

25th anniversary
annual INCOSE
international symposium
Seattle, WA
July 13 - 16, 2015



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



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Problem Statement (Purpose for Paper)-

Lack of Emphasis/Understanding of:



- **System Use Cases** development with the Stakeholders/Users
- **What should be done prior to a Request For Proposal**
 - And must be done first after receiving an RFP
- **Transitioning Knowledge/Info between 3 Teams:**
 - Pre-Development, Development, Operational Support Teams
- **Operational Concept Documents Critical Importance**
- **Establishing the First Baseline Products (Pre- RFP)**
- **The Method used to Implement MBSE and SysML, etc. Architectures/Models**
 - Object Oriented Systems Engineering Method (OOSEM)

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**
- **System Use Cases, Scenarios, Sequence Diagrams**
- **The “Initial Integrated Architecture/Model”**
- **The Essential Operational Documents**
- **Requirements Hierarchy and Relationship to the Integrated Architecture**
- **System Life Cycle and the Evolution of the Integrated Architecture & Development Milestones**
- **Manpower Resources throughout the Life Cycle**
- **Get It Right in the First Stages : Questions/Check List**

The OOSEM “Analyze Stakeholder Needs”



This presentation is focused on and an expansion of:

- Object Oriented Systems Engineering Method's Second Activity:
 - “Analyze Stakeholder Needs”*
- Development and Analysis of associated SysML™ architecture diagrams
- 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

*Reference: “A Practical Guide to SysML”, second edition, page 445, et al

Figure 17.2 (Object Oriented Systems Engineering Method)

