NASA System Engineering Design Process

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What is System Engineering

- Systems engineering is a methodical, disciplined approach for the design, realization, technical management, operations, and retirement of a system.
- A “system” is a construct or collection of different elements that together produce results not obtainable by the elements alone.
- The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results.
- The results include system-level qualities, properties, characteristics, functions, behavior, and performance. The value added by the system as a whole, beyond that contributed independently by the parts, is primarily created by the relationship among the parts; that is,
  - how they are interconnected.1 It is a way of looking at the “big picture” when making technical decisions.
  - It is a way of achieving stakeholder functional, physical, and operational performance requirements in the intended use environment over the planned life of the systems.
- In other words, systems engineering is a logical way of thinking
One of the fundamental concepts used within NASA for the management of major systems is the program/project life cycle.

- Decomposing the project life cycle into phases organizes the entire process into more manageable pieces.
- Each phase terminates with a Key decision point (KDP).
- KDPs are supported by major reviews, (SDR, PDR, etc).
Project Phases

In order to make our work more effective, NASA's engineering handbook provides a structured approach to project management. This approach divides projects into two major life cycle phases: Formulation and Implementation. Each phase has specific purposes and goals to achieve at the end of the cycle. Additionally, at the end of each phase, a major review is performed to determine the completion of the phase.

**3.5 Project Phases: Preliminary Design and Technology Completion**

During Phase B, efforts are focused on establishing an initial project baseline, which includes:

- **Preliminary Design and Technology Completion**
  - Formulation
  - Implementation

Each major phase is divided into project life cycle phases:

- **Pre-Phase A**
- **Phase A-E**

Each phase has a purpose and a goal to achieve at the end of the cycle.

At the end of each phase, a major review is performed to determine the completion of the phase.
Each major review has a purpose and a goal

- An entry and exit criteria are defined before the review is performed to assess the acceptance of the review
- Typically this reviews are performed by the team/project presenting to a board
- The Board is the entity that determine the success of the review and approving the completion of the current life cycle phase and approving to move into the next phase
- The board is composed of experts, managers, etc.
Documents

- NASA Space Flight Program and Project Management Requirements, NPR 7120.5D
  - http://nodis.hq.nasa.gov/npg_img/N_PR_7120_005D_/N_PR_7120_005D_.pdf

- NASA System Engineering Process and Requirements, NPR 7123.1A

- NASA System Engineering Handbook, SP-2007-6105,