

5-DAY COURSE

# Systems Engineering

## For Technology-Based Projects

Commit to engineering excellence in quality, cost and time

## Years of Learning in a Single Week

The potential of systems engineering is extraordinary, and creates almost unlimited opportunity for professionals with the practical skills and process understanding needed to **engineer systems and products more effectively**. PPI's approach to sharing SE uses expert presentations, discussions, and team workshop activities. We cover core areas of SE conduct, and explain how each of these elements functions within a development system. You'll discover that SE offers a rich body of sound engineering and management methods that benefit the entire enterprise.

## Designed for Busy Professionals Like You

The course is designed with overall development success in mind, and balances theory with a host of practical tools, tips and pitfalls to avoid. Whilst valuable to anyone who holds development responsibility, the primary beneficiaries include:

- Project and program management
- Engineering leadership and all engineers
- Quality, security, specialty engineering areas, system testing, operations, and support.

## Offering a Lifetime of Benefit

Upon course completion, participants will have the ability to create new value in many ways:

- Perform each of the major SE activities, and explain how the SE tasks are integrated into overall project execution.
- Translate fuzzy stakeholder intentions into valid and verifiable requirements, enabling manageable traceability between needs and solutions.
- View all requirements and design as a model, representable in many ways, and recognize when to invest in creation of MBSE and other formal expressions.
- Utilize SE to identify and champion the “voice of everyone” throughout the system life cycle, thereby eliminating entire classes of system risk exposure.
- Effectively apply the logic of SE to fit widely differing needs, ranging from selective use of a few key tools to substantial adoption on major developments.
- If appropriate, unleash your inner entrepreneur and use SE to launch the product of your dreams.

### Earn CE/CPD Credit

*This course is recognized for professional development purposes:*



**INCOSE CSEP  
Renewal**

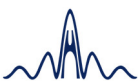
- 40 Continuing Education PDU's



**PMI Talent Triangle®  
Suggested PDU's**

- 35 Technical Project Mgt
- 2 Leadership
- 3 Strategic & Business Mgt

**20,000+ Professionals Trained Across 43 Countries**



PPI-008759-7-US

© Copyright and all other rights reserved Project Performance International 1992–2026.  
All trademarks, logos and brand names are the property of their respective owners.

**ppi-int.com**

# PPI Training Reviews



*“The learning you provided on the **fundamentals of systems engineering** has helped me throughout my entire career.”*

**Course participant,  
Türkiye**



*“This intensive course has been an **enlightening journey**, and I’m excited to apply these principles in my future endeavors.”*

**Course participant,  
Saudi Arabia**



*“The workshops were very **effective**; we were able to apply the acquired knowledge and share it with other course members.”*

**Course participant,  
Japan**



PPI-002756-4

## Why PPI?

### Trusted Worldwide

PPI delivers outstanding training and consulting to many hundreds of enterprises worldwide, from Fortune 100 companies (presently 19% of them) to small start-ups. PPI is a truly international company, with personnel based in eight countries, and clients across six continents benefiting from our work.

### PPI Presenters

PPI’s presenters are internationally recognized systems engineering practitioners and consultants who bring decades of real-world experience, ensuring every concept taught is value-adding, practical, relevant and immediately implementable.



# Systems Engineering 5-Day Course Outline

## Welcome and 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, Model-Based Systems Engineering (MBSE)
- Operational Concept Description (OCD)/Concept of Operations (CONOPS)/Operational Solution Description (OSD)/Architectural Design Description (ADD) issues
- Architecture 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, scaled agile framework and concurrent/simultaneous engineering
- Product Line Engineering (PLE)
- Digital engineering, digital thread, digital twin
- Summary of key concepts

### 2. Systems Engineering Standards

- Definitions of systems engineering from standards
- Standards and guidelines – pitfalls and pointers
- Electronic Industries Alliance (EIA)/Interim Standard (IS) 632, EIA 632, Institution of Electrical and Electronic Engineers (IEEE) 1220, International Standardization Organization (ISO)/International Electrotechnical Commission (IEC) 15288: 2008, ISO/IEC/IEEE 15288: 2015, ISO/IEC/IEEE 15288:2023
- Capability Maturity Models (CMMs)

### 3. Systems Engineering Processes: Principles, Concepts and Elements

- **Workshop – principles of systems engineering**
- Design concepts
- The engineering overhead-design complexity tradeoff
- The Wedge Model™ – verification and validation
- 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
- Specification of systems elements – requirements 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 and 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 – design requirements analysis (interactive whiteboard exercise)**
- **Workshop – states and modes analysis**
- **Workshop – parsing analysis of example requirements**
- Requirements quality metrics
- **Workshop – functional analysis in requirements analysis**
- Entity Relationship Attribute (ERA) analysis, rest of scenario analysis, out-of-range analysis, other constraints search, stakeholder value analysis
- The Operational Concept Description (OCD)/Concept of Use (CONUSE)/Concept of Operations (OpsCon)
- Managing RA
- Requirements analysis and management software tools
- Application of AI to RA
- 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
- Application of AI to initial physical conceptualization