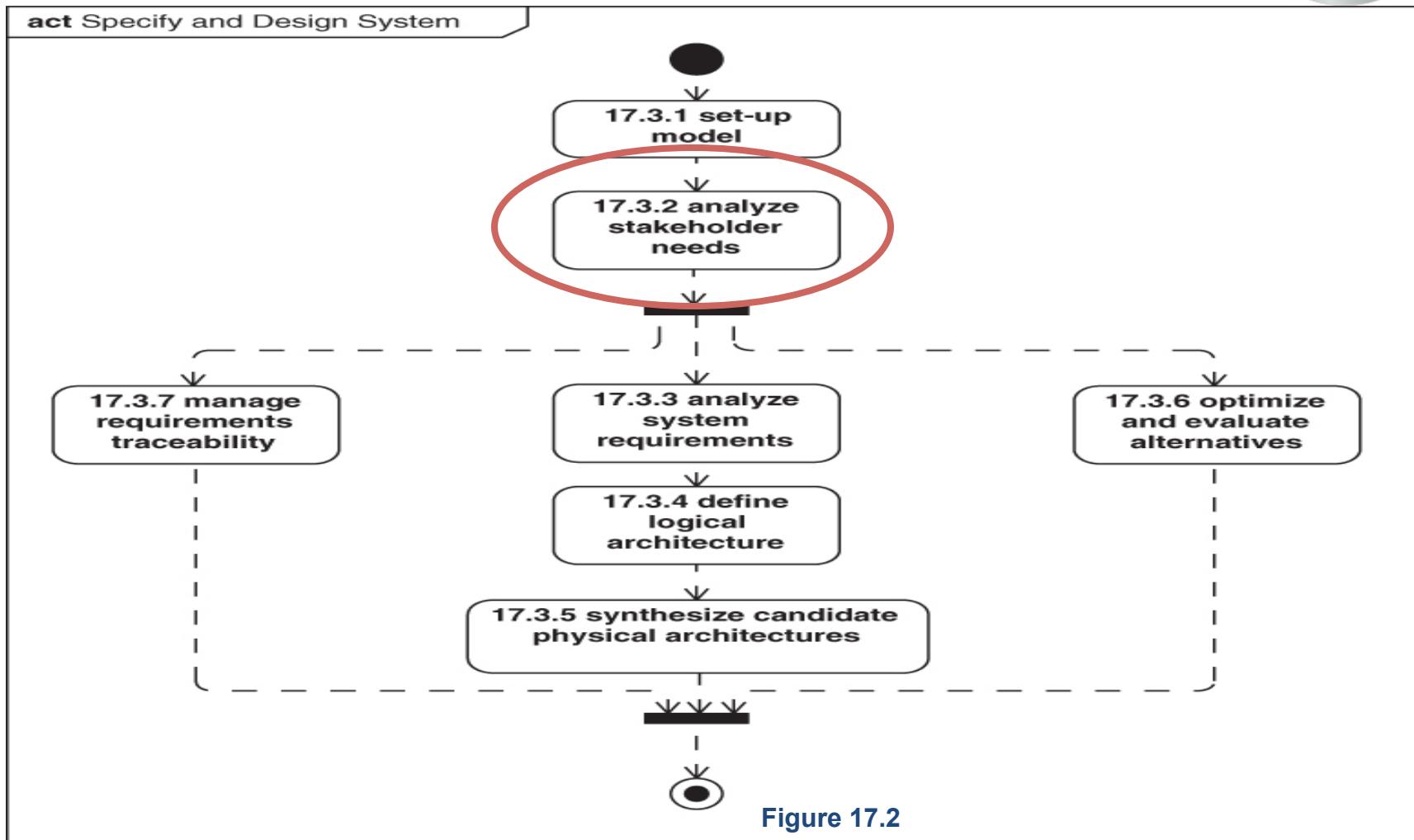
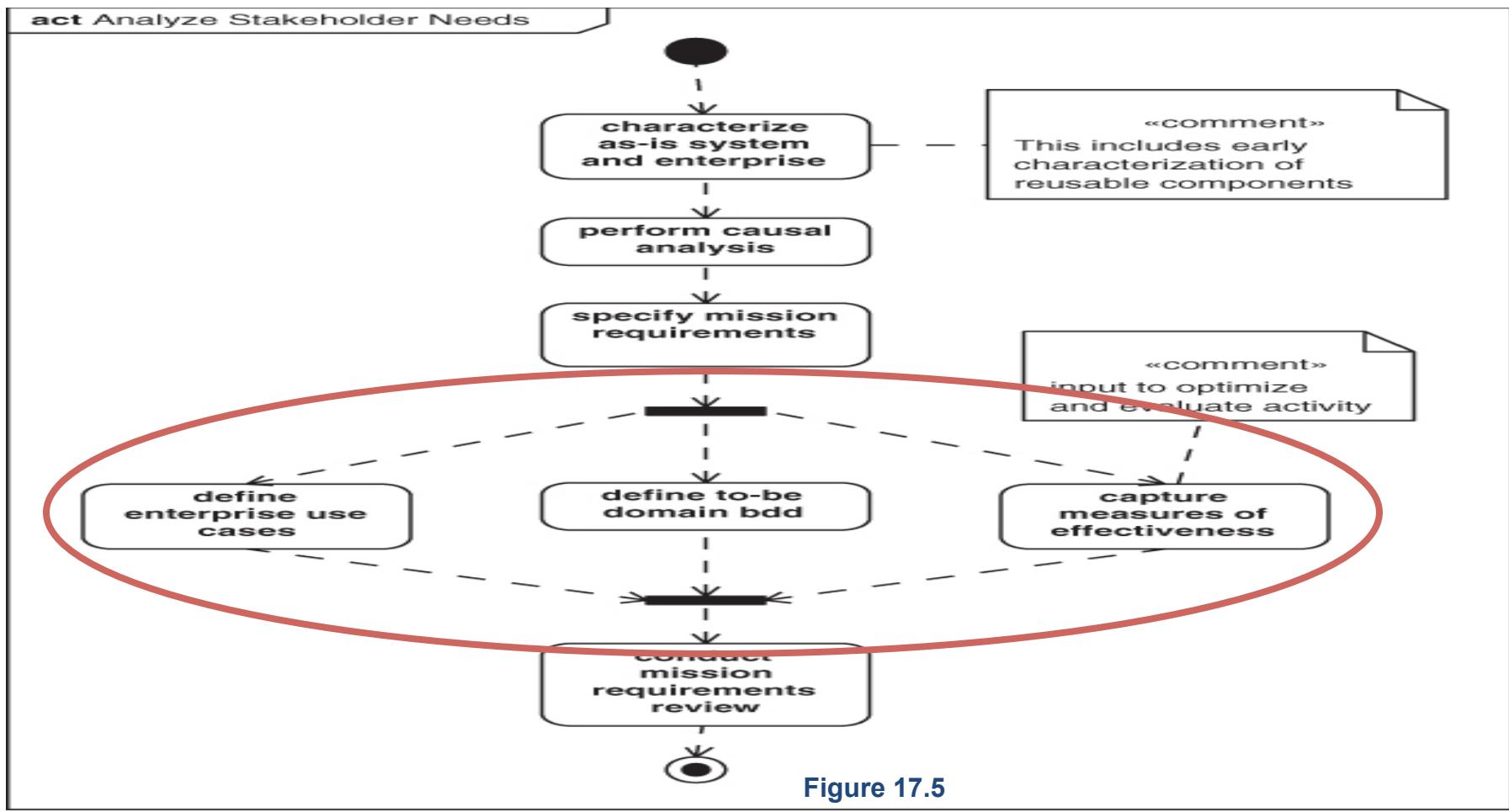


