PI LAUNCHPAD
VIRTUAL SUMMIT
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Architecture & Formulation

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You are interested in developing your first flight mission proposal but have no idea where to start.

Pre-Phase A Concept Studies - so you get *approved* for formulation.

### NASA/JPL Project Lifecycle (7120.5E)

#### Lifecycle Phases

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#### Assigned Missions

- **NASA Decision Points**
  - Down Select
  - Project Selection

- **NASA Project Reviews**
  - Step 1
  - Proposal Reviews
  - Step 2
  - Proposal Reviews

- **JPL Project Reviews**
  - Proposal Reviews
  - Step 1

#### Completed Missions

- **NASA Decision Points**
  - KDP C
  - KDP D
  - KDP E
  - KDP F

- **NASA Project Reviews**
  - KDP C
  - KDP D
  - KDP E
  - KDP F

- **JPL Project Reviews**
  - KDP C
  - KDP D
  - KDP E
  - KDP F

#### Other Reviews and Events

- **ASM**
- **PMSR**
- **PIR**

#### Notes

1. Review is followed by a JPL CMC. If the review immediately precedes a KDP, a Mission Directorate and/or Agency PMG/GPMC, as appropriate, are required prior to the KDP.
2. The SRR and MDR may be combined.
3. SIR is a “soft gate”, project may initiate Phase D work immediately upon completion of Phase C work products, absent a notice of discontinuance from the Program Manager.
4. CERRs are established at the discretion of Program Offices.
5. When missions are extended beyond their prime mission, JPL conducts an EMR. NASA conducts an SR; the extended mission remains in Phase E.
6. When there are multiple (3) copies of a system, a Production Readiness Review is held.
7. Projects selected with a one-step proposal process start in Phase A and conduct the reviews identified for Assigned Missions beginning with the SRR.

#### Legend

- **ASM** - Acquisition Strategy Meeting
- **CDR** - Critical Design Review
- **CERR** - Critical Events Readiness Review
- **CMC** - Center Management Council
- **DR** - Decommissioning Review
- **DRR** - Disposal Readiness Review
- **EMR** - Extended Mission Review
- **EQPM** - End of Prime Mission
- **FRR (LV)** - Flight Readiness Review Launch Vehicle
- **GPM** - Governing Program Management Council
- **KDP** - Key Decision Point
- **MC** - Mission Concept Review
- **MDR** - Mission Definition Review
- **MRB** - Mission Readiness Briefing
- **MRR** - Mission Readiness Review
- **ORR** - Operations Readiness Review
- **PDR** - Preliminary Design Review
- **PIR** - Proposal Implementation Review
- **PLAR** - Post Launch Assessment Review
- **PMG** - Program Management Council
- **PMSR** - Project Mission System Review
- **SIR** - System Integration Review
- **SMR** - Safety and Mission Success Review
- **SR** - Senior Review
- **SRR** - System Requirements Review

#### Review Dates

- 08/05/2013
- 08/05/2013

#### Review Conducted

- Reviews conducted with NASA-appointed Standing Review Board
The Purpose of Pre-Phase A Concept Studies

to conduct trades

- The purpose of Pre-Phase A Concept Studies is to produce a broad spectrum of ideas and alternatives for missions from which new programs/projects can be selected. Determine feasibility of desired system, develop mission concepts, draft system-level requirements, assess performance, cost, and schedule feasibility; identify potential technology needs, and scope.
- Trade: to exchange something for something else, an alternative
...from which new programs/projects can be selected (approved)

The three principal boundary conditions

- **CAPABILITY WALL**
  - e.g., Size, Mass, Power,...

- **COST CEILING**
  - e.g., Cost Cap

- **SCIENCE FLOOR**
  - e.g., Past, Current, and Future Projects.

- **NASA DESIRABILITY**
- **TECHNICAL FEASIBILITY**
- **APPROVABILITY**
- **PROJECT VIABILITY**
Principal Trade Space Dimensions for Approvability

Science, Engineering, Management, & Communications

Architecture & Formulation

6/21/21
When your approach breaks (hollow arrows), look at the choices you are making (boxes - design), and at the choices that brought you there (branches - architecture).

**EXAMPLE:**
Your system cannot downlink all the data collected over the course of a day. You could upgrade the radio, add instrument data compression, and/or revisit your sampling requirements.
Science Trades: Requirements Architecture

You will always run out of money before you run out of science

MTM

STM

NASA Goal(s)

Project Objective(s)

Measurement Requirements for Physical Parameter(s)

Measurement Requirements for Observable(s)

Mission Requirements

Instrument Requirements

Mission Design Requirements

Spacecraft Requirements

Ground System Requirements

Operations Requirements
Big changes come from changing branches, not leaves.

Architecting is changing the allocation of functions *amongst* branches. Designing is finding the solution *at* a node. Designs includes *structure* and *behavior*.

EXAMPLE: Split in data processing between Flight Segment and Ground Segment

EXAMPLE: Split in pointing between Instrument and Spacecraft

EXAMPLE: Split in attitude control between wheels and thrusters
Trade Space Methods

*Use phase and detail appropriate estimation methods – not only bottoms up*

![Diagram showing Trade Space Methods]

- Early in a Project
  - High Level of Detail
    - Analogy
  - Low Level of Detail
    - Parametric
    - Grass Roots/Bottoms Up
    - Actual Results

- Late in a Project
• Alfred Nash
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