

# System Operational Model

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## Overall System – Elements and Interactions

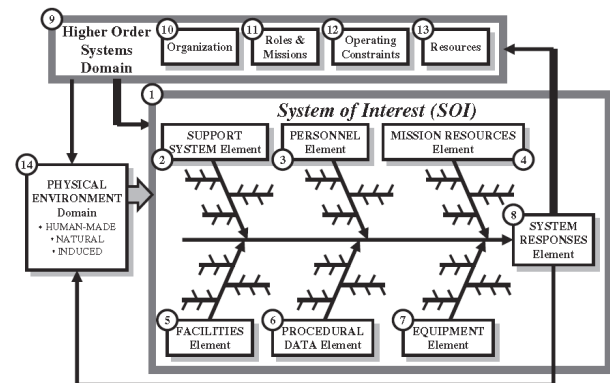


Figure 15.7 System Element Contributions to Overall System Performance

## System Mission Analysis

- 1: Define the primary and secondary mission objective(s).
- 2: Develop a mission strategy.
- 3: Define phase-based operations and tasks.
- 4: Create a Mission Event Timeline (MET).
- 5: Bound and specify the mission OPERATING ENVIRONMENT interactions.
- 6: Identify outcome-based system responses to be delivered.
- 7: Identify mission resources and sustainment methods.
- 8: Perform a mission task analysis.
- 9: Assess and mitigate mission and system risk.

## Mission Event Timeline

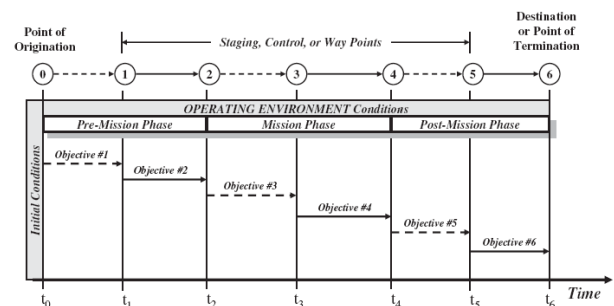


Figure 16.1 Operational Concept Timeline Example

## 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

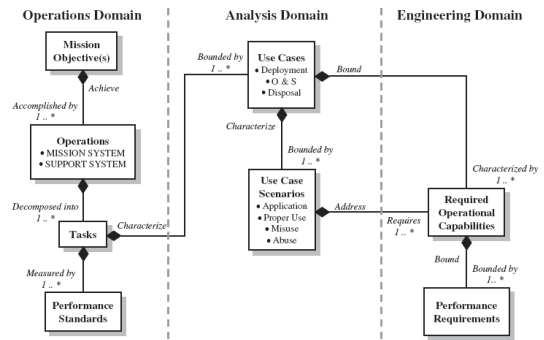


Figure 17.1 System/Product Use Cases and Scenarios Entity Relationships

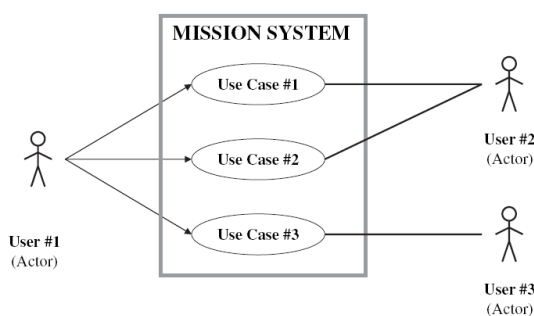
## Attributes of Use Case

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

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## UML Use Case Diagram



Where: UML® = Unified Modeling Language

Figure 17.2 UML® Use Case Diagram

## Use Case Sequence Diagram

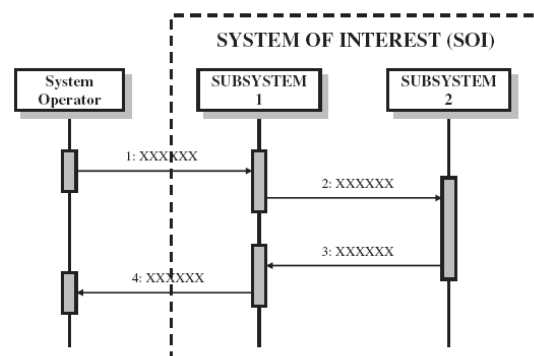
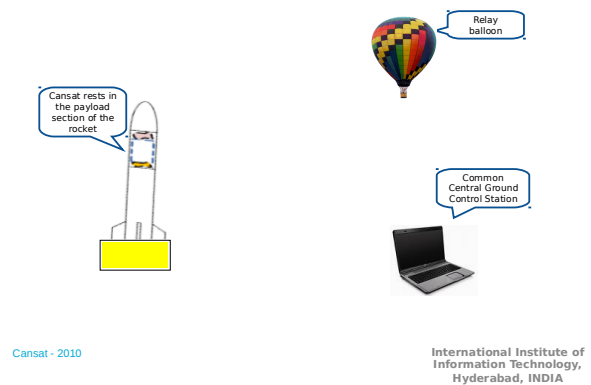


