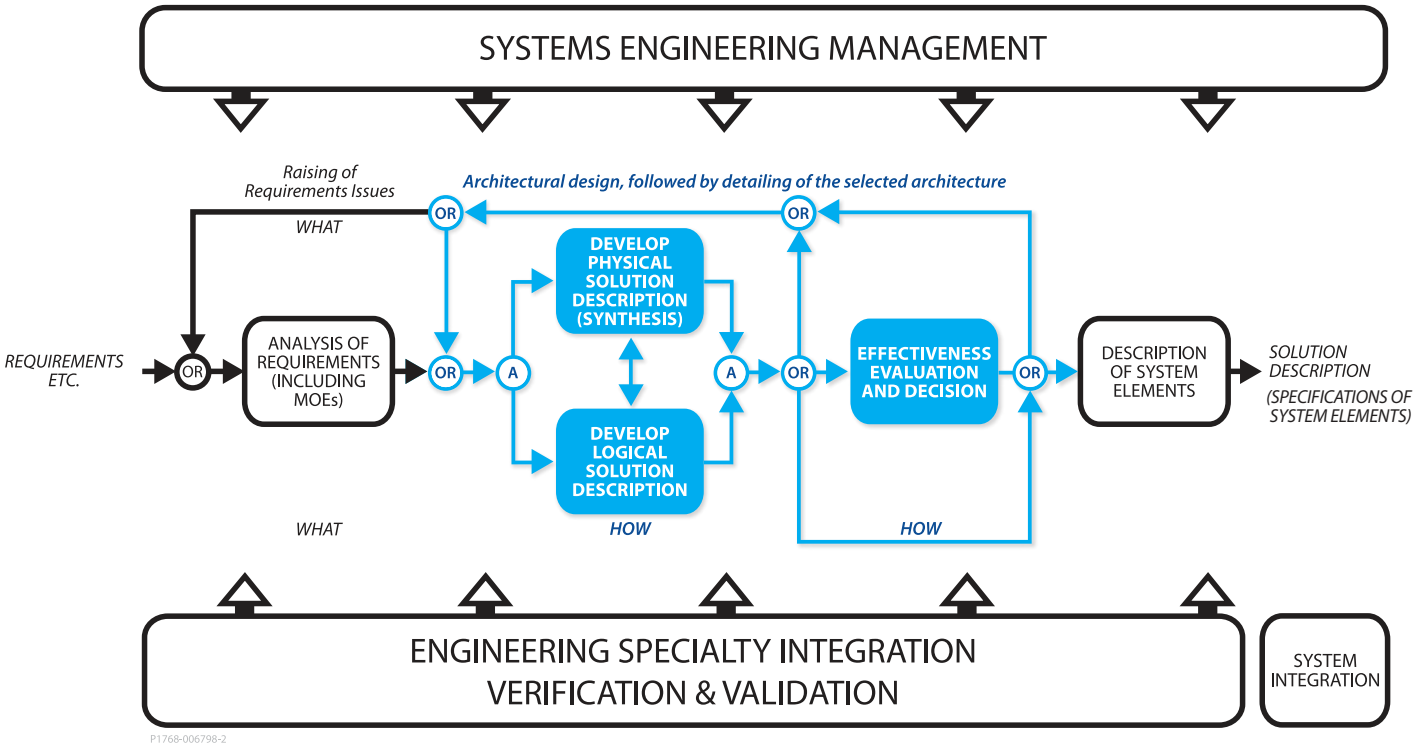
ARCHITECTURAL DESIGN

TECHNOLOGY KNOWLEDGE AND CREATIVITY ARE INDISPENSABLE ...

5-DAY COURSE

... BUT ONLY SOUND DESIGN PRINCIPLES WITH EFFICIENT METHODS LIKE MBSE RELIABLY TURN GREAT IDEAS INTO GREAT SOLUTIONS.

This five-day course addresses the principles and methods of designing, regardless of what is being designed. Historically, design errors have been a major cause of loss of value in technical projects, or worse, major disasters involving substantial loss of life. This course provides an integrated approach to the set of technical design process disciplines to minimize errors and maximize value. These disciplines combine with technology knowledge and creativity to achieve solutions that satisfy requirements and maximize system effectiveness, enhancing project success and reducing risk to the engineer and the enterprise.



"Thank you for a great course. I thoroughly enjoyed myself and learned a lot throughout the week. I particularly liked how you are able to bring everything together with real-world examples. I'll be definitely recommending your course to others who might benefit from your expertise."

