned this course examines the root causes of aerospace mishaps and the lessons that can be derived from those historical incidents.	• Assessment of Aerospace Mishaps and Root Causes • Analysis of "Normalization of Deviance Concept" • Engineering Design Principles • Technical Decision-Making and Analysis • Non-Analytical Aspects of Design • Critical Thinking and Project Principles
APPEL-SSVV (3 days)	Space System Verification and Validation	Demonstrates processes, information, and tools necessary to implements credible verification, integration and test program; provides exposure to NASA and DoD standards, lessons-learned, tools and experiences in validation and verification.	• Product Verification • Product Validation
APPEL-TL (3 days)	Team Leadership	Builds capabilities to manage and facilitate processes needed for successful team performance; provides concepts, processes, and practices to develop and manage superior teams.	• Team Dynamics and Management. • Mentoring and Coaching • Communication/Decision- Making
APPEL-TM (2 days)	Team Membership	Provides information on team dynamics, processes, roles/ responsibilities, and other practical information for working effectively within a team environment.	• Collaboration Skills • Team Dynamics

APPEL COURSE COMPETENCY MATRIX (IN-DEPTH)			
Course Descriptor (# of days)	**Course Name**	**Course Goal**	**Competencies and Technical Areas Addressed**
APPEL-TW (1 day)	Technical Writing for Engineers	Provides intensive instruction in technical writing to improve practitioners' technical communication skills so that they effectively communicate technical/project information to various audiences.	• Communication/Decision Making • Stakeholder Management
APPEL-TPDMO (4 days)	Transition, Product Delivery, and Mission Operations	Demonstrates processes, procedures, and strategies necessary to implement an effective product development, transition, delivery and operations.	• Product Implementation • Product Integration • Product Verification • Product Validation • Product Transition • Product Operations
APPEL-UEVM (2 days)	Understanding Earned Value Management	Provides an understanding of how to get up and running with Earned Value Management (EVM) by establishing the Performance Measurement Baseline (PMB), assessing earned value, analyzing cost and schedule variances, and determining an Estimate At Completion (EAC) of the project's or contract's final cost and schedule.	Budget and Full Cost Management
APPEL-UPS (1 day)	Understanding Project Scheduling	Provides a foundation in how to develop, update and maintain a project schedule and includes an overview of the key steps involved including: activity definition, activity sequencing, activity duration estimating, schedule development, schedule status accounting and data maintenance, and schedule performance reporting.	Project Control

OUR BUSINESS LINES

ACADEMY OF PROGRAM / PROJECT & ENGINEERING LEADERSHIP

APPEL

PERFORMANCE ENHANCEMENT

NASA APPEL Performance Enhancement services increase a project's probability of success by delivering the right support to a project team at the right time. Through one-on-one assistance, focused workshops, or large-group sessions, performance enhancement programs achieve immediate project goals while enhancing long-term team capabilities.

Project Performance Enhancement begins with the NASA project community submitting a request for support, directly to APPEL, through a statement of work (SOW) that outlines a project's background and general development needs. Next, assessments and consultations take place between APPEL team members and the NASA project leaders to evaluate these needs and propose developmental activities that specifically respond to the SOW. Funding can be obtained from either APPEL or the Centers concerned, depending on the nature of the project and the type of support required.

ASSESSMENT AND DEVELOPMENT

Team managers improve project and executive team dynamics most effectively when they assess team and individual behavior. APPEL tools can measure behavioral effectiveness for teams and leaders, as well as measure overall team knowledge. Following assessment, intervention to meet team needs can include workshops, working with a coach, and individual or team consultation with experienced practitioners, many of them retired NASA and aerospace industry project managers.

PROJECT LIFE-CYCLE SUPPORT AND TECHNICAL ASSISTANCE

APPEL meets the needs of NASA project teams by providing expert practitioners to support any project competency. Services in the various stages of the NASA project life cycle include team building, planning and scheduling, program control analysis, systems integration support, risk management, and software management—in short, every project phase from formulation through implementation and evaluation. NASA teams of all sizes benefit from these customized consultations with expert practitioners.

