# Lecture 7: System Architecture-2

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## Systems Engineering Engine/Cycle

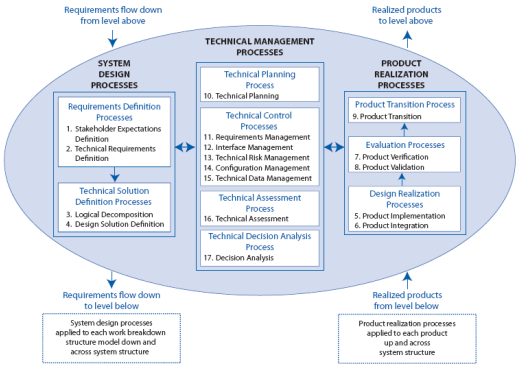



Figure 2.1-1 The systems engineering engine

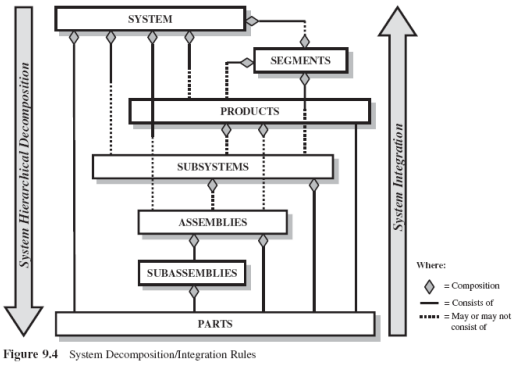



Figure 9.4 System Decomposition/Integration Rules

## Components of the Architecture

- System of Interest Architecture
- Architecture of Operating Environment
- System Interfaces
- Organization Roles, Missions and System Applications
- Problem, Opportunity and Solution Spaces
- System Interaction with Operating Environment

Watch
The Making of the Nano

https://www.youtube.com/watch?v=rS3Aq_2II-s

## Operating Environment

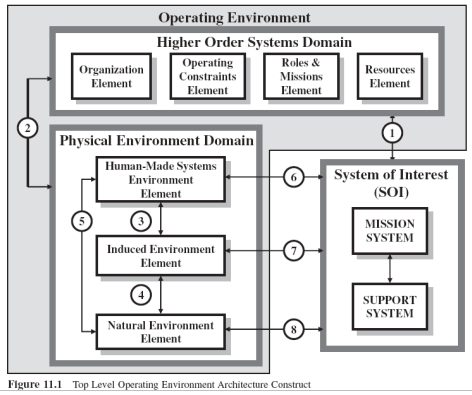



Figure 11.1 Top Level Operating Environment Architecture Construct

# Physical Environment System (E-R)

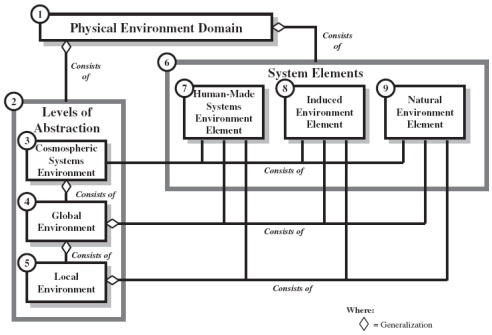
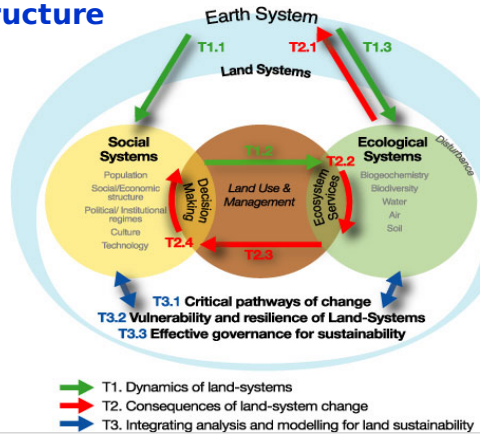



Figure 11.2 Physical Environment System Element Entity Relationships

# Operating Environment

- ✓ Identify and define the Op Env
  - ✓ political, social, legislative, economic, cultural and natural environmental factors that significantly affect the implementation
- ✓ Abstract them
- ✓ Linkages / Interfaces

# GLOBAL LAND PROJECT: Analytical Structure




# Organization Roles, Missions and System Applications

- The Planning process
  - Strategic
  - Tactical
  - Frame of Reference or Terms of References
- System Objectives and Mission Objectives
- Contextual Roles
  - Mission system
  - Support system

