Systems Engineering Workflow
Use Cases
SysML Roadmap Activity
INCOSE IW Working Sessions

John Watson, Rick Steiner, Dick Welling
1/27/2015
Background

• This activity is part of the SysML Roadmap activity within the OMG SE DSIG

• Intent
  – Identify the SE Capabilities and Infrastructure needs to develop systems through the entire lifecycle

• Near Term Goal
  – Identify where SysML may be used in the future to better support the SE needs

• Longer Term Goal
  – Help tool vendors support and automate SE Capability Needs
  – Framework for common practices
Basic Approach for SysML Roadmap

• Capture work in a SysML model
• Define the System Context Workflow Use Cases
• Capture the SE Workflow Use Cases
  – Use case goal, textual abstract and actors
  – Mature SE Workflows into Activities
  – Manage, refine and mature use cases
• Identify where SysML is/could be used
• Derive SysML Requirements from those tasks
• Periodically generated a review document from the model
Use Case Source Material

- INCOSE-TP-2003-002-03.2.2, *NCOSE Systems Engineering Handbook* v. 3.2.2, October 2011
Team Members

- Model Capture and Management Team
  - Eldad Palachi, IBM
  - Rick Steiner, Skygazer Consulting
  - John Watson (Lead) - Lockheed Martin
  - Dick Welling - Boeing

- SME Contributors
  - Robert Karban (JPL)
  - Chris Delp (JPL)
Workflow Use Cases organized by Life Cycle Phases

- **Total 31 Use Cases Under Construction**
- **Organization of Use Cases by Stages**
  - Exploratory/Concept Stage
  - System Development Stage
    - Management Use Cases
    - SE Domain Use Cases
    - Validation and Verification Use Cases
  - Production Stage
  - Product and Service Life Management
    - Utilization Stage
    - Support Stage
    - Retirement Stage
Use Case Context

[Diagram showing relationships between different roles and systems in product development, including Customer, Project Management, SE, Manufacturing, Support, Software Development System, Hardware Development System, Electrical Development System, Mechanical Engineer, Software Engineer, Electrical Engineer.]
## Use Case Name | Use Case Goal
--- | ---
Analyze Stakeholders Needs | The goal of this workflow use case is to identify all stakeholders and better understand and capture their required needs expectations, goals, and objectives across the entire product life cycle.

Derive System Requirements | The goal of this workflow use case is to derive a set of system level requirements for the system-of-interest based on the all stakeholder's needs requirements.

Derive Product Architecture | The goal of this workflow use case is to evaluate the System Requirements and from them derive the most appropriate architecture to satisfy the customer needs.

Evaluate System Safety | The goal of this workflow use case is to evaluate the system for safety related hazards and derive a plan to mitigate these risks.

Collaborate with Implementation Domain Team (software, mechanical, electrical) | Goal of this workflow use case is provide an automated capability to effectively share information between Systems Engineering and the component implementation engineering domains, such as the software, electrical, and mechanical domains.
Workflow and Task Patterns

• Significance of Patterns
  – They become a reference for creating other workflows
  – They help identify repeatable, common steps
  – They become a focus for language and tool development

• Workflow Pattern 1
  – This pattern is common across many SE Workflow Use cases
  – Most actions are Workflow Task Patterns

• Task Patterns → ✱
Example Task Patterns

Review Pattern

- Characterize Audience
- Prepare Review Package
- Distribute Review Package
- Adjudicate Comments with Reviewers
  - Publish Review Results
  - Make Updates Based on Results
- Create a new Baseline

<table>
<thead>
<tr>
<th>Reviewee</th>
<th>Reviewers</th>
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<tbody>
<tr>
<td></td>
<td>Review Package</td>
</tr>
<tr>
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<td>Submit Comments</td>
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</table>

Change Impact Pattern

- Identify Changed Item
- Present View of all items related to Changed Item
- Evaluate View for Non-Impacted Items
- Capture Rational for Removing Unimpacted Items
- Remove Non-Impacted Items from View
  - [No] Complete
  - [Yes] Generate Change Impact Summary Artifact
    - Review Results
      - [Yes] Change
      - [No] Complete

Example Use Case to Evaluate SysML Usage
Perform System Security Engineering

• **Goal** – The goal of this use case is to incorporate in the system of interest the necessary security design features to meet the needs of the customer.