KNOWLEDGE SHARING

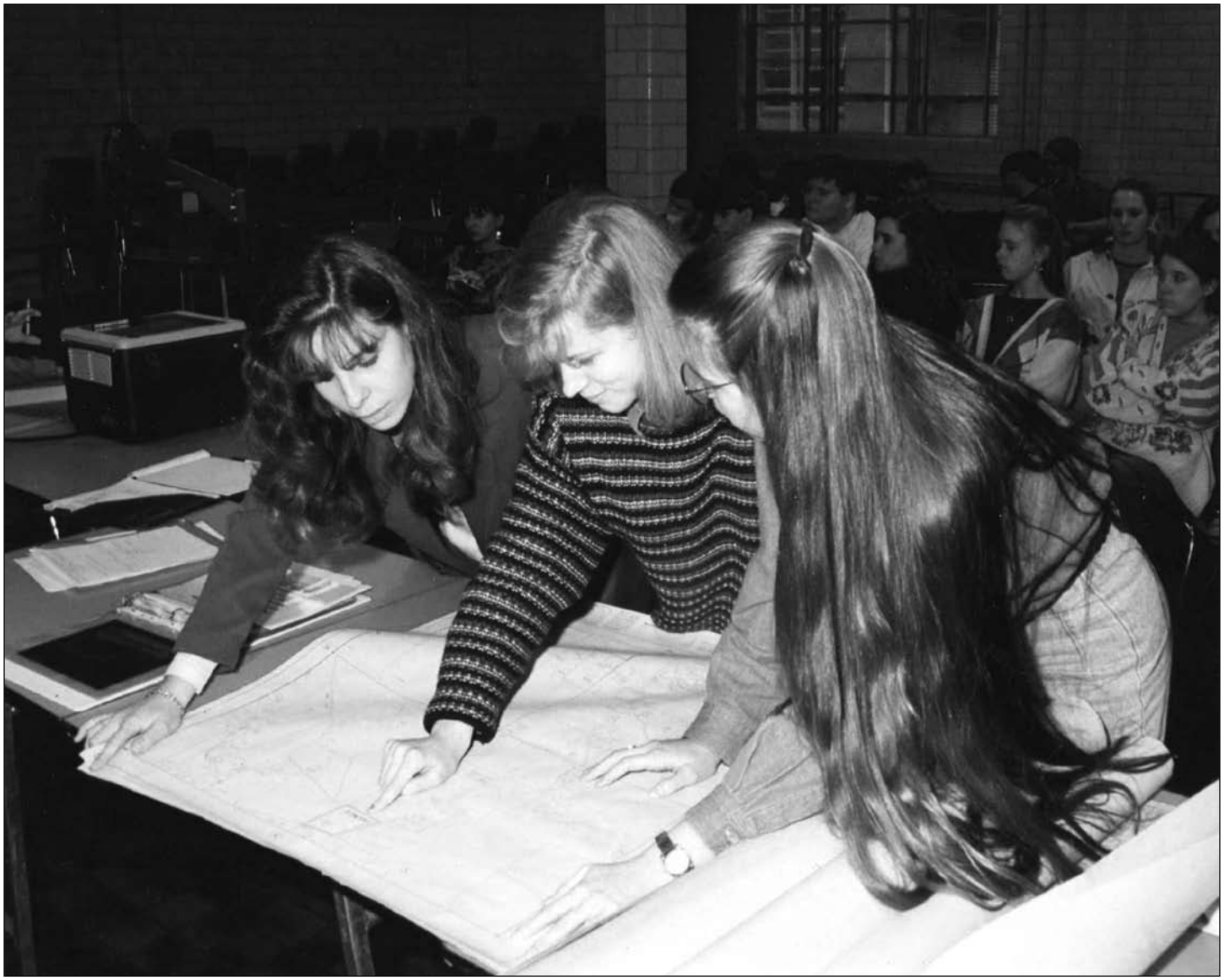
The Knowledge Sharing Initiative promotes excellence in project management and engineering leadership development. Its primary strategy focuses on gathering and sharing knowledge and wisdom from the best program/project and engineering leaders across the agency. This initiative has proven to be an effective catalyst in building and supporting ongoing NASA communities of practice. Capturing and sharing knowledge is a consistent theme across the programs and services of the Academy. Garnering such knowledge is particularly important to project success as project complexity is continually increasing, especially in terms of size, detail, and extent of required internal and external coordination.

