SEArri Short Course Series

Course: PI.27s Value-driven Tradespace Exploration for System Design

Lecture: Lecture 0: Course Introduction

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A slightly earlier version of this course was taught at PI.27s as a part of the MIT Professional Education Short Programs in June 2009 in Cambridge, MA. The lectures are provided to satisfy demand for learning more about Multi-Attribute Tradespace Exploration, Epoch-Era Analysis, and related SEArri-generated methods. The course is intended for self-study only. The materials are provided without instructor support, exercises or “course notebook” contents. Do not separate this cover sheet from the accompanying lecture pages. The copyright of the short course is retained by the Massachusetts Institute of Technology. Reproduction, reuse, and distribution of the course materials are not permitted without permission.
PI.27's VALUE-DRIVEN TRADESPACE EXPLORATION FOR SYSTEM DESIGN

Lecture 0
Course Introduction

Dr. Donna Rhodes and Dr. Adam M. Ross
MIT
Welcome and Introductions

- MIT Team
- Course Schedule/Logistics
- Learning Objectives
- Class Introductions
Mission

Advance the theories, methods, and effective practice of systems engineering applied to complex socio-technical systems through collaborative research

Current Sponsors:


292 Main Street
E38-575
Instructor Team

• Dr. Donna H. Rhodes, MIT
  – SEARI Director

• Dr. Adam M. Ross, MIT
  – SEARI Lead Research Scientist
Logistics & Information

• We are in MIT Building E38, 5th floor, located at 292 Main Street

• Nearby:
  – MIT Press Bookstore (below us)
  – MIT COOP Bookstore (across from us)
  – Food Court (across/behind MIT COOP)
  – Rooftop garden (top of parking structure by Marriott)
  – Starbucks – one in Marriott, one nearby
  – Many restaurants along Main Street
Daily Schedule

Value-Driven Tradespace Exploration for System Design

Class runs 9:00 – 5:00
(4:00 end on Thurs)
  – Working Breakfast at 9
  – Mid-morning break
  – Lunch break (on your own)
  – Mid-afternoon break
About the Course

Value-Driven Tradespace Exploration for System Design

• One of the key contemporary challenges in developing successful systems is to be able to make effective architectural design choices in the face of complexity and a changing world.

• The course presents a new method for tradespace exploration based on a value driven perspective, allowing designers to better understand and meet both present and future stakeholder needs and expectations.

• The Multi-Attribute Tradespace Exploration (MATE) methodology was developed at MIT for exploring tradespaces of possible architectures rather than settling quickly on an optimum.

Learning Objectives: Fundamentals, Application, Strategic
Learning Objectives

**Fundamentals**

1. Understand the **motivation for and increasing importance of tradespace exploration** in the context of the contemporary engineering environment and associated challenges.

2. Grasp **how the value driven perspective can help designers** better understand both present and future stakeholder needs and expectations.

3. Identify **where in the system lifecycle** the tradespace exploration and system design activities should be performed.

4. Describe **fundamental concepts** including stakeholder preferences, decisional vs. experienced value, latent value, attributes, design vectors, and multi-attribute utility theory.
Learning Objectives

Application

5. Understand Multi-Attribute Tradespace Exploration (MATE) method, and how it has been applied to real-world systems.

6. Choose and use appropriate tools for analysis of the tradespace (e.g., Multi-attribute Utility Theory, N-squared or Design Structure Matrix analysis, etc.)

7. Set up and justify a tradespace analysis using system attributes, stakeholder utilities, and a scoped and quantified design vector.

8. Analyze a simple tradespace using the Multi-Attribute Tradespace Exploration (MATE) framework, and identify and assess the effects of risk, uncertainty, and/or policy effects using appropriate techniques.
Learning Objectives

Strategic

9. Identify the metrics for quantifying changeability of a design, and active vs. passive strategies and methods for increasing the perceived changeability of a system.

10. Gain insight into the latest thinking on advanced topics including valuation of selected “ilities”, uncertainty management, change taxonomy, tradespace networks, and real options.

11. Discuss strategic issues such as temporal considerations in tradespace exploration, and exploring complex tradespaces for families of designs and systems of systems.

12. Have knowledge of latest published literature in the field and insight into ongoing research.
Day 1: Introduction

Value Driven Tradespace Exploration for System Design
Participants will be introduced to the value driven perspective as a paradigm for system architecting and design. The motivations for and challenges of tradespace exploration will be discussed with regard to the contemporary engineering environment, and methods in use. Practical approaches to setting up the tradespace will be described and experienced.

Topics will include:
• Why Use Trade Studies?
  – Motivations, Drivers, Challenges
  – Benefits of the Value Driven Perspective
• Overview of Classical Methods for Architecting and Design
  – Tradespace Exploration and Design in Context of System Lifecycle
  – Basics of Architecting and Design Methods
• Introduction to Multi-Attribute Decision Making
• Exercise 1: Setting up a Simple Decision Space
• Introduction to Tradespace Exploration
In Your Course Notebook

• Lecture Materials
• Exercises
• Survey and Assessment
  – Daily Feedback Survey
  – Learning Objectives Assessment
• Reading List
• Supplemental Materials