Project Management Workshop
11th Annual First Nations Launch

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NASA Vision & Mission

- Vision: To discover and expand knowledge for the benefit of humanity

- Mission: Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and bring new knowledge and opportunities back to Earth
Goddard does work in teams and through projects.

Teams
- Common Goal(s)
- Interdependent
- Complementary skills

Projects
- Time-defined
- Cost-controlled
- Limited scope

Projects have to be planned, organized, implemented and controlled.
Project and Project Management

- Project has a start date, end date and produces a tangible product
- Project Management is both an art and a science
  - As a science, it is the foundation for the art of leadership
- Good Project Manager (PM) demonstrate vision, motivate, and coordinate people to achieve objectives
  - Their skills set are a cross between a diplomat, ballet dancer, and Marine Corp drill sergeant—all while having a lot of patience
At NASA, it all begins and ends with science. We derive and share information, solutions, and technology for the benefit of all—NASA, the Nation, and the World.

Engineers and many others are involved in all parts of the Project Life Cycle.
• Organize the execution of NASA projects in such a way that they can be well-tracked and well-managed.
• Prevent the expenditure of large amounts of effort and money in vain.
A schedule is… a tool for identifying what the Project Manager (PM) and her/his team intends to do and when they intend to do it.

Functions:

- Integrates subsystem’s tasks/activities into a logical flow.
- Establishes the intended timetable for achieving objectives.
- Helpful for setting work priorities
- Supports the development of a time-phased cost estimate and resource plan
- Provides a means to measure work accomplishment
- Helpful in identifying potential problems early

Developing a credible schedule is critical to the project’s success
For the purpose of this workshop, we define a schedule as containing the following elements:

- **Task**: A higher level subdivision of work scope that will be further broken down into supporting activities.
- **Activity**: A detailed step that needs to be performed to complete a task.
- **Sequence (Logic)**: The order in which activities and milestones need to take place.
- **Milestone**: An important event with no duration signifying measurable progress toward, or achievement of, an activity, task or objective.
- **Duration**: Length of time estimated to complete an activity.
- **Critical Path**: Longest sequence of activities in the schedule from beginning to end.
- **Slack**: The amount of duration an activity or milestone can be delayed without causing a delay to subsequent activities or the project/subsystem completion date.
Work Breakdown Structure (WBS)

- Used to decompose the system by assembly, subassembly and components (rather than by discipline or functional organization)
  - Major element
    - Sub elements
- WBS is the basis for work assignments, budgeting, scheduling, risk assessment, cost assessment, and performance statusing
- WBS depth (number of levels) depends on the risk and complexity
- WBS developed early in project Life Cycle of a project
- Configuration controlled
- Maintained and updated as mission definition proceeds
### Example of WBS

<table>
<thead>
<tr>
<th>1.0 Project Support</th>
<th>2.0 Spacecraft</th>
<th>3.0 Payload Development</th>
<th>4.0 Ground Systems</th>
<th>5.0 Launch Vehicle</th>
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<tr>
<td><strong>1.1 - PMO Staff</strong></td>
<td><strong>2.1 - Attitude Control System</strong></td>
<td><strong>3.1 - HMI Instrument NAS5-02139</strong></td>
<td><strong>4.1 - Ground System Management</strong></td>
<td><strong>5.1 - Launch Systems Management</strong></td>
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<tr>
<td>JONs 884-05-01</td>
<td>JONS 884-01-01,-02</td>
<td>JONS 884-02-01</td>
<td>JONS 884-06-02</td>
<td><strong>5.2 - Launch Vehicle</strong></td>
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<tr>
<td><strong>1.2 - Business Management</strong></td>
<td><strong>2.2 - Flight Dynamics</strong></td>
<td><strong>3.2 - EVE Instrument NAS5-02140</strong></td>
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<td><strong>1.3 - Education Public Outreach</strong></td>
<td><strong>2.3 - Communications KA-Band</strong></td>
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<td><strong>1.4 - Transportation</strong></td>
<td><strong>2.4 - Communications S-Band</strong></td>
<td><strong>3.4 - Instrument Mgmt &amp; Systems</strong></td>
<td><strong>4.4 - Mission Operations Management</strong></td>
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<tr>
<td>JONS 884-05-04</td>
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<td>JONS 884-02-04</td>
<td>JONS 884-06-04, -05</td>
<td><strong>5.2 - Launch Vehicle</strong></td>
</tr>
<tr>
<td><strong>1.5 - MPS</strong></td>
<td><strong>2.5 - CADH</strong></td>
<td><strong>3.5 - Project Scientist</strong></td>
<td><strong>4.5 - Mission Operations Center</strong></td>
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<td><strong>1.6 - Systems Engineering</strong></td>
<td><strong>2.6 - Flight Software</strong></td>
<td><strong>3.6 -</strong></td>
<td><strong>4.6 - Mission Readiness &amp; Testing</strong></td>
<td><strong>5.2 - Launch Vehicle</strong></td>
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<tr>
<td>JONS 884-05-06</td>
<td>JONS 884-01-07</td>
<td><strong>3.7 -</strong></td>
<td>JONS 884-06-07</td>
<td><strong>5.3 - Launch Site Ops</strong></td>
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**2.1** - Spacecraft