Figure 17.2

*Reference: "A Practical Guide to SysML", second edition

Figure 17.5 (Analyze Stakeholder Needs Activity)



DoDAF v2.02, Chg 1

31 January 2015

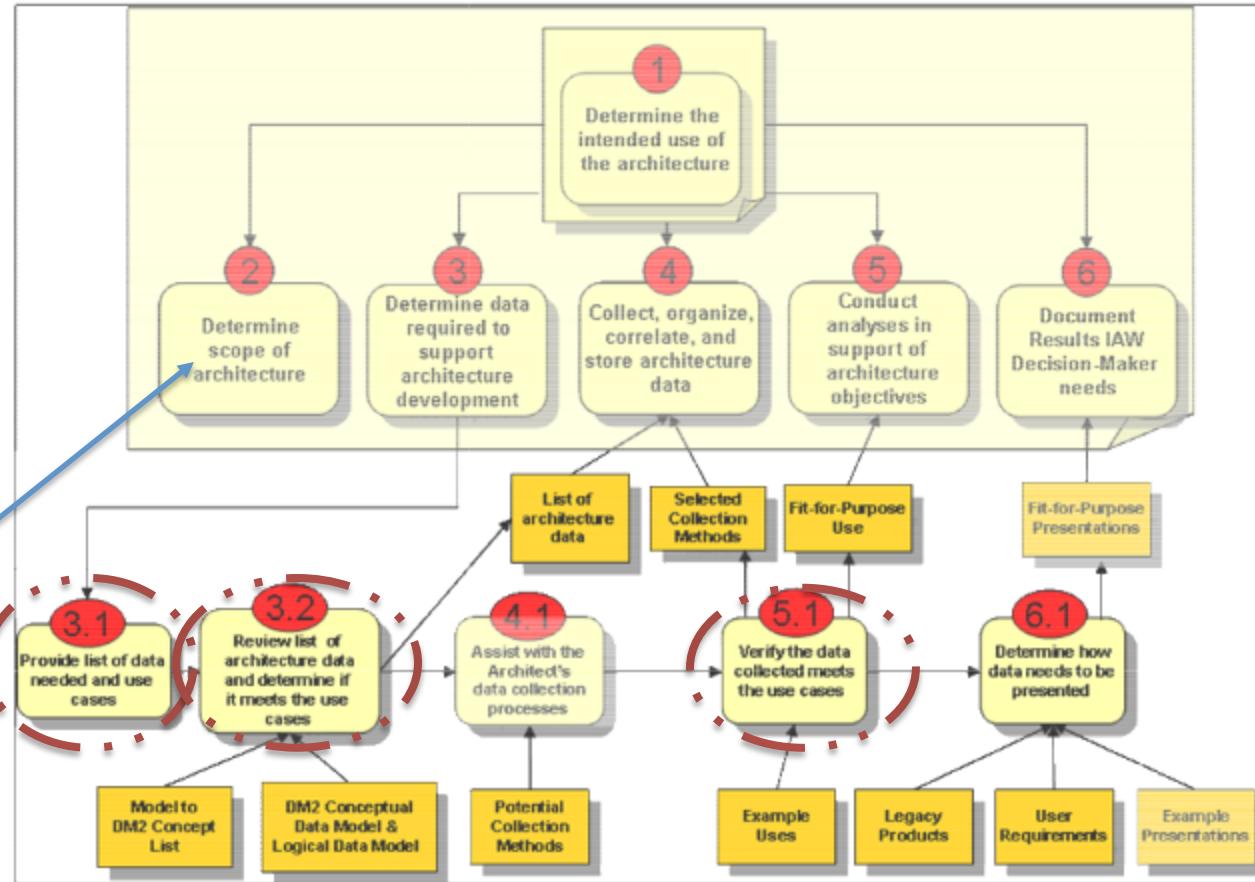
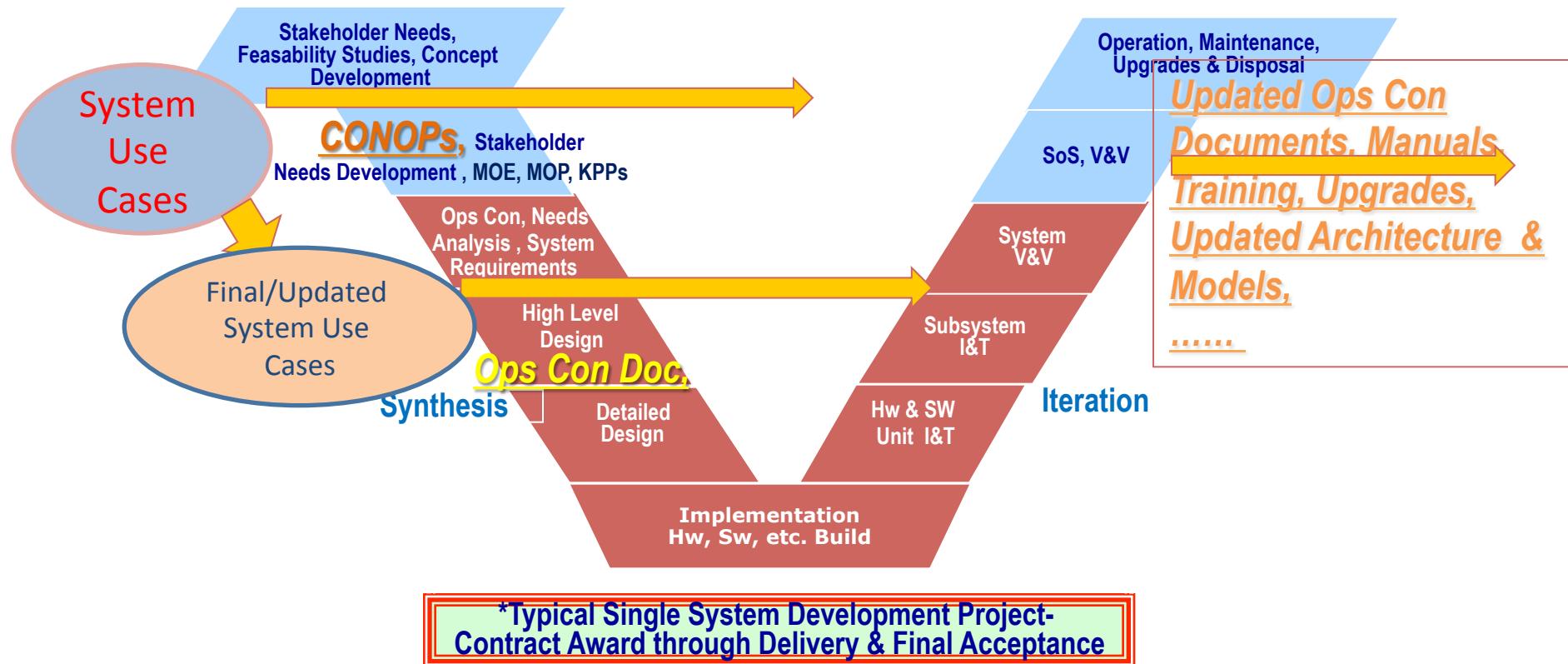


