

14. Systems Design & Engineering

Systems Design and Engineering deals with integrating aspects of other engineering disciplines, ensuring that all likely aspects of a project or system are considered and efficiently integrated together. This area contains a strong cross coupling to Industrial Engineering. Refer to the Systems Engineering Body of Knowledge (SEBoK) for additional details.

14.1. Mission Engineering

- 14.1.1. Articulation and analysis of purpose for the system

14.2. Requirements Analysis and Allocation

- 14.2.1. Requirements statements
- 14.2.2. Obtaining requirements
- 14.2.3. Derived & allocated requirements
- 14.2.4. Requirements analysis
- 14.2.5. System specification
- 14.2.6. Interfaces
 - 14.2.6.1. Internal
 - 14.2.6.2. External
- 14.2.7. Value engineering
- 14.2.8. Sensitivity analysis
- 14.2.9. Trade studies

14.3. System Architecting

- 14.3.1. Architecture descriptions
- 14.3.2. Steps in system architecting
- 14.3.3. Fundamental design choices in constructing a system
- 14.3.4. Pareto Principle (80 - 20 rule)

14.4. Subsystem Design

- 14.4.1. Detailed design of elements
- 14.4.2. Interface control

14.5. System Construction

- 14.5.1. Hardware, software, human components
- 14.5.2. Integration

14.6. Verifying and Validating Requirements

- 14.6.1. Verification program components
 - 14.6.1.1. Requirements
 - 14.6.1.2. Planning
 - 14.6.1.3. Success criteria
 - 14.6.1.4. Reports
 - 14.6.1.5. Compliance
- 14.6.2. Test and evaluation

- 14.6.3. Design of Experiments (DOE)
- 14.6.4. Satisfaction of all user and customer requirements

14.7. Design Iteration

- 14.7.1. Refinement
- 14.7.2. Convergence
- 14.7.3. Robust systems

14.8. Product & Services Design

14.9. Role of Models in Systems Design Process

- 14.9.1. Model vs actual system
- 14.9.2. System objectives / User input
- 14.9.3. Analyzing model output for system design decisions

14.10. Completing the Systems Engineering Process

- 14.10.1. Establishing a systematic & repeatable process
 - 14.10.1.1. Technical performance measures
 - 14.10.1.1.1. Technical data management
 - 14.10.1.1.2. Configuration management
- 14.10.2. Life cycle costing
 - 14.10.2.1. Cost estimation models and techniques
 - 14.10.2.1.1. Design, development, manufacturing, operations, and supportability
 - 14.10.2.2. Cost effective trade-offs to customer problems (see Engineering Economic Analysis knowledge area)
- 14.10.3. Limitation of humans in systems
- 14.10.4. Risk analysis
 - 14.10.4.1. Cost, schedule, and performance risk
- 14.10.5. Concurrent engineering
- 14.10.6. Integrated logistics support
 - 14.10.6.1. Interoperability and harmonious system operation
- 14.10.7. Reliability, maintainability, availability (see Quality & Reliability Engineering knowledge area)
- 14.10.8. Quality assurance and management (see Quality & Reliability Engineering knowledge area)
- 14.10.9. Specialty engineering
- 14.10.10. Preplanned product improvement
- 14.10.11. Training
- 14.10.12. Documentation
- 14.10.13. Production
- 14.10.14. Installation
- 14.10.15. Operations and maintenance
- 14.10.16. Operations evaluation / Reengineering
- 14.10.17. Systems engineering management
 - 14.10.17.1. Planning
 - 14.10.17.2. Organizing
 - 14.10.17.3. Directing

14.10.17.4. Monitoring

REFERENCES:

Guide to the Systems Engineering Body of Knowledge (SEBoK). Pyster, Art (ed) and Olwell, David (ed). The Trustees of the Stevens Institute of Technology. 2013.

Systems Engineering and Analysis. Blanchard, Benjamin S. and Fabrycky, Wolter J. Pearson, 5th Edition. 2011

Systems Engineering: Principles and Practice. Kossiakoff, Alexander, Sweet, William., Seymour, Sam., and Biemer, Steven M. John Wiley & Sons, 2nd Edition. 2011.

Essentials of Project and Systems Engineering Management. Eisner, Howard. John Wiley & Sons, 3rd Edition. 2008.

Requirements Engineering. Hull, M. Elizabeth C., Jackson, Kenneth, and Dick, Jeremy. Springer; 2nd edition. 2004.

The Engineering Design of Systems: Models and Methods, Wiley Series in Systems Engineering. Buede, Dennis M., and Miller, W., Wiley-Interscience, Hoboken, New Jersey, 3rd Edition. 2016.

INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, Walden, D. and Roedler, G., Editors, John Wiley 4th Edition, 2015.