Figure 17.3 UML® Use Case Sequence Diagram

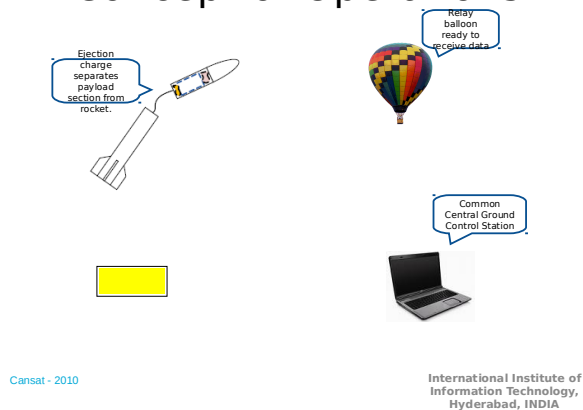
## Concept of Operations

- System Performance Specifications (SPS)
  - similar to System Requirements Specifications (SRS)
- Operation Concept Description (OCD)
- May or may not be cyclical in nature
- Different Systems
  - Single use Systems
  - Reuse Systems
  - Recyclable systems

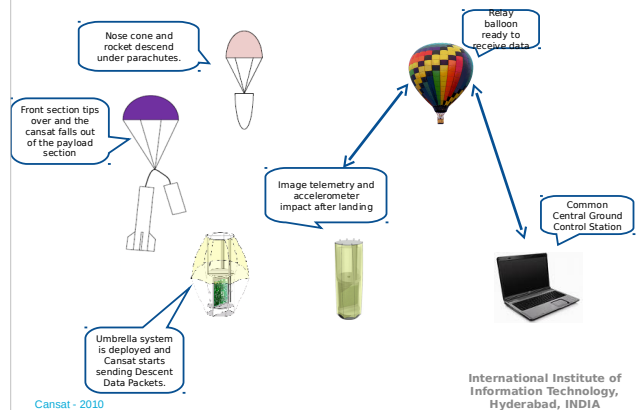
## Concept of Operations



## Concept of Operations



## Concept of Operations



## Systems Operational Model

- *represents* an integrated, multi-level collection of system use case based capabilities and activities required to achieve an overall *mission* objective.