Figure 3-1. Architecture Manager Roles

3.1 Developing Architectures

Stage 1- The “V” Diagram System Life Cycle Stages/Phases



Blue: Pre & Post Development/Contract
Red: Development (Contract)

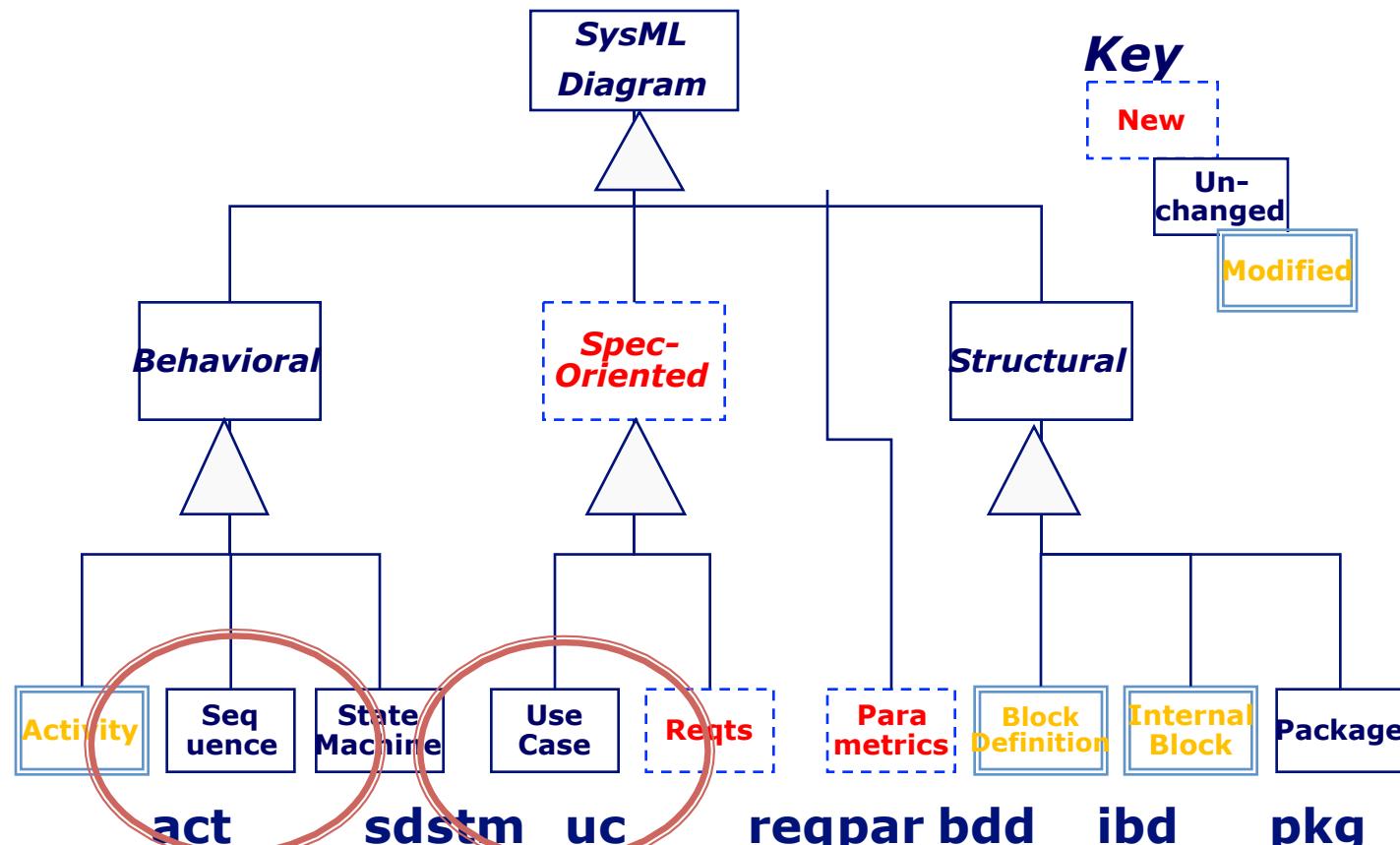
System Use Case Diagram Description (The First Context Diagram)



