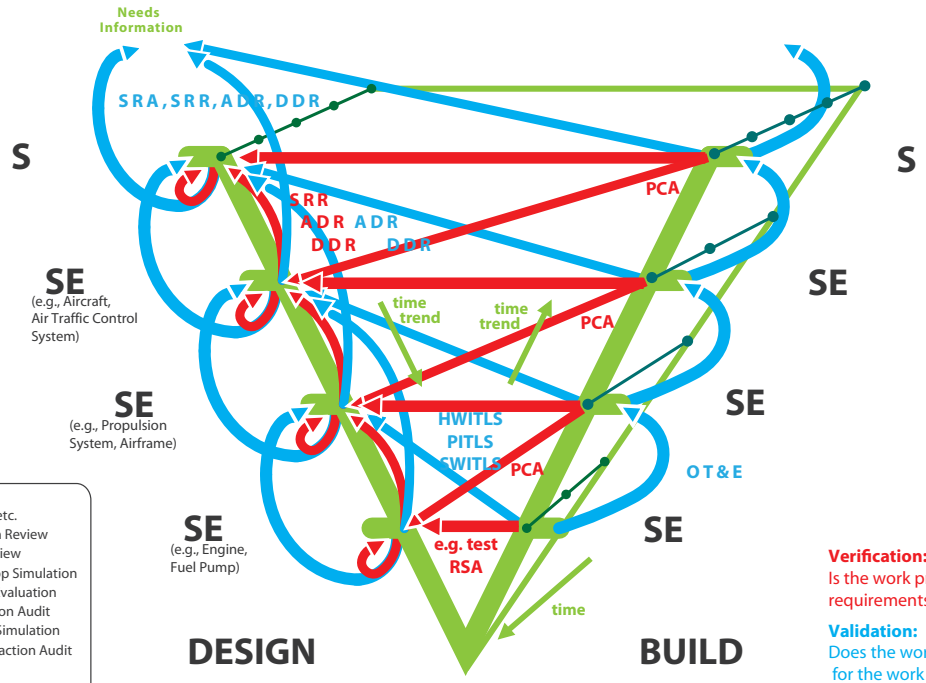
SYSTEMS ENGINEERING

SAVE MONEY, SAVE TIME, AND ...

5-DAY COURSE

... DELIGHT YOUR STAKEHOLDERS WITH THE PRODUCTS OF YOUR ENGINEERING.

This five day Systems Engineering for Technology-Based Projects and Product Developments training is intended for anybody who will perform or manage significant engineering roles, whether under the name "systems engineering" or not. This course is ideal for formal systems engineering training in that it leads the participant through the ways of thinking and acting that is systems engineering. Our Systems Engineering training provides an integrated approach to the set of management and technical disciplines that combine to optimize system effectiveness, enhance project success and reduce risk. Ways of achieving corporate objectives, e.g., time to market, cost of goods sold, product quality, strategic objectives, are a constant theme throughout the course.



Legend :

●	A Build, increment, etc.
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

PPI-006003-10

Verification:
Is the work product correct-meets requirements?

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

WEDGE MODEL™

"I'd like to thank you for the huge amount of knowledge you gave to us. What an impressive performance to fulfill five full days of transferring very interesting stuff, a real enrichment for planning and executing our projects."

- delegate, TNO, the Netherlands

PROJECT PERFORMANCE INTERNATIONAL

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COURSE OUTLINE

0. Introduction – Why Systems Engineering?

1. The System Life Cycle and Solution Development

- systems thinking
- defining "the problem"
- the solution domain: key concepts, relationships, information types and work products, MBSE
- 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
  - EIA/IS-632, EIA 632, IEEE 1220, ISO/IEC 15288: 2008, ISO/IEC 15288: 2015, ISO 9001
  - engineering handbooks, texts

3. Systems Engineering Processes: Principles, Concepts and Elements

- ***workshop – principles of the engineering of systems***
- system concepts
- SE process 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 system elements – specification writing
- system integration
- verification and validation
- engineering management
- ***workshop – matching common activities to the SE process 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. MBSE in the problem domain
- ***workshop – context analysis***
- ***workshop – states and modes analysis***
- ***workshop – parsing analysis of example requirements***
- requirements quality metrics
- ***workshop – functional analysis in requirements analysis***
- ERA analysis, rest of scenario analysis, out-of-range analysis, other constraints search, stakeholder value analysis
- the Operational Concept Description (OCD/CONUSE/OpsCon)
- managing RA
- requirements analysis and management software tools
- common pitfalls in performing RA

5. Development of the System Physical Solution Description – Part 1

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

6. Development of the System Logical Solution (MBSE In Design)

- types of logical representation
- functional analysis in design – how to do it
  - functional analysis/architecture process
  - ***workshop - physical and functional design***
- performance threads
- SysML, AADL, OPM and other systems modeling languages
- state-based modeling
- 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 – 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

- approach to design optimization
  - the role of MOEs and goals
  - constructing a system effectiveness model
  - capturing utility functions
  - taking account of risk
  - iterative optimization of design
- working with budgets, targets and ceilings
- value engineering
- ***workshop – engineering decision-making***
- 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
- good and poor terminology
- recommended DIDs and templates
- 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. System Integration

- integration planning
- alternative system integration strategies
- 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 (FCAs)
  - design description (BS-BS) audits (PCAs)
  - 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 Program Controls

13.6 Risk Management

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

14. In Closing

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

To register please visit our website or call our friendly registration team:

PO Box 2385
Ringwood North
Victoria, 3134 Australia

+61 3 9876 7345

contact@ppi-int.com

www.ppi-int.com

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P006-005937-3/v.32