Knowledge-sharing forums, publications, and multimedia provide NASA managers, scientists, and engineers with examples and lessons learned from attempting to overcome challenges. The Academy Knowledge Sharing team provides an assortment of events in which efforts are made to connect expert practitioners across the agency. Included are the Masters Forums that bring together some of the best project managers and engineers from NASA, private industry, and other government agencies. Exceptional practitioners know how to drive a project toward success, but not necessarily because of what they read in a management text. They know what works based on years of experience nurtured over a career of ups and downs, successes and failures, trials and errors. NASA leverages the knowledge of its most experienced practitioners by inviting them to a Masters Forum, where they share their stories and learn from the stories of their peers. Additionally the Academy hosts the Project Management (PM) Challenge, an annual seminar designed to examine current program/project management trends and to provide

a forum for knowledge sharing and exchange of lessons learned. By attracting stakeholders from all experience levels of our workforce, an important link is established between NASA's world-class experts and emerging leaders for tomorrow. Publications include the award-winning *ASK Magazine,* the biweekly electronic newsletter *ASK the Academy*, and a myriad of robust case studies used throughout NASA to facilitate discussion and learning.

Additionally, the Academy has introduced a new initiative over the past year. Masters with Masters is a series of Web-based learning videos that will bring together two master practitioners to reflect on their experiences, lessons learned, and thoughts about upcoming challenges. Masters with Masters was developed as part of the Academy's ongoing efforts to create a cohesive community of project management and engineering practitioners across NASA. This series will engage master practitioners in a conversation that yields fresh insights and promotes reflection and open sharing.

Finally, Knowledge Sharing broadcasts video clips online of leading thinkers and practitioners in the fields of knowledge management, project management, and systems engineering on the APPEL Web site. To further promote the sharing of knowledge, work is currently under way to create and make accessible to the larger APPEL community an internal online library of archived APPEL footage, including videos of past events, speakers, and other knowledge-sharing activities.



RESEARCH AND ADVANCED CONCEPTS

APPEL supports NASA's goal to bridge programs/projects and the academic community through partnerships, studies, research, and workshops designed to share knowledge between program/project practitioners and university researchers.

The cornerstone for Applied Research is the Center for Program/Project Management Research (CPMR), which was formed by a partnership between NASA APPEL and the Universities Space Research Association (USRA) to engage universities in world-class research that addresses internationally significant problems in the discipline of project management with particular emphasis on the nation's aeronautics and space program.

CPMR aims to promote cutting-edge research, foster greater collaboration, disseminate information, encourage and develop student councils, and generally serve as a resource for program/project management knowledge. CPMR facilitates training, workshops, and developmental opportunities, providing a collaborative environment to openly pursue innovative concepts. In addition, university grants and CPMR fellowships are instrumental in conducting research and sharing valuable knowledge between university researchers and NASA project managers.

OUR STRATEGIC PARTNERS AND EXTERNAL STAKEHOLDERS

NASA ENGINEERING NETWORK (NEN)

The NASA Engineering Network (NEN), available at http://nen.nasa.gov, is an integrated suite of tools that promote collaboration, learning, and knowledge sharing among NASA's engineers. It connects engineers to other engineers, and connects engineers to NASA resources through the following:

NASA's Lessons Learned, which provides the official, vetted lessons learned from NASA programs and projects. Each lesson includes the summary of the driving event and recommendations that drive NASA's engineering training, best practices, policies, and procedures.

