Class 6
System Architecture
Part-1

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WHAT a system is;

WHO its users and stakeholders are;

WHY it exists and HOW it benefits its users and stakeholders;

HOW it is structured; and HOW it operates, is supported, and disposed.

An Analytical view

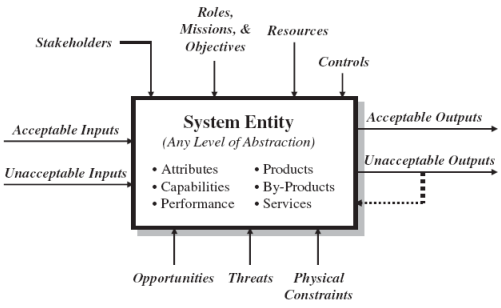

Figure 3.2 Analytical System Entity Construct

System Architecture

- System of Interest
- Operating Environment

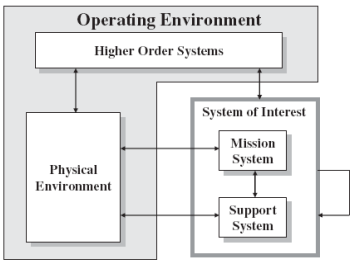

Figure 8.2 Top Level System Environment Construct

Systems Engineering Engine/Cycle

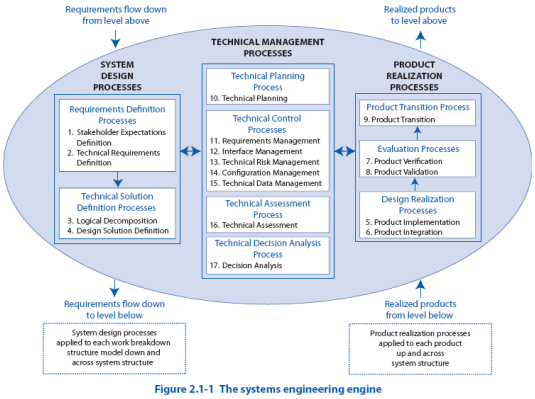

Figure 2.1-1 The systems engineering engine

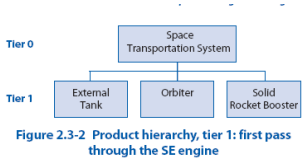

Figure 2.3-2 Product hierarchy, tier 1: first pass through the SE engine

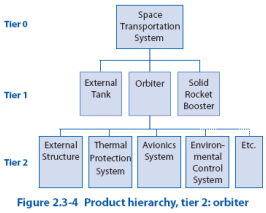

Figure 2.3-4 Product hierarchy, tier 2: orbiter

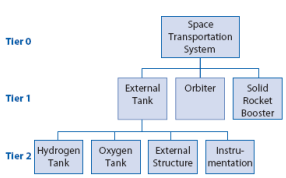

Figure 2.3-3 Product hierarchy, tier 2: external tank

Hierarchy

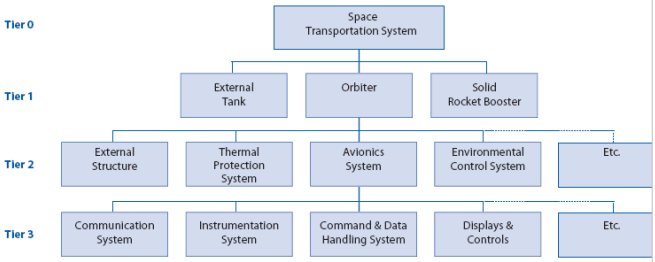

Figure 2.3-5 Product hierarchy, tier 3: avionics system

Complete Hierarchy

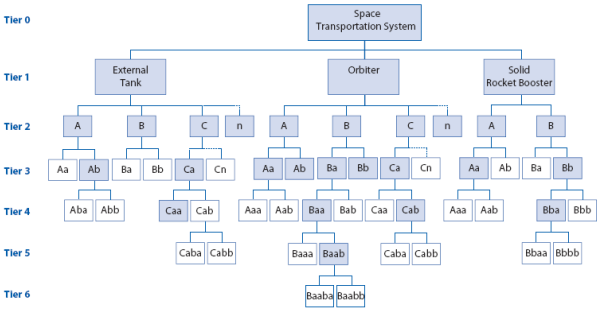

Figure 2.3-6 Product hierarchy: complete pass through system design processes side of the SE engine

Note: The unshaded boxes represent bottom-level phase products.

Full Cycle

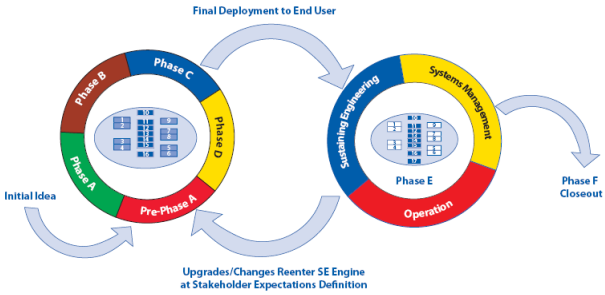

Figure 2.3-8 New products or upgrades reentering the SE engine

Interactions level

- Hierarchical Interactions
  [System of Systems]
- Peer Level Interactions

System Elements

- What is and What is not part of the System
- Logical and Physical parts of the Systems
- Decomposing the larger, Complex system