- delegate, Hatch Mott MacDonald, Las Vegas

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COURSE OUTLINE

0. Introduction - Architectural Design Within Systems Engineering
- the business case for a systems approach to design
- definition of terms
- ***design interactive exercise - basic***
- systems engineering process overview - the football diagram
- design within a systems engineering process model

1. Design-Related Principles of Engineering
- system views
- ***Workshop 1 - design-related principles***

2. Styles of System Development
- the solution domain: key concepts, relationships, and work products
- waterfall, incremental, evolutionary and spiral development approaches
- ***Workshop 2 - solution development strategies for a product***

3. Concepts of Architecture and Detailed Design - Physical & Logical
- physical architecture (structural view) - basic concepts
- logical architecture - basic concepts
- logical architecture related to physical architecture
- useful forms of logical representation - functional, state-based, mathematical, hybrid …with examples
- model-based design in practice - MBSE/MBA/MBD/MDA/MDD

4. Initial Physical Conceptualization
- the role of technology and innovation
- architectural design driver requirements
- ***Workshop 3 - identification of architectural design driver requirements***
- techniques for stimulating innovation: brainstorming, TRIZ
- perspiration engineering: configuration items
- criteria for selecting configuration items
- design complexity trade-off
- relationship of CI definition to system integration
- ***Interactive exercise - a simple physical design***
- ***Workshop 4 - physical conceptualization of solution***

5. Functional Design
- functional analysis in design - how to do it
  - functional analysis/architecture process
  - item flow and control flow
  - un-allocatable and allocatable functions
  - pitfalls in defining functions
  - common pitfalls in functional design
  - ***interactive exercie - a simple functional design***
  - ***Workshop 5 - physical and functional design, part A***
  - ***Workshop 5 - physical and functional design, part B***
  - coupling, cohesion, connectivity
  - FMEA/FMECA in design
  - performance thread analysis
  - relationship to object orientation
  - allocation of functionality between hardware and software
- Fault Tree Analysis
- Event Tree Analysis
- behavior modeling languages
- other languages incorporating functional modeling: SysML, ...
- software tools supporting functional and physical design
- pitfalls in functional design

6. State-Based Design
- state-based design - how to do it
  - ***Workshop 6 - a simple state-based design***
  - relationship to object orientation
- SysML, and alternative languages incorporating state-based modeling
- software tools supporting state-based design
- pitfalls in state-based design

7. Object-Process Methodology (OPM)
- background to OPM
- OPM description
- relationship to object orientation
- software tools supporting OPM

8. Design For Six-Sigma (DFSS)
- what is Six-Sigma?
- DMAIC
- DMADV (DFSS)
- the DFSS toolset

9. Return to Physical Design
- functional to physical allocation
- facilities, procedures, people, and other types of system element
- use of a specification tree
- system elements not designated as configuration items
- some common pitfalls in developing system physical architecture
- use of architectural design driver requirements
- adding the detail to the design
- design creates requirements - the duality of requirements and design
- interface engineering
- interface requirements specifications versus interface design descriptions/ICDs
- the OSI 7-Layer Model and similar in interface engineering
- relationship to system integration
- evolution of interfaces in systems having levels of structure
- some common pitfalls in interface engineering
- major artifacts created in design

10. Design Decision-Making and Optimization - Trade-Off Studies
- designing for feasibility
- designing for effectiveness: approach to design optimization
  - the role of MOEs and goals
  - the origin of a system effectiveness model
  - designing for the company versus designing for the customer - handling conflict of interest
- using a system effectiveness model
  - taking account of risk relating to goals
  - taking account of risk relating to satisfaction of requirements
  - event-based uncertainty
  - risk aversion
  - ***Workshop 7 - using a system effectiveness model***
  - cost/capability, return on investment and like concepts
  - iterative optimization of design - an effective methodology
- other techniques - Quality Function Deployment
- software tools supporting design decision-making
- some common pitfalls in design decision-making

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

12. Concurrent (Simultaneous) Engineering
- system of interest - enabling system relationships
- why concurrent (simultaneous) engineering
- organizational aspects of implementation
- process aspects of implementation
- pitfalls in implementation

13. Reliability and Safety Engineering
- introduction to terminology
- measures of reliability
- probability theory related to reliability and safety
- Reliability Block Diagrams
- FMEA and FMECA
- ***Workshop 8 - performing a basic DFMEA***
- Fault Tree and Event Tree Analysis
- common cause/common mode failures
- root cause analysis
- Markov analysis
- component failure and repair distributions
- Monte Carlo simulation and Latin Hypercube sampling
- reliability data and analysis
- verification of reliability
- measures of safety
- Hazard and Operability (HAZOP) studies
- safety assurance
- ***Workshop 9 - performing a basic HAZOP Study***

14. Maintainability Engineering
- measures of maintainability
- principles of designing for maintainability
- general techniques of designing for maintainability
- modules
- access and handling
- part selection
- verification of maintainability

15. Producibility (Manufacturability) Engineering
- measures of producibility
- Design For Manufacture (DFM) vs. Design For Assembly (DFA)
- techniques of designing for manufacture
- design for 3D printing
- techniques of designing for assembly
- verification of producibility
- producibility risk analysis

16. Summary and Key Points
- action plan

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