

5-DAY COURSE

Engineering Successful Infrastructure Systems

A systems approach to better infrastructure

Why Engineering Successful Infrastructure Systems?

Infrastructure projects shape economies, communities, and industries, yet too many fall short of expectations through cost overruns, schedule delays, fragmented delivery, and outcomes that fail to maximize stakeholder value. The challenge is rarely one isolated issue. More often, it is the cumulative effect of incomplete identification of stakeholders, inadequate definition of requirements and goals, disconnected engineering decisions, and insufficient life cycle-based thinking.

This course teaches how to engineer infrastructure to deliver maximum value to stakeholders. Built on systems thinking and a strong systems engineering foundation, the course provides practical principles and proven methods for defining infrastructure requirements and goals well, developing better solution concepts, making stronger engineering decisions, and improving delivery outcomes. Participants gain a broader and more disciplined way of thinking about infrastructure, one that reduces risk, strengthens alignment, and improves long-term performance.

What You Will Learn

Participants develop practical knowledge in applying systems thinking to infrastructure engineering, from early needs definition through solution design, implementation, and operational use. The course strengthens understanding of how infrastructure should be defined, evaluated, and engineered as a complete system within a bigger social system rather than as isolated parts.

You will learn practical methods for improving infrastructure decisions, quality of design, and delivery outcomes.

Areas of learning include:

- analysis of stakeholder needs and value
- stronger requirements capture and validation
- usage concepts and life cycle thinking
- physical and logical solution development
- evaluation of solutalternatives and trade-off studies.

Earn CE/CPD Credit

This course is recognized for professional development purposes:



**INCOSE CSEP
Renewal**

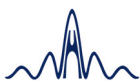
- 40 Continuing Education PDU



**PMI Talent Triangle®
Suggested PDUs**

- 35 Ways of Working
- 2 Power Skills
- 5 Business Acumen

20,000+ Professionals Trained Across 43 Countries



PPI-008989-1-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

Who Should Attend and Why

This course is designed for professionals involved in the planning, design, delivery, operation, or improvement of infrastructure systems. It is particularly valuable where infrastructure projects involve multiple stakeholders, significant investment, operational complexity, and long life cycles.

It is especially relevant for professionals seeking stronger engineering methods to improve infrastructure outcomes.

The course will be valuable to:

- engineers across infrastructure disciplines
- engineering managers and technical leaders
- project and program managers
- planners and asset development professionals
- systems engineering practitioners
- consultants involved in major infrastructure initiatives
- public sector and enterprise decision-makers involved in infrastructure strategy.

Training Methods & Materials

The course is delivered through a balanced combination of formal presentation, guided discussion, and extensive workshop activity designed to reinforce learning through practical application. Realistic exercises help participants connect systems thinking and engineering methods to real infrastructure challenges.

The emphasis is on learning by applying sound methods to practical engineering problems.

Participants receive:

- a comprehensive training manual
- workshop materials and exercises
- practical templates, guides, and checklists
- supplementary reference material for workplace application
- complimentary access to PPI's evolving Systems Engineering Goldmine document and definitions archive.

“The materials shared during the course have been instrumental in expanding my understanding and equipping me with practical insights that I can directly apply to my work starting today.”

– Course participant, United Kingdom

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.



Engineering Successful Infrastructure Systems

5-Day Course Outline

1. Concepts and Definitions

- Problem description definitions
 - Definition: requirement/threshold
 - Definition: measure of effectiveness
 - Definition: measure of performance
 - Definition: target/goal/objective
 - Definition: value (effectiveness) model
 - Definition: operational effectiveness
 - Definition: requirement importance
- Definition: requirements specification
- Definition: design specification
- Concepts related to problem description
 - Definition: need
 - Definition: want
 - Definition: desire
 - Definition: intent
 - Definition: expectation
 - Definition: constraint
- Definition: CONUSE – Concept of Use (also called OCD, OpsCon)
- Definition: solution
- Definition: solution description
- Definition: architecture
- Definition: architectural design description
- Definition: architecture framework
- Definition: OSD – Operational Solution Description
- Definition: detailed design
- Definition: stakeholder
- Definition: verification
- Definition: verification requirement
- Definition: verification requirements specification
- Definition: validation
- Defining the problem, and developing a complete solution
- Life cycle basis of problem definition and solution
- Example requirements and MOEs relating to an infrastructure-related capability
- Example physical levels of solution definition relating to an infrastructure-related capability solution
- Development strategies – waterfall, incremental, evolutionary, spiral

2. Systems Concepts

- Systems thinking
- Problem definition
- Emergence
- Divergence
- Convergence
- Behavior
- Top-down and bottom-up
- Forms of logic
- System dynamics

3. Applying Systems Concepts

- Architecture, physical and logical
- A system solution
- “Systems of systems”
- Systems of autonomously managed systems
- Functional modeling
- Process models

- **Workshop 1 – principles in the engineering of infrastructure systems**
- **Workshop 2 – matching common activities to the SE process elements**
- Requirements, design and verification traceability
- Critical infrastructure development
- Life cycle models

4. Types of Requirements

- Eight basic types
- Exercise – categorizing requirements for an infrastructure system by type

