Model Based Systems Engineering Initial Stages; “Get It Right in the First Stages”

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Get It Right in the First Stages: Topics

- OOSEM “Analyze Stakeholder Needs” Activity
- System Use Case Diagrams Overview & Importance in the First Stage of a Development
- Initial Integrated Architecture
- System Use Cases, Scenarios, Sequence Diagrams and Other SysML and Architecture diagrams -
  - The Integrated Architecture
- The Essential Operational Documents
- Requirements Hierarchy and Relationship to the Integrated Architecture
- Get It Right in the First Stages: Questions/Check List
- Summary & Conclusions
This presentation is an expansion of the Object Oriented Systems Engineering Method’s Second Activity: “Analyze Stakeholder Needs”*

This presentation is about the Development and Analysis of Stakeholder Needs Activity and associated architecture diagrams

Focus is on the Critical Importance of the System Use Cases (SysUC) Diagrams and their Driving Value throughout a system development

Reducing the Risk of Developing a System that does not meet Stakeholders’ Operational Needs, Goals and Expectations

Figure 17.2 (Object Oriented Systems Engineering Method)


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Figure 17.5 (Analyze Stakeholder Needs Activity)

Figure 17.5

SysUCs are used to capture and define stakeholder Operational Needs for ToBe system (also AsIs if not available)

Used to Transition Operational Needs to Systems Engineering and Related Products

Key Communications media with Stakeholders (Operational), Technical (Developers), Managers, Support, etc.

Address Stakeholder identified existing shortfalls/gaps, goals, etc. in current operational capabilities
  - Must continuously review these to show how resolved in architecture views, models, requirement.....

SysUCs are the Foundation for virtually all additional system engineering products (reqts, architecture, testing, documents.....)

Drive/Provide Foundation for System Development
Stage 1 - The “V” Diagram System Life Cycle Stages/Phases

Blue: Pre & Post Development/Contract
Red: Development (Contract)
SysML - Focus is on the UC and Sequence Diagrams

Can also use BPMN diagrams
System Use Cases Context & Initial Integrated Architecture

**Various Source Driving Products**
- Stakeholder Need Statements/Reqs
- ToBe Operational & Mission Capabilities
- AsIs Shortfalls & Gaps
- Users, Constraints & Context
- AsIs Information, Architectures, etc.
- AsIs & ToBe Business Processes

**Initial Integrated Architecture/Models**

**Concept Documents, Manuals, etc.**

**System Use Cases**

**Scenarios**

**Architecture/Models**

**SE Dvlp/Life Cycle Products**
- Requirements
- Architecture/Models
- Training
- V&V-Testing
- SE Docs & Products
- Acquisition Strategy
- Process Improvement
The SysUCDs identify the Stakeholder’s top level Operational Needs & Goals and Perspectives for the ToBe System.

The SysUC Diagrams consolidate the:
- Users/Actors and Organizations,
- Driving Uses and Goals
- External Objects, Systems/System Functions
- Boundaries: Users (HMI) and System to External Systems
- Their Interactions (associations)

The SysUCs should include Multiple Scenarios

Each Scenario includes 1 or more Sequence and other Diagram(s) (e.g. BPMN)

SysUC Diagrams are Architecture Diagrams and provide the Basis for additional Architecture Views and Models
System Use Cases are a SysML “Spec Oriented” Diagram.

Virtually all SysML and other Architecture diagrams/Models are Derived From & Map To System Use Case Diagrams
Example System UC Level 0 Diagram
‘Support Executive Manager with Financial Information’

Key Users & Orgs

Human Machine I/F (HMI)

System Boundary

Use Cases, Goals, etc. (Key Functions/Activities)

System Functions, Tools, etc.

System to System I/Fs

Enabling Use Cases with Actors

Establishes System Boundaries & Operational & Enabling Elements with Descriptions (i.e. Key Driving Requirements/Topics)
SysUC, Scenarios and Sequence Diagrams

System Use Case

Scenario 1: Typical Support Exec Process

Scenario 2: Finding Report Problems

Provide Executive Financial Support

Scenario X
Concept/Operational Documents

- The Concept/Operational Documents are Critical for:
  - Understanding the Stakeholders Operational Needs and Goals in Their Terminology
  - Capturing all of the Use Cases, Scenarios and Sequence Diagrams, et al at the Start of the Development
  - Are Essential for the Life of the Development
  - Lead to Training, Testing, Manuals, etc. for the Operational Life of the System