- **SysUCs & SysUC Diagrams with descriptive Information, are used to capture and help Define Stakeholder Operational Needs for ToBe system (also AsIs)**
- **Used to Transition Operational Needs, Goals, etc. to Systems Engineering and Related Products**
- **Capture the Users/Actors and relationships to ToBe System**
- **Key Communications media with All Stakeholders (Operational), Technical (Developers), Managers, Support....**
- **Address Stakeholder identified existing shortfalls/gaps, goals, etc. in current operational capabilities**
- **SysUCs are the Foundation/Context Diagram for virtually all additional system engineering products (reqts, architecture, testing, documents, LCS)**

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Paper Focus is on SysML UC and Sequence Diagrams for First Stage Products/Info



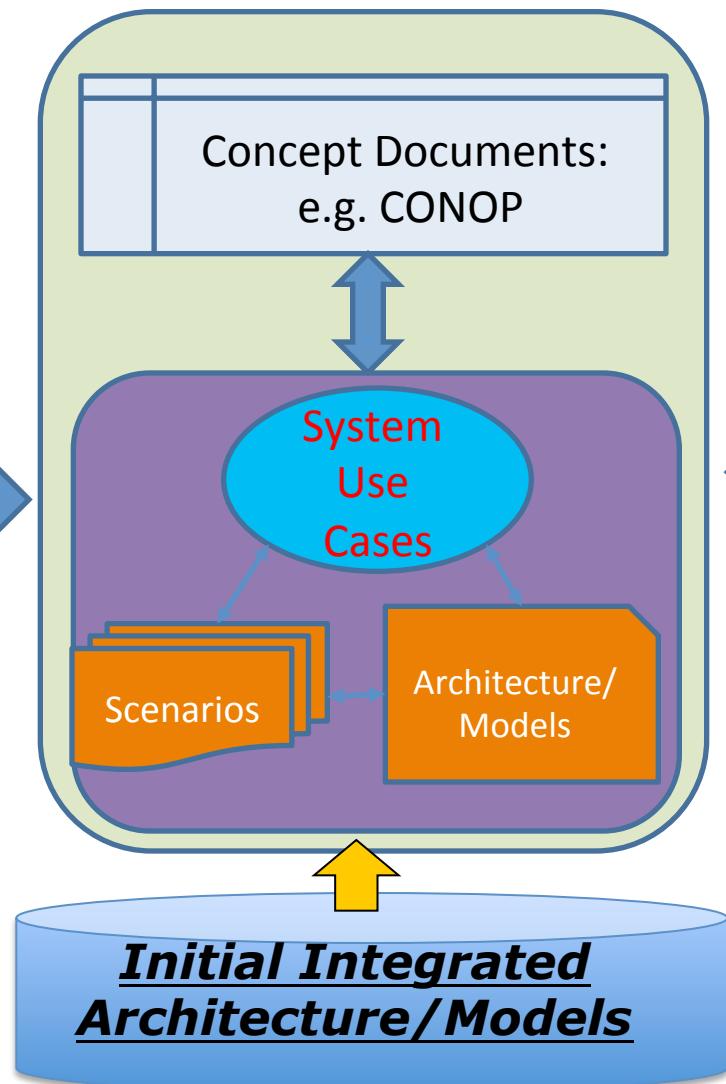
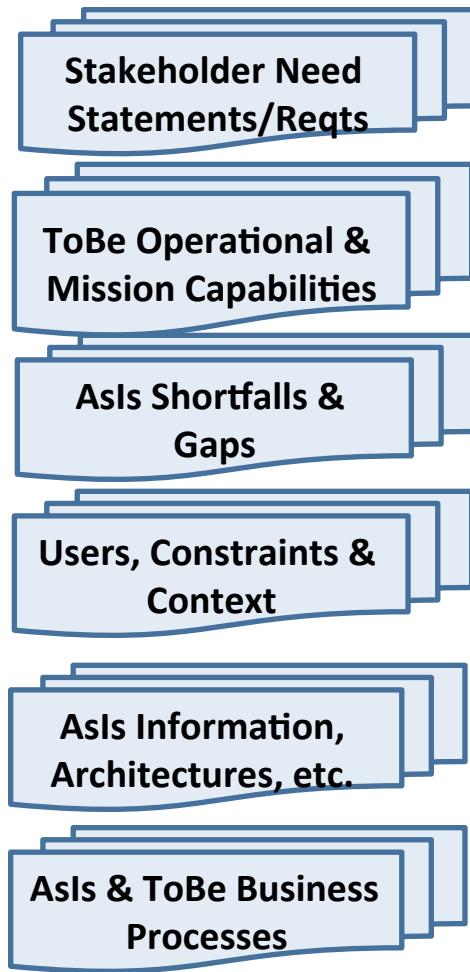
Can also use BPMN diagrams

Other SysML diagrams included in Integrated Architecture Package

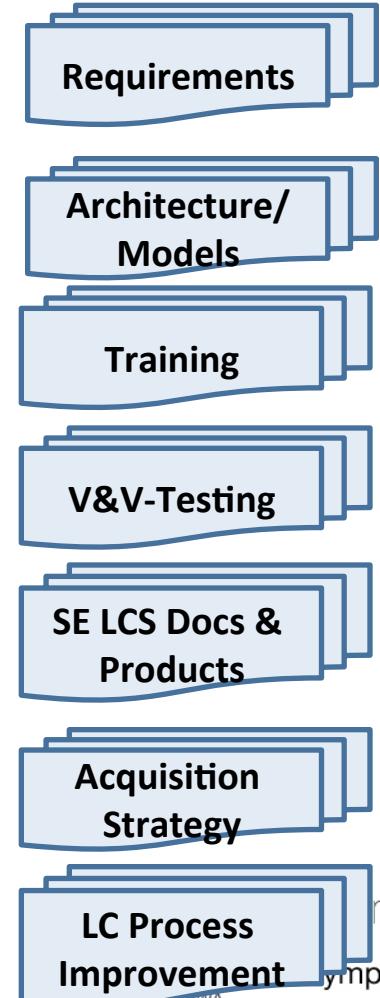
System Use Cases Context & Initial Integrated Architecture