Room Lighting as an Example

"What Logical Association Exists Between Two System Entities"

Step 1
Identify Logical Associations

Room Lighting as an Example

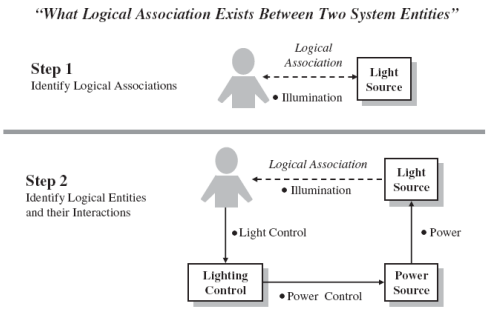

Figure 8.3 Logical Architecture Example

Logical and Physical Elements

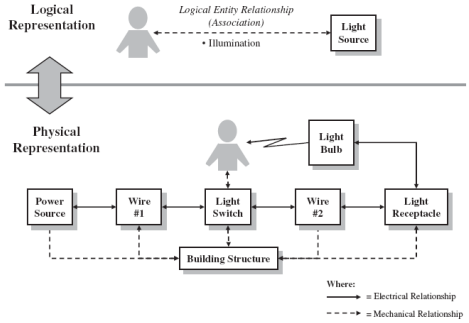

Figure 8.4 Logical-Physical Representations

Level of Abstractions

- Context
- Semantics (frame of reference)

- Users view
- Acquirers view
- Developers view

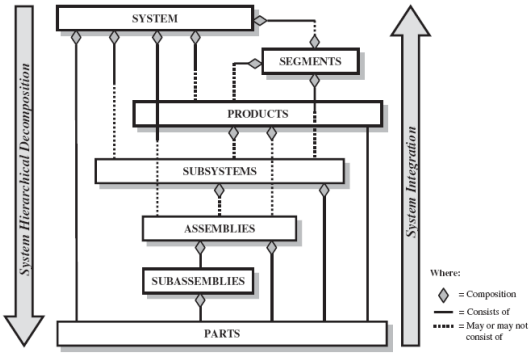

Figure 9.4 System Decomposition/Integration Rules

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

SOI Architecture

- System Element Architecture (SEA)
  - Decomposition and definition of Elements
  - Behaviour

Table 10.1 System elements common to MISSION SYSTEM and SUPPORT SYSTEM roles

System Element	MISSION SYSTEM Role	SUPPORT SYSTEM Role
PERSONNEL	•	•
EQUIPMENT	•	•
MISSION RESOURCES	•	•
PROCEDURAL DATA	•	•
SYSTEM RESPONSES	•	•
FACILITIES		•

SOI Architecture

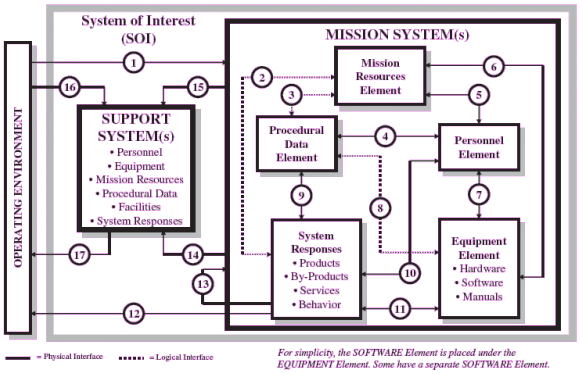

Figure 10.1 The System of Interest (SOI) Architecture and its System Elements

Equipment

Performance Measures

- reliability,
- availability,
- maintainability,
- vulnerability,
- survivability,
- safety,
- human factors
- others

Broad Categories of Equipment

1. Common Support Equipment
2. Peculiar Support Equipment

What capabilities should be implemented in HARDWARE versus those implemented in SOFTWARE?

Support System Environment

- Decision Support Operations
- System Maintenance Operations
- Manpower and Personnel Operations
- Supply Support
- Training and Trng Support
- Technical data operations
- Packaging, Handling, Storage, and Transportation (PHST) Operations.
- Computer resources
- Publication resouces

System Interfaces

- **Objective 1:** Physically link or bind two or more system elements or entities.
- **Objective 2:** Adapt one or more incompatible system elements or entities.
- **Objective 3:** Buffer the effects of incompatible system elements.
- **Objective 4:** Leverage human capabilities.
- **Objective 5:** Restrain system element or its usage.

Interoperability- the Ultimate Interface Challenge

Types of Interfaces

- Active Interfaces
- Passive Interfaces
- Combined Passive/Active Interfaces

- Logical
- Physical – Mech, Elect, Optical, Acoustic, Natural, Chemical, Biological, etc

- **Caution**: Engineers have a strong tendency to jump to defining the *physical interface* BEFORE anyone has decided WHAT the interface is to accomplish.

Understanding Interfaces

- **What Constitutes an Interface Failure?**
- **Consequences of an Interface Failure**
- **Interface Failures**
  - 1) *disruption*, 2) *intrusion*, 3) *stress loading*, and 4) *physical destruction*.
- **Interface Vulnerabilities**
- **Interface Latency**
- **Interface Failure Mitigation and Prevention**