



BURGE
HUGHES
WALSH

System Design

1.0 Introduction and Background

As the world becomes more complex, it is becoming increasingly more important to design our products, processes and service as systems. A systems approach to design ensures we take a holistic through life view taking into account the requirements of all the stakeholders. It also ensures we systematically explore all the design choices to select those options that best match the requirements.

This module on System Design aims to educate and train students in how to practically apply a systems approach to the design of a system.. It is specifically for those people who are involved in new system introduction from marketing through to system support.

The focus on 'doing' the design' makes it unique and a powerful module for anybody interested in systems and systems engineering.

2.0 Course Aims, Outcomes and Content

Aims:

This module aims to:

- introduce and explain the principles and concepts of a systems approach to complete system design that involves:
 - Determining the system requirements
 - Creating system concept design
 - Refining and optimising the concept design
 - Verifying and validating the system concept design
- introduce and explain the principles and concepts of requirements engineering and system concept design
- provide a methodology and tools and techniques that can be applied to undertaking requirements engineering and system concept design.

Learning Outcomes:

Knowledge and Understanding

On completion of the module students should be able to:

- Clearly define the differences between a systems approach and a non-systems approach to system design
- Clearly describe the fundamental process, activities and methodology for a systems approach to systems design
- Recognise and explain the need for a team approach to systems design
- Clearly define and explain the systems approach to requirements engineering outlining its principles, purpose and methodology
- Clearly define and explain the systems approach to system concept design outlining its principles purpose and methodology

Skills and Attributes

On completion of the module students should be able to:

- Apply a systems approach to the design of systems
- Gather requirements for a proposed system
- Analyse requirements for a proposed system to create a complete, consistent, correct and unambiguous measurable set of system requirements
- Write requirements
- Create concept designs for a proposed system
- Evaluate and down-select alternative system concept designs

- Use systems approaches for application to problem scenarios.
- Work in a team recognizing and understanding group dynamics.
- Communicate findings through:
 - Oral presentations
 - written group reports
 - individual reports
- Find resources and information via information search strategies and evaluate usefulness

Content

- Review of Systems, Systems Thinking and Systems Engineering leading to a systems approach to system design.
- Process and tool set for system design
- Understanding customers, stakeholders and their requirements
- A systems approach to requirements engineering
- Gathering requirements
 - Identifying customers and stakeholders using a Stakeholder Influence Map
 - Eliciting requirements using direct and indirect methods
 - Capturing and structuring requirements using Requirements Trees
 - Validating and verifying source requirements
- Analysing requirements
 - Assessing the system meta-solution using Needs Means Analysis
 - Analysing expressed requirements using
 - Viewpoint Analysis
 - Component Analysis
 - Functional/behavioural modelling
 - Sensitivity and failure analysis
 - Validating and verifying deduced requirements using Quality Function Deployment
 - Writing and Managing requirements
- A systems Approach to system concept design
- System Technological design
 - Creative thinking tools and techniques
 - Holistic concept generation Using Function Means Analysis
 - System integration by design
 - Concept evaluation and selection using Decision and Pugh Matrices and The Analytic Hierarchy Process
- System architectural design
 - System architectural principles
 - Logical system architecting and N² Analysis
- Technology to architecture mapping
- Validating and verifying system concept design using Quality Function Deployment
- Specifying system concept designs and provisional Sub-System Specification

3.0 Course Philosophy and Approach

The course approach is based on the Kolb learning cycle with a significant proportion of the course set aside for exercises to reinforce the learning. Indeed, many of the small group exercises involve a case study which provides a practical focus for the course and enables the delegates to practise the tools and techniques presented. This case study culminates with a “design review” on the last day where the participants present their system concept solution.

4.0 Who is it for and Numbers?

The short course in Systems Engineering is aimed at all personnel involved in the new system introduction and product support. Indeed, wherever possible having a mix of engineers, marketing, project managers, and customer support engineers is most beneficial in terms of deploying and adopting a systems approach.

The course has been designed for a maximum of 16 participants.