NEN's Engineering Search is an enterprise search engine that mines the knowledge from NASA Lessons Learned and a continually growing number of repositories of interest.

NEN's Communities of Practice (CoP) are facilitated communities where engineers may interact with their discipline's Technical Fellow, subject-matter experts, and other practitioners to leverage the knowledge, processes, and best practices created and employed by other engineers.

NEN is working with APPEL to provide communities of practice for APPEL training courses so practitioners can find resources and continue learning both during the course and after it is complete. These communities include discussion boards, calendars of upcoming courses, and online resources.

NASA AGENCY TRAINING AND DEVELOPMENT OFFICE

The NASA Agency Training and Development Office extends opportunities to help employees gain the necessary knowledge and skill to fulfill NASA's mission through formal education, training, and on-the-job developmental experiences. The means may be university coursework, traditional classrooms, online learning, satellite broadcast, blended models, or on-the-job training.

The organization is responsible for the agency's overall leadership development training needs serving all NASA centers, mission directorates, and mission support organizations. We work in collaboration with the center training offices, Headquarter's functional offices, and stakeholders in the SATERN online learning environment to ensure that employees receive opportunities to build their professional development in three main areas: building leaders, building technical excellence, and building effective organizations. Our effort in these areas is focused on results through fostering a culture of honesty, learning, and knowledge sharing.

Specific Agency Training and Development opportunities include short-term residential leadership and business courses, supervisory training, long-term leadership development programs for the GS 11-15 population, professional coaching and mentoring, and Agency Fellowship programs. All Agency training and development offerings are based on the NASA Leadership Model, which can be found at http://www.leadership.nasa.gov.

OFFICE OF MANAGEMENT AND BUDGET & THE FEDERAL ACQUISITION INSTITUTE

OMB Requirements for Program/Project Management Certification

In a letter dated April 25, 2007, the White House OMB announced a new set of requirements for project management certification that applies to all civilian agencies. The letter emphasizes the importance of well-trained and experienced project managers who are critical to the acquisition process and the successful accomplishment of mission goals. The Federal Acquisition Certification for Program/Project Managers (FAC-P/PM) establishes the necessary competencies, training, and experience requirements for eligible program and project managers in civilian

agencies to become certified. The Federal Acquisition Institute (FAI) was appointed as the oversight agency. Visit http://www.fai.gov for more information.

To meet OMB's requirements, NASA is required to certify existing and future experienced P/PMs who manage high-visibility projects defined as major acquisitions per NPR 7120.5D. Center senior management with guidance from the Program Management Council is responsible for determining which positions fall under this threshold. At this time, it is not mandatory for P/PMs assigned to non-major projects or programs to be certified.

Continuous Learning Requirements for Certified P/PMs

Certified NASA P/PMs must complete eighty continuous learning points (noted as CPEs in SATERN) every two years to maintain certification. All APPEL courses and activities are eligible for credit toward recertification. The list of APPEL courses and their associated CPEs as well as other self-recordable items can be found in the SATERN Recertification Catalog. To view a list of P/PM recertification-applicable courses and activities in SATERN, log in to your SATERN learner account and click the "Catalog" tab.

Please check the SATERN Recertification Catalog frequently for updates as center, discipline, and other agency-approved courses and activities will be added on an ongoing basis. You may contact your Center Training Office for additional details or visit the APPEL Web site.

PROJECT MANAGEMENT INSTITUTE

PMI Registered Education Provider

PMI is the leading membership association for the project management profession and is recognized around the world for the programs they conduct with governments, organizations, and industries as they recognize and embrace project management.

NASA APPEL is a Registered Education Provider (REP) with PMI. An REP is an organization approved by PMI to issue Professional Development Units (PDU) for its training courses.