5. The Quality of Requirements

- Requirements quality attributes

6. Requirements Analysis for Infrastructure Systems

- Purpose of requirements analysis and its relationship to CONUSE
- Relationship to OSD
- Requirements analysis (capture and validation) methodology
- Context analysis, and relationship to CONUSE
- **Workshop 3 – context analysis for an infrastructure system**
- Design requirements analysis
- States and modes analysis
- **Workshop 4 – states and modes for an infrastructure system**
- Requirements parsing analysis
- **Workshop 5 – parsing analysis**
- Functional analysis, and relationship to CONUSE
- **Workshop 6 – functional analysis for an infrastructure system**
- Rest of scenario analysis
- ERA analysis
- Out-of-range analysis
- Value analysis
- **Workshop 7 – building an infrastructure system value (system effectiveness) model**
- Operational effectiveness
- Operational effectiveness versus overall effectiveness
- Extracting information for a CONUSE and requirements document from users (and others)

7. CONUSE as a Document

7.1 Content and Purpose of a CONUSE

- Users and uses of a CONUSE, in detail
- Principles regarding content
- User stories, use cases, scenarios and the CONUSE
- How does support relate to a CONUSE?
- Relationship of the CONUSE to the requirements document
- CONUSE standards and guides
 - Operational Concept Documents, DID DI-

Engineering Successful Infrastructure Systems

5-Day Course Outline (Continued)

- MCCR-80023, SDD Documentation Set – Data Item Descriptions for DoD-STD-2167, U.S.A. Department of Defense, 1985
- Concept Data Item Description, SMA-DID-P100, NASA Product Specification Document Standard, Release 4.3, 1989
- ANSI/AIAA G-043-1992, Guide for the Preparation of Operational Concept Documents, 1992
- Operational Concept Description (OCD), DID DI-IPSC-81430, Data Item Descriptions for MIL-STD-498, U.S.A. Department of Defense, 1994
- IEEE Standard 1362, IEEE Guide for Information Technology – System Definition – Concept of Operations Document, 1998
- ACC Instruction 10-650, Development and Use of Concepts of Operations, U.S. Department of the Air Force, 1998
- Guide for the Preparation of Operational Concept Documents, ANSI/INCOSE/AIAA, G-043:2012
 - PPI's OCD/CONUSE DID
- Who should prepare a CONUSE
- Timing of preparation of a CONUSE versus requirements document

7.2 Preparing a CONUSE

- Characteristics of a good CONUSE
- Pitfalls in CONUSE preparation
- **Workshop 8 – review of a CONUSE for maritime infrastructure**
- **Workshop 9 – preparing a basic CONUSE**
- Use of graphics in CONUSEs
- Level of detail in the CONUSE
- Design content – when, and when not?
- Makeup of a CONUSE development team
- The role of users
- Beyond the basic CONUSE
- Extending the CONUSE to other stakeholders
- Pitfalls in preparing CONUSEs

8. Operational Solution Description (OSD)

8.1 Content and Purpose of an OSD

8.2 Relationship of the OSD to Overall Solution

8.3 Styles of Solution Development

- The solution domain: key concepts, relationships, and work products
- **Workshop 10 – principles of OSD development**
- Waterfall, incremental, evolutionary and spiral capability development approaches
- **Workshop 11 – infrastructure solution development strategies**

8.4 Concepts of Architecture – Physical and Logical, in OSD Development

- Physical architecture (structural view) – basic

concepts

- The role of technology and innovation
- Techniques for stimulating innovation in solution development
- Use of design driver requirements
- Perspiration engineering: configuration items
- Criteria for selecting configuration items
- Relationship of CI definition to future system integration
- **Workshop 12 – physical conceptualization of an infrastructure solution**
- Logical architecture – basic concepts of model-based architecting
- Logical architecture related to physical architecture
- Useful forms of logical representation – functional, state-based, mathematical, ...
- Model-based design in practice

8.5 Functional Modeling in OSD Development

- Functional modeling in OSD development – how to do it
 - Functional analysis/architecture process
 - Item flow and control flow
 - Coupling, cohesion, connectivity
 - Unallocatable and allocatable functions
 - Pitfalls in defining functions
 - **Workshop 13 – a simple functional solution**
 - **Workshop 14 – physical and functional solution**
- FMEA in functional solution
- Performance thread analysis
- Languages incorporating behavior modeling
- Software tools supporting functional and physical solution
- Pitfalls in functional solution development

8.6 Return to Physical Solution Development in OSD Development

- Facilities, procedures, people, and other types of solution element
- Some common pitfalls in developing OSD
- Adding the detail to the solution
- Solution creates requirements – the duality of requirements and solution
- Interface engineering
- Evolution of interfaces in solutions having levels of physical structure
- Interface requirements specifications versus interface design descriptions
- Some common pitfalls in interface engineering

8.7 Decision-Making in OSD Development

- Solution development for feasibility
- Solution development for effectiveness: approach to solution optimization
 - The role of MOEs and goals
 - Using a value (system effectiveness) model
 - Taking account of risk relating to goals
 - Taking account of risk relating to satisfaction of requirements

Engineering Successful Infrastructure Systems

5-Day Course Outline (Continued)

- Event-based uncertainty
- Risk-aversion
- **Workshop 15 – using a value (system effectiveness) model in developing solution for an infrastructure**
- system problem
- Cost/capability, return on investment and like concepts
- Iterative optimization of solution – an effective methodology
- Software tools supporting OSD decision-making
- Common pitfalls in OSD development

8.8 OSD Document

- OSD Template
- Example OSD

9. Development of Requirements and Requirements Specifications for Elements of Solution

10. In Closing

- Action plan
- References and recommended reading



www.ppi-int.com

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