- Attitude Control System (JONS 884-01-01,-02)
- Flight Dynamics (JONS 884-01-03)
- Communications KA-Band (JONS 884-01-05)
- Communications S-Band (JONS 884-01-04)
- CADH (JONS 884-01-06)
- Flight Software (JONS 884-01-07)
- Power (JONS 884-01-13, -14, -15)
- Propulsion (JONS 884-01-21)
- Harness/Electrical (JONS 884-01-18)
- Thermal (JONS 884-01-23)
- Mechanical (JONS 884-01-09, -10)
- Mechanisms (JONS 884-01-25)
- Subsystem Data Node (JONS 884-01-29)
- Subsystem Power Node (JONS 884-01-30)
- Spacecraft I&T (JONS 884-01-20)
- EGSE (JONS 884-01-08)
- Parts (JONS 884-01-18)
- Materials (JONS 884-01-19)
- Contamination Control (JONS 884-01-19)
- Radiation (JONS 884-01-17)
- Systems Assurance (JONS 884-01-11)

**3.1** - Payload Development

- HMI Instrument NAS5-02139 (JONS 884-02-01)
- EVE Instrument NAS5-02140 (JONS 884-02-02)
- SHARPP Instrument S-15702-Y (JONS 884-02-03)
- Instrument Mgmt & Systems (JONS 884-02-04)
- Project Scientist (JONS 884-02-05)

**4.1** - Ground Systems

- Ground System Management (JONS 884-06-02)
- Science Data Distribution (JONS 884-06-01)
- Antenna Facility (JONS 884-06-03)
- Mission Operations Management (JONS 884-06-04, -05)
- Mission Operations Center (JONS 884-06-06)
- Mission Readiness & Testing (JONS 884-06-07)
- Network & Communications (JONS 884-06-09)
WBS, Defined Budgets & Schedules

2.0 Spacecraft

2.11 Mechanical
Responsibility: Carrier Systems Branch Subsystem and Product Design Lead—Guilio Rosanova

2.11.1 Responsibilities
- Engineering
- Hardware
- Equipment

Consistent with Organization Budgetary and Schedule Processes

WBS Derived
Planning a Project and Creating the Schedule

• Steps in Gathering Project Information
  – Set goals & objectives
  – List the tasks
  – Estimate duration
  – Determine sequence
  – Assign resources

• Entering General Information
  – Set up the calendars
    • Project, and
    • Resource
What are Milestones?

- An important event signifying measureable progress toward, or achievement of, an activity, task or objective. By definition milestones have no duration.

Milestones - Characteristics

- Demonstrate accomplishment of work scope
- Indicate to external stakeholders that progress is being made
- Signify the achievement of major objectives such as the completion of a design review, finish of a test, or delivery of a component
- Represent the retirement of risk such as the completion of a life test, receipt of a long lead component
Defining the Project - 2

• Break Project into Tasks and Milestones
  - Scope project first
  - Create list of tasks
  - Use experienced staff to plan the project

• Tasks
  - Activities that must be finished to achieve end result of the project
  - Take project from event to event
  - May include reviews & walk throughs

• Tasks - Characteristics
  - Precise and detailed
  - Significant
  - Appropriate level of detail
  - Task scope and assumptions

• Defining Tasks
  - Top down
    • start with major project phase
    • add details
  - Bottom up
    • list all tasks group into phases

Consider using notecards or Post-It to visualize your activities on the wall when discussing them within your team
Determining Task Duration: *period between start and end of task*

**Do’s**
- Apply realistic estimates
- Consider each task independently
- Consider experience of the assigned resource
- Estimate in units [e.g., hours, days]
- Assume normal working conditions
- Match resource with type of task
- Consider task complexity

**Don’ts**
- Consider resource availability
- Consider target finish date
- Schedule too tight
- Allow PM to set schedule
Sequencing Tasks - 1

• Task Dependencies
  - Task sequence
  - Task relationship
  - Lead or Lag time
  - Constraint

• Task Sequence
  - What determines sequence?
  - What tasks must be finished before another?
  - Predecessor - successor

• Task Relationships
  - What are the related tasks?
  - Four basic types
Types of Relationships (see diagrams)
- Finish to Start
- Finish to Finish
- Start to Start
- Start to Finish - seldom used
Assigning Resources -1

- Assigning People, Equipment and Costs to Tasks
  - Who will do the task?
  - When are they needed?
  - Over allocated - under allocated

- Resource Requirements - Considerations
  - Skills required - specialist/consultants
  - Number of resources required
  - Types of other resources required - (e.g. equipment)
Assigning Resources -2

- Estimating Costs - Considerations - Why Plan Costs?
  - Resource cost - people
  - Equipment costs
  - Other costs
  - Are costs fixed or variable?

