Systems Engineering at JPL

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What is Systems Engineering?

1. SE is not based on physics
2. SE is cultural
3. SE is how people in an organization agree to behave
4. SE is practiced different in different cultures and organizations
5. SE is frequently identified as being lacking or poorly implemented on projects which fail
6. SE is rarely noted as being well implemented on projects that succeed.
7. SE is hard to measure
8. SE frequently causes passionate debate among practitioners.

What is Systems Engineering?

There are many long definitions…

NASA SE Handbook: “Systems Engineering is a robust approach to the design, creation, and operation of systems.”

INCOSE What Is Systems Engineering: “Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem: Operations, Performance, Test, Manufacturing, Cost & Schedule, Training & Support and Disposal.”

CMMI Systems Engineering: “Systems engineering covers the development of total systems, which may or may not include software. Systems engineers focus on transforming customer needs, expectations, and constraints into product solutions and supporting these product solutions throughout the life of the product.”

EIA/IS-632: Systems engineering is “an interdisciplinary approach compassing the entire technical effort to evolve and verify an integrated and life-cycle balanced set of system people, product, and process solutions that satisfy customer needs.”

USAF SMC 2004: “SE involves both technical and management processes. SE is the management function that controls the total system development effort for the purpose of achieving an optimum balance of system elements. It is a process which transforms an operational need into a description of system parameters and integrates those parameters to optimize overall system effectiveness over the lifetime of the system.”

JPL Systems Engineer Competency Model

"JPL systems engineering is the implementation of the 10 functions, across the product life cycle at any WBS level and is performed by individuals exhibiting the highly effective behavioral characteristics of JPL systems engineers, who have authentic technical domain expertise essential to the success of the system they are developing."

This model will be used to:
- Perform active career management
- Drive training content
- Assess candidates for open positions
- Conduct internal assessments

Personal Behaviors

Demonstrates a designated set of personal behaviors

- Intellectual curiosity- ability and desire to learn new things
- Ability to make system wide connections
- Strong team member and leader
- Comfortable with uncertainty and unknowns
- Proper paranoia - expect the best but plan for the worst
- Self confidence and decisiveness short of arrogance
- Appreciation for process rigor and knowing when to stop
- Diverse technical skills - ability to apply sound technical judgement
- Comfortable with change
- Exceptional two way communicator
- Ability to sees the big picture - yet get into the details

Technical Knowledge (breadth & depth)

- Expresses an authentic grasp of the technical fields pertinent to the system of interest
- Is a generalist in nature, but with proven depth of technical knowledge in 1 or more areas relevant to their system
- Pertinent technical knowledge is unique to each SE domain, e.g., Flight System, MOS, Radar, Avionics, Software, . . .

SE Practices & Processes

Has proven knowledge of systems engineering functions & practices, RULES! 75012

1. Architecting
2. Requirements
3. Analyze and Characterize
4. Interfaces
5. Verification and Validation
6. Technical Resources
7. Reviews
8. Risk Management
9. Change Management
10. SE Task Planning

JPL 10 Systems Engineering Functions

At JPL Systems Engineering practices are organized as ten systems engineering functions

1. Architecture
2. Requirements
3. Analyze and Characterize the Design
4. Manage Technical Resources and Performance
5. Interface Development and Management
6. Verification and Validation
7. Systems Engineering and Reviews
8. Systems Engineering and Risk Management
9. Manage and Control the Design
10. Manage the Systems Engineering Task

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