Courses offered by PMI REPs are preapproved for contact hours in fulfillment of certification eligibility requirements, as well as PDUs to fulfill the Project Management Professional (PMP®) Continuing Certification Requirements. The REP program has been designed to enhance the ongoing professional development of PMI's members, those credentialed through PMI, and others in the project management profession. The Academy currently offers more than twenty-five courses with PDU credits. The numbers of PDUs are shown on each course description. (A list of APPEL courses and the relevant PDUs can also be found on the APPEL Web site: http://appel.nasa.gov.)

PMI's Certification Programs

Project management practitioners can advance their careers through PMI's globally recognized certification program that consists of a comprehensive certification program for professionals with varying levels of experience. The credentials are as follows:

- Certified Associate in Project Management (CAPM®)
- Project Management Professional (PMP®)
- Program Management Professional (PgMPSM)

The Certified Associate in Project Management (CAPM®) Credential is for project team members who

- Provide subject-matter expertise (e.g., marketing, finance, customer care, processing, fulfillment).
- Serve as project team sponsors, facilitators, liaisons, or coordinators.

The Project Management Professional (PMP®) Credential is for candidates who

- Perform their duties under general supervision and are responsible for all aspects of the project for the life of the project.
- Lead and direct cross-functional teams to deliver projects within the constraints of schedule, budget, and resources.
- Demonstrate sufficient knowledge and experience to appropriately apply a methodology to projects that have reasonably well-defined project requirements and deliverables.

The Program Management Professional (PgMPSM) Credential is for candidates who

- Under minimal supervision, are responsible and accountable for the coordinated management of multiple related projects directed toward strategic business and other organizational objectives. These programs contain complex activities that may span functions, organizations, geographic regions, and cultures. Program managers build credibility, establish rapport, and maintain communication with stakeholders at multiple levels, including those external to the organization.
- Define and initiate projects and assign project managers to manage cost, schedule, and performance of component projects, while working to ensure the ultimate success and acceptance of the program. Program managers maintain continuous alignment of program scope with strategic business objectives and make recommendations to modify the program to enhance effectiveness toward the business result or strategic intent. Program managers are responsible for determining and coordinating the sharing of resources among their constituent projects to the overall benefit of the program.
- Possess the knowledge and skills needed to be effective in both the project and business or government environment and to make decisions that accomplish strategic objectives. In addition, the program manager should have advanced skills in finance, cross-cultural awareness, leadership, communication, influence, negotiation, and conflict resolution.

As part of APPEL's commitment to your development, we plan to offer review courses for each certification as part of our curriculum.

For more information on the certifications, visit PMI's Web site at http://www.pmi.org/CareerDevelopment/Pages/Obtaining-Credential.aspx.

What Credential Am I Eligible For?

The Academy provides a systematic approach to professional growth for program and project managers ranging from early on in their careers to more advanced levels. The figure below aligns APPEL's four-level development framework for project managers with PMI's current certification levels. By reviewing these requirements, you can determine the preparation process and relevant level of certification based on where you are in your career.

NASA PROJECT MANAGEMENT DEVELOPMENT FRAMEWORK AND PMI CERTIFICATION ALIGNMENT

Project Management Development Framework	PMI Certifications
Level 1: Project Team Members NASA employees who are at the beginning of their project management careers	Certified Associate in Project Management (CAPM): Must meet the following education and experience requirements and then pass exam: • Must have 1,500 hours of work on a project team or 23 hours of formal education
Level 2: Managers of Small Projects NASA project practitioners who have established a solid base of technical expertise and who independently manage definite portions of projects	
Level 3: Managers of Large Projects NASA project practitioners who have had prior experience in projects at a supervisory level and manage larger projects	Project Management Professional (PMP): Must meet the following education and experience requirements and pass exam: • 4,500 hours in a position of leading and directing tasks and 36 months of PM experience • 7,500 hours in a position of leading and directing tasks and 60 months of PM experience without a bachelor's degree • 35 hours of PM education
Level 4: Program Managers Upper-level managers serving as leaders of entire projects and programs of the organization as a whole	Program Mgmt Professional (PgMP): Over the past 15 consecutive years, must have 4 years of project management and 4 years of program management experience; without BS, individual must have additional 3 years of program management experience

