Course 332:
Systems Engineering and Systems Engineering Management
(4 days)

Course Description…

Systems engineering is an interdisciplinary approach to enable realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle; documenting requirements; designing and constructing the system; validating and deploying the system; and maintaining and evolving the system during its operational lifetime. This course explores the system engineering process and its benefits to customers, users, managers, and maintainers, with the concepts reinforced by student workshops.

Learning Objectives…

- Understanding systems and systems engineering
- How to construct system engineering requirements.
- How to perform a functional analysis
- How to develop a system architecture
- How to perform system design and development
- How to validate and deploy a system
- How to maintain a system

Who should attend…

Systems engineers, software and hardware engineers, maintenance personnel, and system engineering managers.

Prerequisites…

No specific prerequisites are needed.

See next page for a detailed course outline…

Course Outline…

Chapter 1: Introduction

Chapter Objectives

Definitions

- System
- System engineering

Understanding Systems and Systems Engineering

- Systems and systems engineering in the project/program environment
- The system development life cycle
- The systems engineering process

Need for systems engineering

- Meet complex requirements
- Ensure interoperability
- Reduce implementation risk
- Ensure sustainability

System life cycle phases

- Concept exploration
- Program definition and risk reduction
- Engineering and manufacturing development
- Production, deployment, and operational support

System engineering infrastructure

- Project management
- Configuration management
- Quality assurance

System engineering standards

- INCOSE
- IEEE
- NASA

Chapter Summary and Best Practices

Chapter 2: Requirements Analysis

Concepts

- Requirements analysis process overview
- Objectives
- Inputs and outputs
- Requirements analysis views
- Analytical questions to ask
- Requirements types
- Properties of good requirements

Process activities

- Establish customer expectations and constraints
- Produce operational scenarios and measures of effectiveness
- Define system boundaries and interfaces
- Preliminary assessment of recommended concept (cost, schedule, …)
- Elicit functional and performance requirements

- Articulate operational environments
- Specify life cycle process concepts and environment profile

Requirements engineering

- Definitions
- Relationship of requirements to other work products
- Specification structure, audience, and standards
- Gathering information
- Using the context diagram

Workshop: defining a context diagram

Functional and performance requirements

- Definitions
- Functions, modes, and states
- Use case properties
- Types of non-functional requirements
- Response time, throughput, availability, and capacity

Workshop: specifying functional and performance requirements

Chapter Summary and Best Practices

Chapter 3: Functional Analysis and Allocation

Concepts

- Process objectives
- Inputs and outputs

Process activities

- Lower-level decomposition
- Define and refine functional architecture
- Allocate requirements
- Define and refine functional interfaces
- Conduct trade-off studies

Functional analysis

- Functional decomposition
- Functional partitioning
- Functional analysis tools

Workshop: functional decomposition

Allocation

- Allocation process
- Requirements allocation
- Trade-off analysis

Workshop: trade-off study

Chapter Summary and Best Practices

Chapter 4: Design Synthesis

Concepts

- Process objectives
- Inputs and outputs
- Decision database
- Modular design

Process activities

- Group and allocate functions
- Identify solution alternatives
- Assess safety and environmental hazards
- Assess lifecycle quality factors
- Assess technology requirements
- Define design and performance characteristics
- Define physical interfaces
- Identify standardization opportunities
- Identify available off-the-shelf hardware or software
- Identify make or buy alternatives
- Develop models and prototypes
- Assess failure modes, effects, and criticality
- Assess testability needs
- Assess design capacity to evolve
- Finalize design and initiate evolutionary development
- Produce integrated data package
- Establish design architecture

Workshop: design alternatives

Chapter Summary and Best Practices

Chapter 5: Systems Analysis and Control

Concepts

- Process objectives
- Inputs and outputs

Process activities

- Measure progress
- Perform cost effectiveness and risk analyses
- Select preferred alternatives
- Control and manage
- Retirement
- Trade-off studies and analyses
- Analysis of alternatives

Tools and techniques

- Modeling and simulation
- Technical reviews and audits
- Work breakdown structure
- Configuration management
- Metrics
- Risk management

Exercises: simulation; work breakdown structures; measures of effectiveness; earned value analysis.

Chapter Summary and Best Practices

Chapter 6: Loops

Concepts
- Objectives
- Loop termination criteria

Requirements Loop
- Requirements evaluation process
- What to look for

Design Loop
- Criteria for revisiting functional architecture
- Design traceability

Verification Loop
- Objectives
- Verification process
- Verification techniques

Workshop: specifying verification techniques

Chapter Summary and Best Practices

Chapter 7: The Bottom Line

Course summary
Students' perspectives

Please contact your ROI Representative to discuss customizing/tailoring this course to your unique environment!!!