- Calculating Resources
  - calculate work = duration x resource units
  - Resource driven vs. fixed duration scheduling
Managing Projects w/ Microsoft Project

- Why Plan? - Time-consuming, but critical
- Do Computers Help?
  - Create schedules quickly
  - Provide quick alternatives
  - Support centralized project planning
- Critical Path Model
  - Supported by all PM software
  - Developed in 1958
  - Defines project critical tasks
  - Delay in Critical Path delays whole project
The Critical Path: What is it and why is it important?

**Critical Path.** Longest sequence of activities in the schedule from beginning to end.

- If a critical path activity is delayed for a day, the entire project (or subsystem) will be delayed for a day unless the activity following the delayed activity is completed a day earlier or another workaround is found.

- Understanding the subsystem’s critical path (and near-critical paths) helps PDLs focus on the activities driving their schedule

- Your subsystem may or may not be driving the overall project’s critical path
Can you find the critical path for the Laser X Subsystem?

Legend:
- Predecessor Dependency
- Activity Description
- Successor Dependency

NOTE: All dependencies are “Finish-to-Start”
Schedule Management - 1

- Schedule management is a critical component of project planning and control
  - Program control milestones hard coded into network

- Schedules are part of project baselines, and critical milestone completions often are important project events that are reported to stakeholders

- Schedule development and control starts with the technical scope, assumptions, activity definition, logic sequencing, & duration estimation
  - Comprehensive - Thousands of activities
  - Highly integrated - Thousands of relationships between activities

- Expert judgment based on similar projects is best applied during these early steps to determine reasonable schedules and to limit future schedule risk
  - Durations based on experience with similar projects
Schedule Management - 2

- Network is statused monthly based on product team progress
  - Gantt charts updated based on network data
- Establish, manage, and control of baseline master schedule
  - Milestones which are controlled by the approving officials (Project Manager)
  - Identify the “critical path”
  - Include all internal and external critical milestones
  - Include traceability based on network logic format (dependencies and interdependencies)
- Provide the framework for time phasing and coordinating all project efforts into a master plan
- Ensure objectives are accomplished within project commitments
- Key element in management of risk
Example of Top Level Schedule (Gantt Chart)

- Critical path (red) through the spacecraft
- Funded schedule reserve (green) distributed throughout Life Cycle
The Program Evaluation Review Technique (PERT) breaks down the individual tasks of a project for analysis.

A PERT chart is a project management tool that provides a graphical representation of a project's timeline.
Risks, Issues, and Opportunities

- Risk Management: Planning for the “bad things” that may occur during the project’s life cycle
- Issue Management: Addressing events that have occurred during the project’s life cycle
- Opportunity Management: Seeking “good things” that may benefit the project
Managing Projects: What to Look for in PM Software

• The ability to:
  − Save a Baseline plan
  − Track progress
  − Allocate and level resources
  − Create and maintain calendars
  − Create a dynamic link between projects
  − Change presentation - tables, charts, graphs
  − Enter regular occurring tasks
  − Filter information
  − Modify tables/views
Helpful Collaboration Tools

The 12 Best Free Project Management Apps*

- **Trello** (Web, macOS, Windows, iOS, Android) for individuals and teams who need a work pipeline
- **MeisterTask** (Web, Windows, macOS, iOS, Android) for combining project ideation, planning, and execution
- **KanbanFlow** (Web) for combining kanban, time tracking, and Pomodoro
- **Freedcamp** (Web, iOS, Android) for managing all projects and communications in a single tool
- **Asana** (Web, iOS, Android) for creating a to-do list powerful enough to manage projects
- **Paymo** (Web, Windows, macOS, Linux, iOS, Android) for freelancers who charge by the hour
- **Bitrix24** (Web, Windows, macOS, iOS, Android) for classic project management with Gantt charts
- **Wrike** (Web, Windows, Mac, iOS, Android) for spreadsheet-like features in a project management app
- **Podio** (Web, iOS, Android) for customizing your project management tool
- **Yodiz** (Web, iOS, Android) for Agile and Scrum teams
- **Agantty** (Web) for creating Gantt charts quickly and easily
- **AND CO** (Web, macOS, iOS, Android) for projects that require invoicing

[https://zapier.com/blog/free-project-management-software/](https://zapier.com/blog/free-project-management-software/)
“Building what we’ve never built before, to discover what we’ve never known before.”
Set goals, challenge yourself, and achieve them. Live a healthy life... and make every moment count. Rise above the obstacles, and focus on the positive.