PMI PROFESSIONAL DEVELOPMENT UNITS (PDU) FOR APPEL COURSES

In order to satisfy Continuing Certification Requirements (CCR) and maintain an active credential status, individuals who have attained the PMP and/or Program Management Professional credential(s) must accrue and report a minimum of sixty professional development units (PDUs) during each CCR cycle, which is typically three years. The PDU is the measuring unit used to quantify approved learning and professional service activities. Certificants are responsible for reporting qualifying activities as they occur. PDUs should be reported using the Online PDU Resources system accessible from a section of the PMI Web site at https://www.pmi.org/ccrs/.

Below is a list of PMI-registered APPEL courses, the PMI Course ID, and the number of assigned PDUs. Upon claiming your PDUs, you will need to have the provider ID number, which is 1895.

APPEL—PMI COURSE ID			
APPEL Designator	**APPEL Course Name**	**PMI Course ID**	**Number of PDUs**
Core			
PM&SE	Project Management and Systems Engineering	PMSEA01	79
APM&ASE	Advanced Project Management and Advanced Systems Engineering	APMSE03	39
In-Depth			
AEVMT	Advanced Earned Value Techniques	AEVMT05	7
APP	Assessing Project Performance	APP006	15
BEVMB	Beyond EVM Basics	BEVM07	15
BSB	Beyond Scheduling Basics	BSB008	7
CESA	Concept Exploration and System Architecting	CESA30	36
CTI	Communicating Technical Issues	CTI009	15
CRM	Continuous Risk Management	CRM010	23
SEMP	Developing/Implementing a Systems Engineering Management Plan	SEMP11	23
EVMO	EVM Overview	EVM012	7
FSE	Fundamentals of Systems Engineering	FSE031	40
ICS	Integrating Cost and Schedule	ICS013	15
IDEA	Innovative Design for Engineering Applications	IDEA32	24

APPEL—PMI COURSE ID			
APPEL Designator	**APPEL Course Name**	**PMI Course ID**	**Number of PDUs**
In-Depth (Continued)			
IPM	International Project Management	IPM014	40
LCP	Leading Complex Projects	LCP015	23
NBP	NASA's Budgeting Process	NBP016	7
NG	Negotiations	NEG018	15
PBSOW	Performance-Based SOW	S20008	14
PMLAB	Project Management Leadership Lab	PMLAB19	31
PMP	Passing the Project Management Professional Examination	PPMP27	27
PPAC	Project Planning Analysis and Control	FOU150	33.5
PRPS	Project Review Processes/Strategies	PRPS21	32
REQ	Requirements Development and Management	S30012	21
RM	Risk Management	RM022	7
SAGE	Seven Axioms of Good Engineering	SAGE33	24
SCC	Scheduling and Cost Control	SCC023	31
TL	Team Leadership	TL0024	19
UEVM	Understanding Earned Value Management	UEVM25	15
UPS	Understanding Project Scheduling	UPS26	7
	4D 3-Day Workshop for Intact Project Teams	4DWKS3	26
	4D 2.5-Day Workshop for Intact Project Teams	4DWKS25	22
	4D 2-Day Workshop for Intact Project Teams	4DWKS2	18

APPEL PHILOSOPHY

It is the intent of the APPEL program to ensure that NASA engineers—systems, project, or program managers—be supported in acquiring the knowledge and skills that will be required for their success at increasing levels of assignment complexity at NASA. The satisfactory completion of any or all of the development activities every engineer pursues should enhance their capability, success probability and value as an asset to NASA. As the improved quality of their job performance is demonstrated, the opportunities for assignment to increased levels of responsibility should be a possibility. An individual's competence will always be the critical factor in his or her consideration for advancement.

http://appel.nasa.gov

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