• **Primary Actor** – SE Security Specialist

• **Secondary Actors** –

• **Preconditions** –
  1. A list of known potential threats are available
  2. A list of applicable policy documentation is available
Activity - Perform System Security Engineering

This use case begins early in the development cycle and continues to iterate through the remaining development cycles as the product matures.

1. Obtain and/or define the customer’s security protection goals for the following security domains including:
   1. Information security governance and risk management
   2. Access control
   3. Cryptography
   4. Physical (environmental) security
   5. Security architecture and design
   6. Business continuity and disaster recovery planning
   7. Telecommunications and network security
   8. Application development security
   9. Operations security
   10. Legal, regulations, investigations, and compliance

2. Capture the system vulnerabilities by analyzing the known or perceived threats and their behavior.
Activity - Perform System Security Engineering

3. Derive a set of security requirements that address the vulnerabilities and other applicable security policy documents.

4. Evaluate points of Interface;
   1. Identify all external interface points
   2. Identify internal interface points of major subsystems such as server farms, sensors, security management, business network, etc.
   3. Identifying the points of interface may have been completed earlier in a use case such as “Derive Product Architecture”.
   4. Determine and capture the level of security required for the information exchanged at the points of interface.

5. Capture the security architecture design that satisfy these requirements and minimize or contain the vulnerabilities.

6. Measure the change impact to other domains and mitigate issues

7. Conduct appropriate reviews within engineering and with the customer

8. Capture test cases that validate the security requirements have been reached.

9. If the proposed design does not meet the System goals, refine the design.

10. Prepare the necessary documentation for system accreditation and certification.

Post Conditions – Accreditation Certificate is submitted
Perform System Security Engineering UC

Diagram: [Diagram of system security engineering process]
Artifact Review Pattern

![Diagram showing the process of artifact review]

1. **Reviewee**
   - Prepare Review Package
   - Distribute Review Package
   - Adjudicate Comments with Reviewers
   - Publish Review Results
   - Make Updates Based on Results
   - Create a new Baseline

2. **Reviewers**
   - Receive Review Package
   - Submit Comments
   - Review Package
 Define SE Development Environment Domain

SE Workflow Use Case Context

Systems Engineering Development Systems (SEDS)

Organizations

Other Development Systems

Engineering Roles
System Modeling Environment
Basic Functionality in Support of MBSE

Slide from
"System Modeling Assessment Roadmap Intro and Results-Boston-palachi-friedenthal-140617-e.ppt"
Exploratory/Concept Stage Use Cases

**SE Development System**

1. **System Architect**
   - **Plan a Response to a Customer Request**
   - **Analyze Stakeholders Needs**
   - **Derive System Requirements**
   - **Analyze System Life-cycle Costs**

2. **Customer**
3. **Program Manager**
4. **Analyst**

**uc [Package] Exploratory and Concept Stage [Exploratory and Concept Stage Workflow Use Cases]**
System Development Stage – Management Use Cases

- Plan a Development Cycle
- Manage Development Progress
- Manage Development Environment
- Create a Baseline

Engineering Mgr.

Systems Engineer

Systems Engineer

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System Development Stage – System Development
Specialty Engineering Use Cases
1. Establish SE Use Case modeling team
   – Small team responsible for managing and capturing the model

2. Initial Modeling Effort
   – Capture Context
     • Systems Engineering Development System (SEDS)
   – Capture set of SE Workflow Use Cases
     • References include:
       – ISO/IEC 15288-2008
       – INCOSE Systems Engineering Handbook
       – System Engineering Book of Knowledge (SEBok)
     • Span across Life cycle
     • Initial effort identifies “What an SE does”
3. Prioritize Use Cases
4. Refine and complete each of the use cases
   - solicit help from experts across the industry
5. Use Cases can be added, deleted or replaced
6. Periodically report progress to the SysML Roadmap Team and to the SysML RTF Team
7. Goals
   - Short Term - Help define the SysML Roadmap
   - Longer Term
     • Define a reference architecture for a fully integrated, cost effective, automated, and highly productive SEDS
     • Framework for common practices
How to Contribute

• Total 31 Use Cases Under Construction
• At the last OMG meeting we selected 5 to address first
• Go to the IW MBSE wiki and follow the link to the SE UC Wiki for background and instruction
• On Tuesday there will be 2 sessions at 9 AM and 1 PM
• On the SE UC Wiki, the 5 use cases are listed
• Either tell or email me, Rick or Dick which ones you feel you could contribute and then show up
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## Selected Use Cases at OMG Tech Meeting

**Dec 2014**

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