## Generalized ConOps

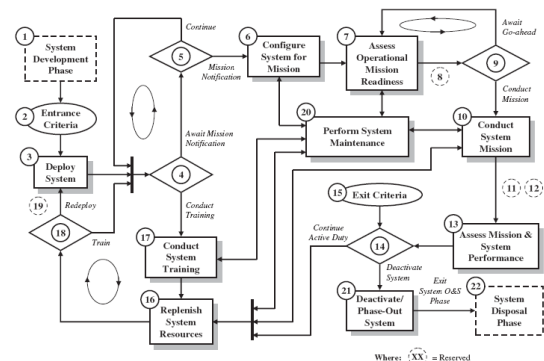
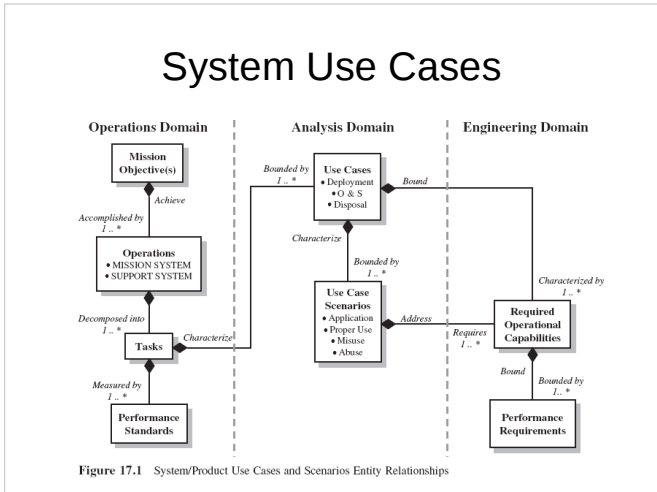
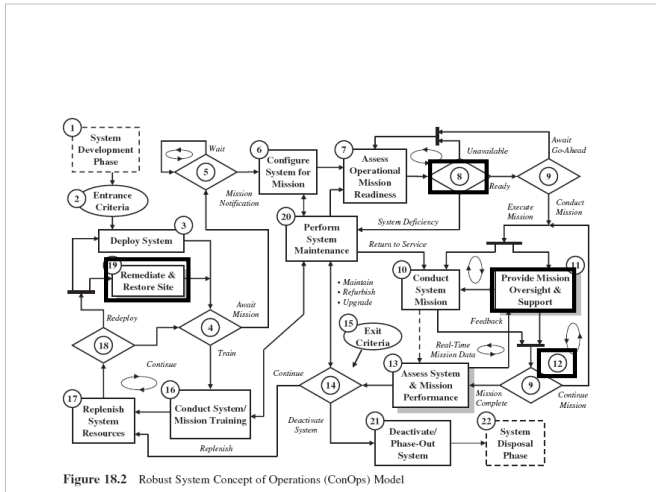
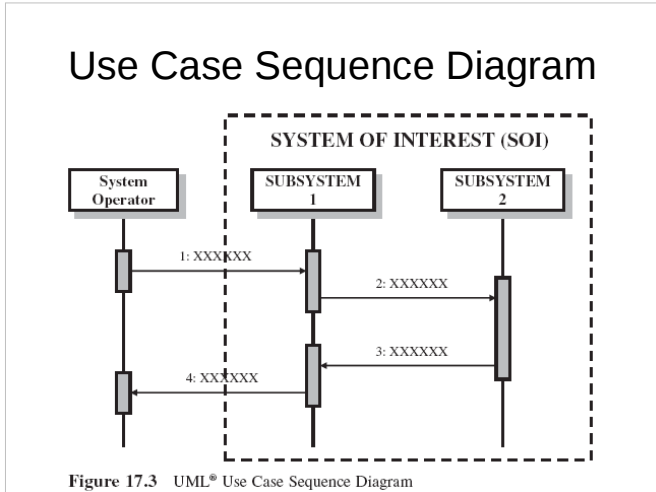
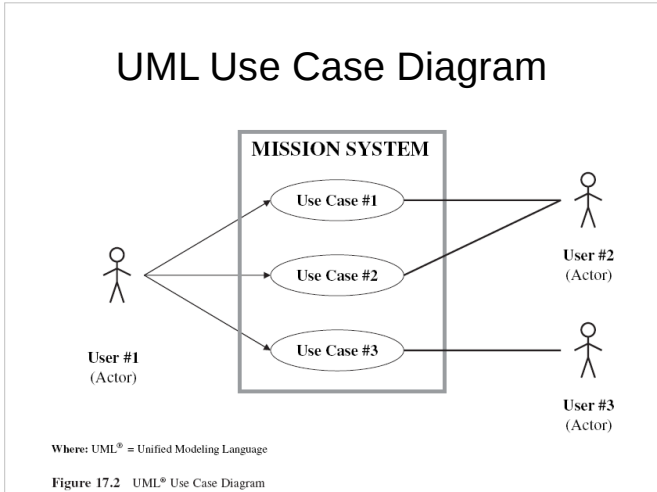


Figure 18.1 Generalized System Concept of Operations (ConOps) Model



## Attributes of Use Case

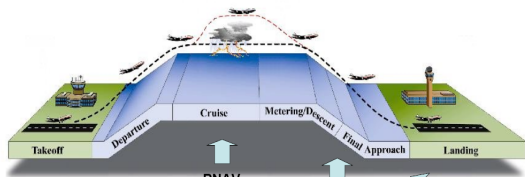
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## Flow of Operations

- Phases
- Modes
- States
  - *it* relates to the structure—meaning a configuration—and the level of activity present within the structure

## Multiple Phases for an Aircraft motion



1. Taxiing
2. Takeoff
3. Departure
4. Cruise
5. Descent
6. Landing
7. Taxiing to Gate/Bay
8. Parking

## E-R diagram

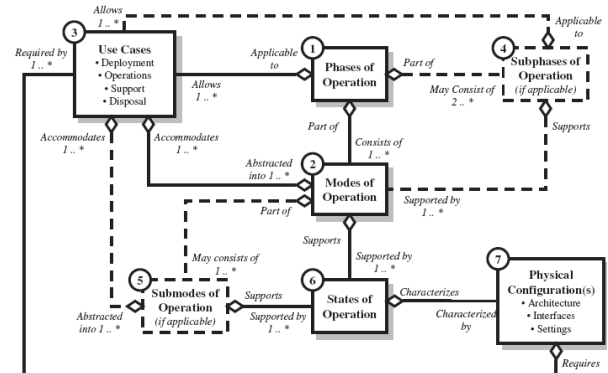


Figure 19.1 Relationships Between System Use Cases and Phases, Modes, and States of Operation