Various Source Driving Products



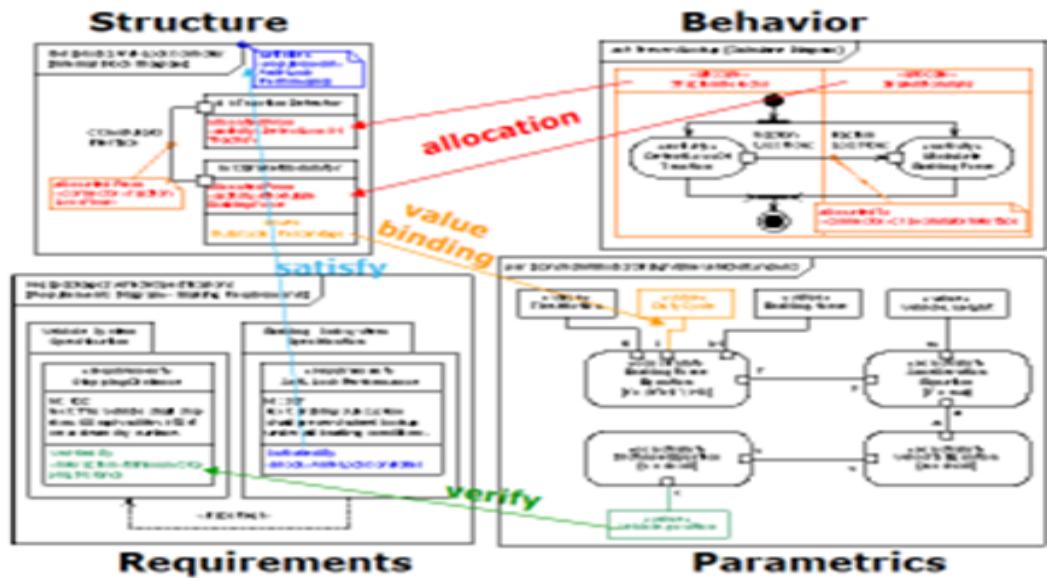
SE Dvlp/Life Cycle Products



First Stage: Stakeholders' System UCs, Scenarios & Sequence Diagrams



SysML 4 Pillars



System Use Cases are a SysML™ “Spec Oriented” (Requirements) & Behavior Diagram.

Virtually all SysML and other Architecture diagrams/Models are Derived From & Map To Stakeholders' System Use Case Diagrams

System Use Cases Diagram (SysUCD)