- Key Operational Documents Over Life Cycle:
  1. Pre Development Concept of Operation (CONOP)
     - Written by the Stakeholders with SE/Architects Support
  2. During Development Operational Concept Document (or equivalent) (OCD)
     - Written by the Developer with the Stakeholder
  3. Testing, Manuals, Training for the systems Life Support
     - Written by developers, operational and support personnel, et al
Requirements Hierarchy- Top Level From Use Cases

Hierarchy of Requirements

1. Initial Stakeholder Mission Requirements/Operational Needs/Goals (Measures of Effectiveness?) - *Captured in SysUCDs*
   - Use Cases Contents (Actors, Use Cases, Ext. System Functions & Interactions/associations)
   - Scenarios’ Descriptions & Sequence Diagrams’ symbols

2. Identified Parameters (values) within Scenario descriptions and Sequence Diagrams (Measures of Performance?)
   - Top Level Stakeholder Operational Performance Needs

3. Key Performance Parameters (KPPs)
   - Derived from Stakeholder Operational/Performance Needs
   - And Additional Holistic Systems Engineering Reqts

4. Technical Performance Measures (TPMs)
   - Derived from KPPs
   - Comprehensive/Holistic System LCS Detailed Derived Requirements
     - All Categories/Types (Reference IEEE 1233, etc.)
Use Cases and the Evolution of the Architecture

MBE To-Be State

All Architecture Views & Operational Concept Documents Evolved and Expanded

- Collaborative Foundation:
  - Standards
  - Model Registry
  - Trusted Environment with SIP
  - Supporting Policy

MBE Enhances Affordability, Shortens Delivery and Reduces Risk Across the Acquisition Life Cycle
Each Stage/Milestone of a Development

- Requirements and Architecture Models Evolve Together
  - They must be consistent with each other
  - Supporting documents are essential for written text

- Operational Concept Documents (CONOP, OCD, etc.) must capture the ToBe system Use Cases, Detailed Scenario Descriptions, and supporting Sequence Diagrams

- This information is the basis for following system development products:
  - Requirements Analysis and Derived Requirements
  - All remaining & Evolving SysML Models: Structure, Behavior (Activities, States...), Parametrics
  - All SE Documents: Plans, Testing, Decisions, Training, .....
Get it Right in the First Stages: Questions to Answer/Check List

- Did the Team do the OOSEM “Analyze Stakeholder Needs” Activities?
- Did the Team Develop the SysUCs’ Purpose, Scope, Objectives, .... with the Stakeholders?
- Did the Team Develop & Fully Document Actors/Users, Use Cases, Scenarios and Sequence Diagrams with the Stakeholders? (e.g. CONOP)
  ▪ Stakeholders, Managers and Development Team Approved?
- Did the Team Develop Fully Define & Document the Required Initial Integrated Architecture (i.e. an Integrated Architecture Package)?
- Do System Use Cases, Scenarios, Sequence Diagrams and Other SysML Architecture diagrams Map to the Stakeholders’ Short Comings/Gaps, Goals/Objectives?
- Are the Requirements and Integrated Architecture Views Mapped to each other and the Use Cases, .....& Concept Document?
- Will the follow-on Contractors/Developers produce Operational Documents & Integrated Architecture at Required Development Milestones?
  ▪ Will the Contract Require the developer to produce the OCD, etc. and associated Architecture Views?
- ..........
“Get It Right in the First Stages”
Summary/Conclusions

- Assure the SysUC, Scenarios and Sequence Diagrams are developed/defined Completely
  - Foundation for all additional Architecture Diagrams, Systems Engineering Documents, etc.

- Initial Architect Development Activity is within the Stakeholder Needs Analysis (Define Enterprise Use Cases, ....)

- Documenting SysUCs, Scenarios and Seq Diagrams in an Operational Concept Document (e.g. CONOP) is critical to:
  - Capture the Stakeholders’ ToBe Operational Needs & Goals in Their Terminology and Views/Diagrams

- Effective Decision Making & Risk Reduction:
  - Based on Review/Approval of Complete Set of Architecture Views/Models for each Stage and Key LC Milestones

- Develop First Stage Questions and Check List, Verify at Completion

- Use & Evolution of the Operational Documents to Disposal

- Assuring various LC teams understand Stakeholders’ Needs/Expectations