Systems Engineering

for Technology-Based Projects & Product Developments

A Course Over Five Days




This course will provide a strong foundation to help you and your organization meet budgets and schedules and delight your stakeholders with the products of your work.

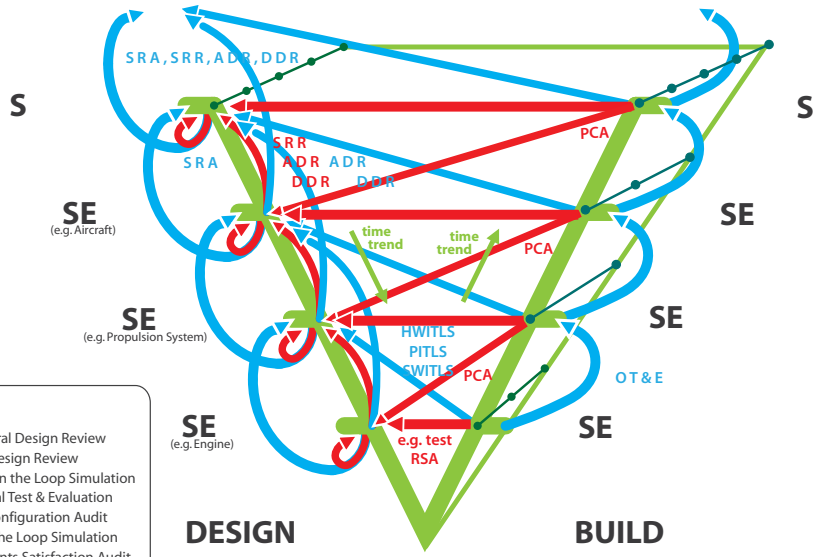
The course, already delivered to over 6,000 satisfied delegates on six continents, addresses systems engineering as it is understood and practiced in high performance organizations (developer, acquirer, and supplier). The course is directly applicable within any enterprise business model – product-oriented companies, systems houses, and purveyors of internal projects. The course provides an integrated approach to the set of technical and management disciplines which combine to help satisfy requirements, optimize system effectiveness, enhance project and product success, and reduce risk.

Who should attend this course?

- systems engineers
- software engineers
- electrical engineers
- design engineers
- project directors
- project advisers
- project managers
- engineering managers
- Anyone who develops non-trivial solutions to non-trivial problems, regardless of job title

"Awesome! Motivated from the very beginning. The examples are well chosen and meaningful."
delegate, INPE, Brazil

"Mr Halligan's "common sense" approach to systems engineering. With such a variety of SE techniques used on DoD projects, it's nice to know there is a sound systematic approach – now if only everyone I work with could learn it!"
delegate, U.S.A



Legend :

●	A Build
ADR	Architectural Design Review
DDR	Detailed Design Review
HWITLS	Hardware in the Loop Simulation
OT&E	Operational Test & Evaluation
PCA	Physical Configuration Audit
PITLS	People in the Loop Simulation
RSA (FCA)	Requirements Satisfaction Audit
S	Top Level System
SE	System Element
SRA	System Requirements Analysis
SRR	System Requirements Review
SWITLS	Software in the Loop Simulation

Verification :
Is the work product correct-meets requirements?

Validation:
Does the work product satisfy the need for the work product?

WEDGE DIAGRAM™

This course is recognized by Engineers Australia for CPD purposes (40 Hours)

This course is certified by ECSA for 5 points (ref. INCOSE 13/002/15)

Attendance at public courses and on-site delivery in Australia may be eligible for SADI funding.

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Systems Engineering

Course Outline

PROJECT PERFORMANCE INTERNATIONAL

0. Introduction - Why Systems Engineering?

1. The System Life Cycle and Solution Development

- systems thinking
- defining "the problem"
- the solution domain: key concepts, relation ships, information types and work products
- OCD/CONOPS/OSD/ADD issues
- architectural frameworks
- relationship between problem definition and stakeholder satisfaction
- systems of systems engineering (systems of autonomously managed systems)
- waterfall, incremental, evolutionary and spiral developments
- concepts of agile, lean and concurrent/simultaneous engineering
- summary of key concepts

2. Systems Engineering Standards

- definitions of systems engineering from standards
- standards and guidelines – pitfalls and pointers
  - ISO 9001, IEEE 1220, EIA/IS–632, EIA 632, J–STD-016, ISO/IEC 15288: 2008, ISO/IEC I5288: 2014
  - engineering handbooks, texts

3. Systems Engineering Processes: Principles, Concepts and Elements

- ***workshop - principles of the engineering of systems***
- system concepts
- SE process principles & elements
- requirements analysis
- development of physical solution description
- development of logical solution description
- MBSE: (model-based architecting/design)
- effectiveness evaluation and decision – trade studies
- description of systems elements – specification writing
- system integration
- verification and validation
- engineering management
- ***workshop - matching common activities to the SE elements***
- work product attributes
  - requirements traceability
  - design traceability
  - test/verification traceability