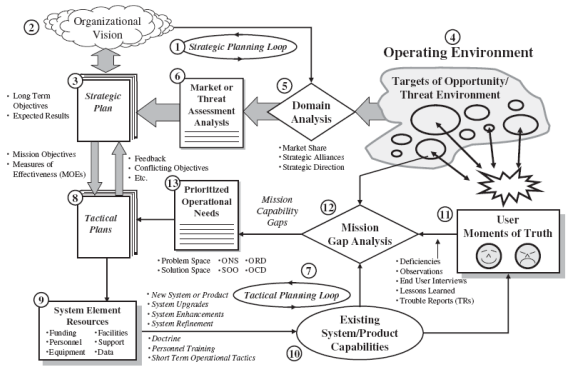



Figure 13.1 Operational Needs Identification Process

# Mission Event Timeline

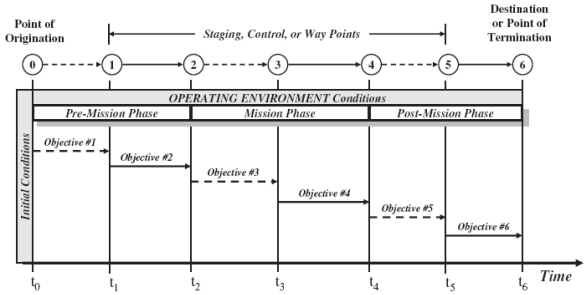



Figure 16.1 Operational Concept Timeline Example

## Problem, Opportunity and Solution Spaces

- Problem space and Opportunity Space
  - Risk mitigation; vulnerability assessment
- Look at what you have – products, services, etc that can fit
- Modify the products, if need

- One's Problem is Other's Opportunity
  - Example: Saint-Gobain's DryWall

## Problem Space

- Problem vs Symptom solving
- Dynamics of the problem
  - Dynamic nature of the problem vs Static view
- Forecasting of the Problem
  - Gap → Problem
- Establish Problem Space Boundaries
  - Control, resources or spheres of influence
- Partition the Problem Space

## Solution Spaces

- Depends on the Boundary conditions
  - Clear, rigid vs. Fuzzy vs. Overlapping/Conflicting
- Force Multipliers
- Selecting Candidate solutions

- Operating Environment

## System Use Cases

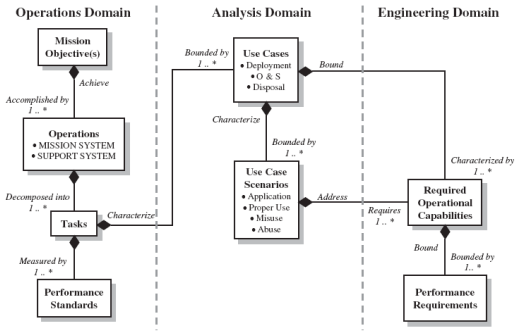
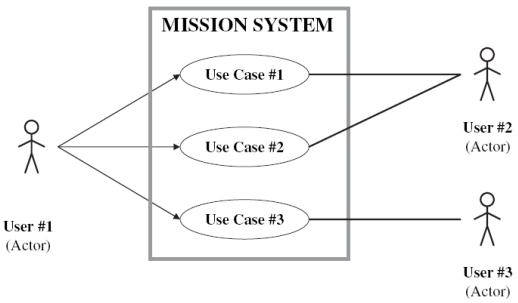



**Figure 17.1** System/Product Use Cases and Scenarios Entity Relationships

## Attributes of Use Case

- Unique identifier
- Objective (performance)
- Outcome-based results
- Assumptions
  - Initial state
  - Final state
  - Environmental conditions
  - Preceding circumstances (optional)
  - Operating constraints
  - External inputs
  - Resources
  - Event-based timeline
  - Frequency of occurrence and utility priorities
- Processing capabilities / response function
- Scenarios and consequences
  - Probability of occurrence
  - Use case scenario actors
  - Stimuli and cues
  - Consequences
  - Compensating/mitigating actions

## UML Use Case Diagram




**Where:** UML® = Unified Modeling Language

**Figure 17.2** UML® Use Case Diagram

# Use Case Sequence Diagram

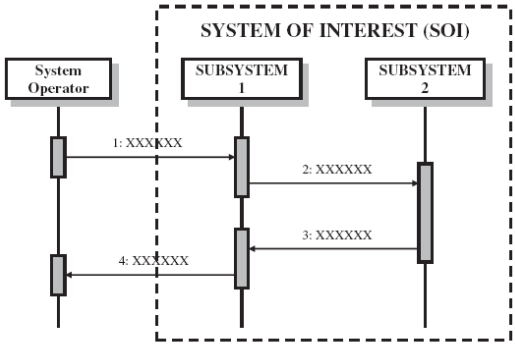



**Figure 17.3** UML® Use Case Sequence Diagram

# Class test – 28 Jan 2019

1. In the Nano Project,

(a) What is the Problem or Opportunity Space?

(b) Was the Solution appropriate? Support your answer

2. In the world of Online (non-contact) mode of Learning (as a future option)

(a) List the characterisitcs of the Operating Environment

(b) What modifications are needed to the current Solutions (systems) to be more comprehensive