— Robert H. Goddard
Additional Resources
10 Rules For Managing Projects
Rule Number 1
Set a Clear Goal

Effective Project Managers:

Plan projects starting with the end result (e.g. the goal) - and work backwards

Keep their eyes on the goal

Develop, communicate and ensure a commitment to a project goal

Create a common vision
Rule Number 2
Determine the Objectives

• To Accomplish the Following:
  − Break down a project into specific tasks and commit team members to each task
  − Identify who should be on a project team and establish ownership
  − Help team to focus on the overall project goal
  − Establish rewards that are linked to overall project success
  − Empower those assigned with the authority to achieve the goal
Rule Number 3
Establish Checkpoints, Activities, Relationships, and Time Estimates

• The Objective Is To:
  - Define Checkpoints to mark project progress
  - Define Activities to focus on the end result
  - Define Relationships to sequence the various project tasks
  - Define Time/Cost estimates for resource or other activity costs
  - Plan for contingencies
  - Prepare accurate estimates
Rule Number 4
Create a Schedule - Picture of Project

- Apply the Following Techniques:

  - Diagramming:
    - Gantt charts - to provide a quick project overview
    - Flow charts [PERT] - to show the flow of critical activities

  - Management - to manage and monitor project activities.
Rule Number 5
Develop People Individually and as a Team

- To Manage People Effectively the PM Must:
  - Understand the entire team
  - Assess the potential for different perspectives
  - Understand individual motivational factors - “different strokes for different folks”
  - Understand the stages of team development: orientation, dissatisfaction, resolution, production and termination
Rule Number 6
Reinforce the Commitment and Excitement of People

- To Build a Committed Team the PM Must:
  - Establish a sense of ownership
  - Provide the BIG picture
  - Align the team’s goals with the project goal
  - Demonstrate your confidence in the individual team members
  - Praise accomplishments - give attaboys!
Rule Number 7
Inform Everyone Connected with the Project

• To Be Effective the PM Must:
  – Communicate the goals, objectives, milestones & progress all project participants
  – Post the message - communicate as frequently as needed
  – Apply effective listening techniques - a primary form of communication even more important than talking
Rule Number 8
Vitalize People by Building Agreements

The PM Can Generate Energy in the Project By:

- Confronting rather than avoiding project conflict
- Creating a common ground upon which to resolve project or personal issues
- Negotiating conflict - strive for the win-win scenario [if possible]
Share power with the team - develop leaders

Demonstrate the traits of a leader:
- honesty,
- competency,
- direction, and
- inspiration
Rule Number 10  
Risk Approaching Problems Creatively

- Foster an atmosphere where creativity is encouraged rather than discouraged

- Encourage creativity through:
  - increased problem sensitivity,
  - idea fluency,
  - originality, and
  - greater flexibility
PM Tips

• Manage by Exception - focus on key tasks
• You can’t do it alone
• Compliance = Commitment
• People working together = a Team
• Great ideas result from lots of ideas
• Treat these as project variables:
  - People, and
  - politics
Definitions

• **Project Phase** – A collection of logically related project activities, usually culminating in the completion of a major deliverable.

• **Key Decision Points (KDPs)** – The event at which the Decision Authority determines the readiness of a program/project to progress to the next phase of the life cycle.

• **Formulation** – The identification of how the program or project supports the Agency’s strategic needs, goals, and objectives; the assessment of feasibility, technology, and concepts; risk assessment, team building, development of operations concepts and acquisition strategies; and establishment of high-level requirements and success criteria.

• **Implementation** – Execution of the Program Plan [the Formulated Project] in a cost effective manner.
Project Phases

• **Pre–Phase A** – Concept Studies – Evaluation of a broad spectrum of ideas and alternatives for new missions including mission concepts, requirements, and technology

• **Phase A** – Concept & Technology Development – Formation of project team, development of baseline mission concept, define/begin development of needed technologies

• **Phase B** – Preliminary Design and Technology Completion – Completion of preliminary design and technology development

• **Phase C** – Final Design and Fabrication – Completion of final design, begin fabrication of test and flight article components, assemblies, and subsystems

• **Phase D** – System Assembly, Integration and Test, Launch – Completion of system assembly, integration and test

• **Phase E and F** – Operations and Closeout – Transition from Phase D to Phase E occurs when on–orbit checkout has been completed—typically 30 to 90 days after launch.
  - At the end of the nominal operational lifetime of the mission, HQ may decide (on the basis of science and programmatic data provided by the Center) to go into “Extended Operations”. A formal decision is made – KDP–F—to continue operations or to initiate decommissioning.
  - At the end of the useful lifetime of the mission, a Decommissioning Review is held to confirm readiness to proceed with the safe decommissioning and disposal of mission assets in accordance with NASA policy on limiting orbital debris.