4. Requirements Analysis

- what are requirements?
- types of requirements, and how they relate to analysis, specification & design
- requirements quality attributes
- requirements languages other than natural: operational, formal
- requirements analysis (RA) – how to do it
- ***workshop - context analysis***
- ***workshop - design requirements analysis (interactive whiteboard exercise)***
- ***workshop - states and modes analysis***
- ***workshop - parsing analysis***
- requirements quality metrics
- ***workshop - functional analysis***
- lean concepts in functional analysis for the product-oriented enterprise
- ERA analysis, rest of scenario analysis, out-of-range analysis, other constraints search, stakeholder value analysis
- the Operational Concept Description (OCD)
- managing RA
- requirements analysis and management software tools
- common pitfalls in performing RA

5. Development of the System Physical Solution Description (Synthesis) - Part 1

- technology and innovation in solution development
- configuration items
- criteria for selecting configuration items

6. Development of the System Logical Solution

- types of logical representation
- functional analysis in design – how to do it
  - functional analysis/architecture process
  - ***workshop - development of a physical solution***
  - ***workshop - development of functional solution***
- performance threads
- SysML, LML and other systems modeling languages
- n-squared charts, behavior modeling, and other functional notations
- analysis and design software tools
- pitfalls in developing system functional solution

7. Development of the System Physical Solution Description (Synthesis) - Part 2

- use of design driver requirements
- the system physical architecture related to the functional architecture
- facilities, procedures and people
- the specification tree
- object oriented design
- common pitfalls in developing system physical architecture
- adding the detail to the design
- DFSS: e.g. Design of Experiment (DOE) and test matrices
- interface engineering
- common interfacing pitfalls

8. Effectiveness Evaluation and Decision Making

- design meetings
- approach to design optimization
  - the role of MOE's and goals
  - constructing a system effectiveness model
  - designing utility functions
  - taking account of risk
  - iterative optimization of design
- working with budgets, targets and ceilings
- value engineering
- ***workshop - engineering decision making - developing a system effectiveness model***
- ***workshop - engineering decision making - performing a trade-off study***
- multiple stakeholders, multiple uses, event based uncertainty
- handling, in design, conflict of interest between customers and suppliers
- pitfalls in effectiveness evaluation and decision (avoiding the smoke and mirrors)

9. Description of System Elements - Requirements Specification Development

- the eight requirement specification types and their uses
- public specification standards - the good, the bad, and the ugly
- specification structure principles
- use of FFBD's to structure a requirements specification
- good and poor terminology
- recommended DID's and templates
- ***optional workshop - evaluation of two requirements specifications***
- pitfalls in preparing requirements specifications

10. Engineering Specialty Integration (ESI)

- what makes an engineering specialty special?
- common engineering specialties
- a generic approach to ESI
- organizational issues of ESI
- pitfalls, and specialty engineering examples

11. Systems Integration

- design interaction with hardware and software production
- integration planning
- integration
- integration testing
- using incremental builds
- configuration audits
- qualification
- pitfalls and pointers in system integration

12. Verification and Validation

- verification and validation terms defined
- lean concepts in V&V
- technical reviews
  - requirements reviews
  - principles of design review
  - architectural design review (ADR) - relationship to PDR
  - detail design review (DDR) - relationship to SDR, CDR
  - test readiness review (TRR)
  - requirements satisfaction audits (FCA's)
  - design description (BS-BS) audits (PCA's)
  - technical reviews and incremental builds
  - administration of technical reviews
  - customer involvement in technical reviews
  - pitfalls in conducting technical reviews
- test and evaluation
- other verification and validation methods and tools

13. Systems Engineering Management

13.1. Management Principles

- basic concepts
- application of lean concepts in planning and process design
- organization - functional, project, Integrated Product Teams

13.2. Engineering Planning

- scoping SE - the SEP (SEMP)?
- why prepare a SEP?
- how a SEP may relate to other plans
- content of the SEP
- pitfalls in preparing a SEP
- functional interfaces

13.3. Project Breakdown Structures

- types of PBS (WBS)
- why the PBS is a foundation of effective engineering management
- rules in preparing a PBS
- PBS/WBS Standards and Guides
- relationship of a PBS to cost accounts
- relationship of a PBS to work packages
- PBS (WBS) development pitfalls and pointers
- ***optional workshop - developing a PBS (WBS)***

13.4. Configuration Management (CM)

- what is configuration?
- the concept and types of baseline
- CM standards – EIA, IEEE, etc.
- the four fundamental CM activities
- pitfalls and pointers in CM

13.5. Technical Performance Measurement

13.6. Risk Management

- the nature of risk
- components of risk
- the five key activities of risk management

14. Summary

- systems engineering summarized
- tailoring to specific activities or projects
- getting the most out of systems engineering methods
- systems engineering capability assessment and improvement