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

- Types of logical representation
- Functional analysis in design – how to do it and to what degree
  - Functional analysis/architecture process
  - **Workshop – physical and functional design**
- Coupling, cohesion and connectivity
- Performance thread analysis
- Systems Modeling Language (SysML v2), and other system modeling languages
- State-based modeling
- N-squared charts
- Analysis and design software tools
- Application of AI to logical design
- Pitfalls in developing system functional solution

# Systems Engineering 5-Day Course Outline (Continued)

## 7. Development of the System Physical Solution

### Description – Part 2

- Review of progress against challenges
- 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
- Design For Six-Sigma (DFSS): e.g., Design of Experiments (DOE)
- Interface engineering
- Common interface engineering pitfalls
- Further application of AI to physical design

## 8. Effectiveness Evaluation and Decision-Making

- Approach to design optimization
  - The role of Measure of Effectiveness (MOEs) and goals
  - Constructing a system effectiveness model
  - Capturing utility functions
  - Taking account of differences in level of risk related to not meeting requirements
    - Iterative optimization of design
- Working with budgets, targets and ceilings
- Value engineering
- **Workshop – engineering decision-making: conducting a trade-off study**
- Multiple stakeholders, multiple uses, dealing with event-based uncertainty
- Application of AI to trade studies
- Pitfalls in effectiveness evaluation and decision (avoiding the smoke and mirrors)

## 9. Specification of System Elements – Requirements Specification Development

- The eight requirements specification types and their uses
- Public requirements specification standards – the good, the bad, and the ugly
- Requirements specification structure/screen view principles
- Good and poor terminology
- Recommended Data Item Descriptions (DIDs) and templates
- Application of AI to requirements specification of subsystems
- 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
- Application of AI to engineering specialty integration
- Pitfalls, and specialty engineering examples

## 11. System Integration

- System integration planning
- Nine alternative system integration strategies
- Typical system integration activities
- Integration testing
- Configuration audits
- Qualification
- Application of AI to system integration
- Pitfalls and pointers in system integration

## 12. Verification and Validation (consolidation)

- Verification and Validation (V&V) terms defined
- Lean concepts in V&V
- Technical reviews
  - Requirements reviews
  - Principles of design review
  - Architectural Design Review (ADR) – relationship to Preliminary Design Review (PDR)
  - Detailed Design Review (DDR) – relationship to System Design Review (SDR), Critical Design Review (CDR)
  - Test Readiness Review (TRR)
  - Requirements satisfaction audits (Functional Configuration Audits [FCAs])
  - Design description (Build State-Build Standard [BS-BS]) audits (Physical Configuration Audits [PCAs])
    - Technical reviews and incremental builds
    - Administration of technical reviews
    - Pitfalls in conducting technical reviews
- Test and evaluation
- Other verification and validation methods and tools
- Application of AI to verification and validation

## 13. Systems Engineering Management (mainly for reference)

### 13.1 Engineering Planning

- Scoping SE – the Systems Engineering Plan (SEP), Systems Engineering Management Plan (SEMP)?
- Why prepare a SEP?
- How a SEP may relate to other plans
- Content of the SEP
- Pitfalls in preparing a SEP

### 13.2 Project Breakdown Structures (PBS/WBS)

- Types of PBS (Work Breakdown Structure [WBS])
- Why the PBS/WBS is a foundation of effective engineering management
- Rules in preparing a PBS/WBS
- PBS/WBS Standards and Guides
- Relationship of a PBS/WBS to cost accounts
- Relationship of a PBS/WBS to work packages
- PBS/WBS development pitfalls and pointers
- Integrated Product Teams

# Systems Engineering 5-Day Course Outline (Continued)

## 13.3 Configuration Management (CM) – Reference Only

- What is configuration?
- The concept and types of baseline
- CM standards – EIA, IEEE, etc.
- The four fundamental CM activities
- Pitfalls and pointers in CM

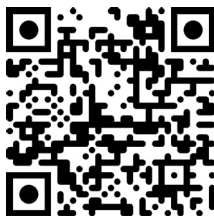
## 13.4 Technical Program Controls – Reference Only

## 13.5 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
- Systems engineering capability assessment and improvement



[www.ppi-int.com](http://www.ppi-int.com)

*systems/product engineering training & consulting  
for project success ...*