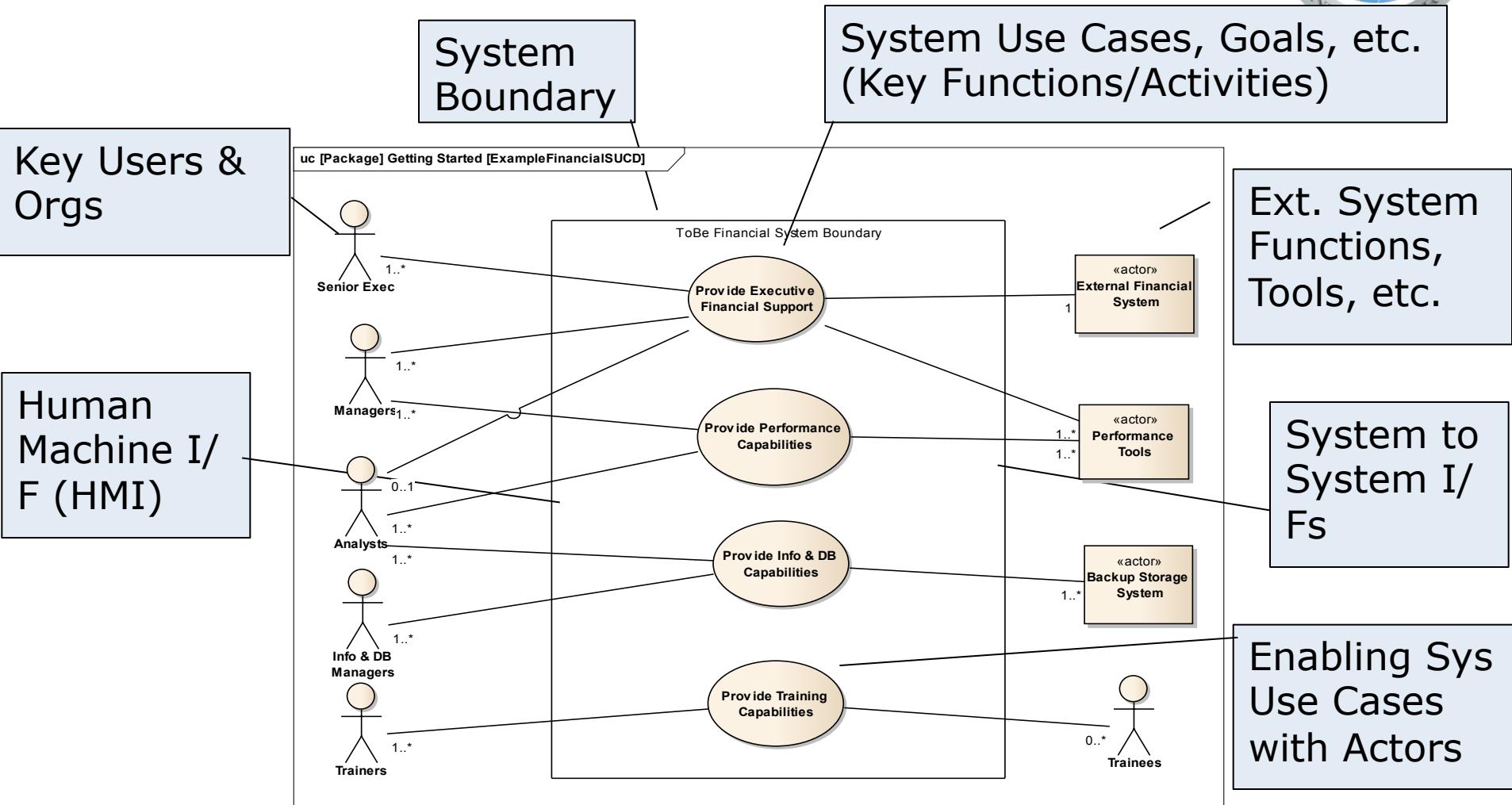


- The SysUCDs identify the Stakeholder's top level Operational Needs, Goals, Perspectives for ToBe System
- The SysUCDs consolidate the:
 - Users/Actors and Organizations, Driving Uses and Goals, External Objects, Systems/System Functions,
 - Boundaries: Users (HMI) and System to External Systems and Interactions (associations)
- Each SysUCs should include Multiple Scenarios
- Each Scenario includes 1 or more Sequence and other Diagram(s) (e.g. BPMN, Activity, etc.)

SysUC Diagrams are First Architecture Context Diagrams and Foundation for other Architecture Views/Models

Example System UC Diagram (top level)

‘Support Executive Manager with Financial Information’

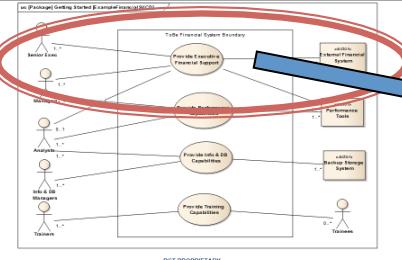


Establishes System Boundaries & Operational & Enabling Elements with Descriptions (i.e. Key Driving Requirements/Topics)

SysUC, Scenarios and Sequence Diagrams



Example System UC Diagram



Provide Executive Financial Support

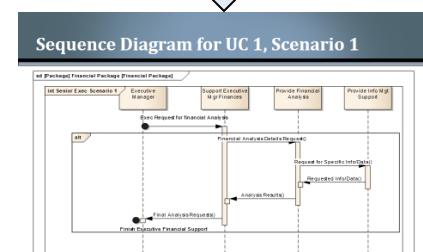
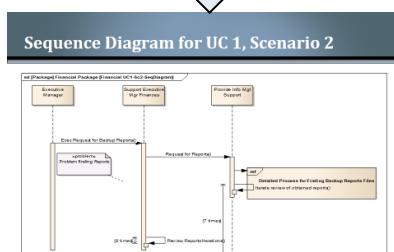
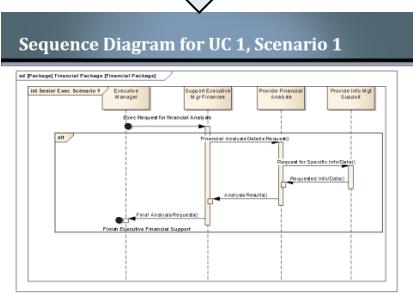
System Use Case

Scenario 1:
Typical Support Exec Process

Scenario 2:
Finding Report Problems

.....

Scenario X



We make you look good because we do it right the first time.

Concept/Operational Documents



- **The Concept/Operational Documents are Critical for:**
 - Understanding the Stakeholders Operational Needs and Goals in User Operational Terminology