## Understanding the System Modes of Operation

- Modes are Options in a given set of conditions and criteria
- System Modal Transition
  - Triggering Event – Entry or Exit criteria
- Mission Event Timeline (MET)
- Standard Operation Practices and Procedures (SOPP)

## States in a System

- Operational States
- Physical States

## States and its descriptors

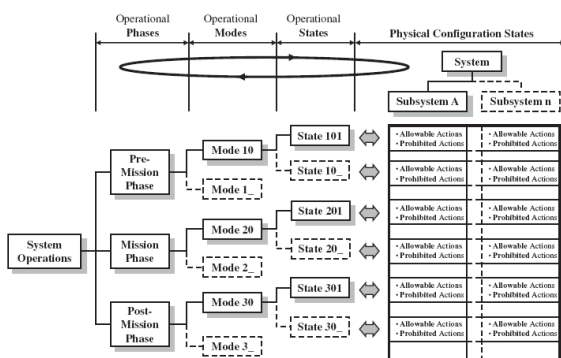


Figure 19.6 How Operational Phases, Modes, and States Influence Physical System Design and Vice Versa

## Matrix Approach to detailing

# = Reference to description  
 □ = Not Applicable

Operational Task	System Phase of Operation					
	Pre-Mission MISSION SYSTEM Elements	Mission SUPPORT MISSION SYSTEM Elements	Post Mission MISSION SYSTEM Elements	Pre-Mission MISSION SYSTEM Elements	Mission SUPPORT MISSION SYSTEM Elements	Post Mission MISSION SYSTEM Elements
3.0 Deploy System						
4.0 Conduct Training Decision						
5.0 Mission Notification Decision						
6.0 Configure System for Mission						
7.0 Assess Mission Readiness						
9.0 Mission Go-Ahead Decision						
10.0 Conduct System Mission						
13.0 Assess Mission & System Performance						
14.0 Deactivate System Decision						
16.0 Replenish System Decision						
17.0 Conduct System Training						
18.0 Redeploy System Decision						
20.0 Perform System Maintenance						
21.0 Deactivate / Phase-Out System						

Figure 20.1 Mapping Operational Tasks to MISSION SYSTEM and SUPPORT SYSTEM Elements as a Function

# Mission and Support Operations

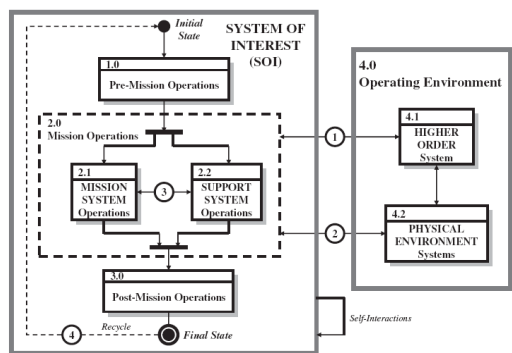


Figure 20.2 Concurrent Mission Operations

# System Applications

- 1. General use or multipurpose
- 2. Dedicated use applications.
- 3. Types of stakeholders.

# Operational Capabilities Matrix

Where:  
⊗ = Reference to Required Operational Capabilities  
⊞ = Scenario-Based Operational Capabilities

	PHASE		SYSTEM ELEMENTS										OP. ENVIRON.				Design & Constraint Constraints	Architectural Configuration
Operational Mode	Pre-Mission	Mission	Post-Mission	Mission Resources	Procedural Data	Equipment	Personnel	Facilities	System Responses	Man-Made Systems	Man-Made Systems	Man-Made Systems	Man-Made Systems	Man-Made Systems	Man-Made Systems	Man-Made Systems		
POWER-OFF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
POWER-UP INITIAL	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
CONFIGURE	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
CALIBRATE/ALIGN	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
TRAINING	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
NORMAL OPS	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
ABNORMAL OPS	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
SAFING	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123
ANALYSIS	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138
MAINTENANCE	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
POWER-DOWN	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168

Figure 21.3 System Operational Capability Identification