 - Capturing all of the System Use Cases, Scenarios and Sequence Diagrams and supporting descriptive Information at the Start of the Development
 - Are Essential for the Life of the Development
 - Lead to Training, Testing, Manuals, etc.
- **Key Operational Documents Over Life Cycle:**
 - Pre Development ‘ToBe’ Concept of Operation (CONOP)
 - Written by the Stakeholders with SE/Architects Support
 - During Development ‘AsIs’ Operational Concept Document Written by the Developer with the Stakeholder
 - Testing, Manuals, Training for the systems Life Support

Requirements Hierarchy- Top Level From System Use Cases



- **Initial Stakeholder Mission Requirements/Operational Needs/Goals - Captured in/related to SysUCDs**
 - System Use Cases Contents (Actors, Use Cases, Ext. System Functions & Interactions/associations) & Scenarios' Descriptions & Sequence Diagrams' symbols
- **Identified Parameters (values) within Scenario descriptions and Sequence Diagrams (Measures of Performance?)**
 - Top Level Stakeholder Operational Performance Needs
- **Key Performance Parameters (KPPs)**
 - Derived from Stakeholder Operational/Performance Needs & Additional Holistic SE Reqts, All Categories (IEEE 1233, etc.)
- **Technical Performance Measures (TPMs)**
 - Derived from KPPs by SEs, LC support, etc.
 - **Comprehensive/Holistic System LCS Detailed Requirements**

Use Cases and Evolution of the Architecture

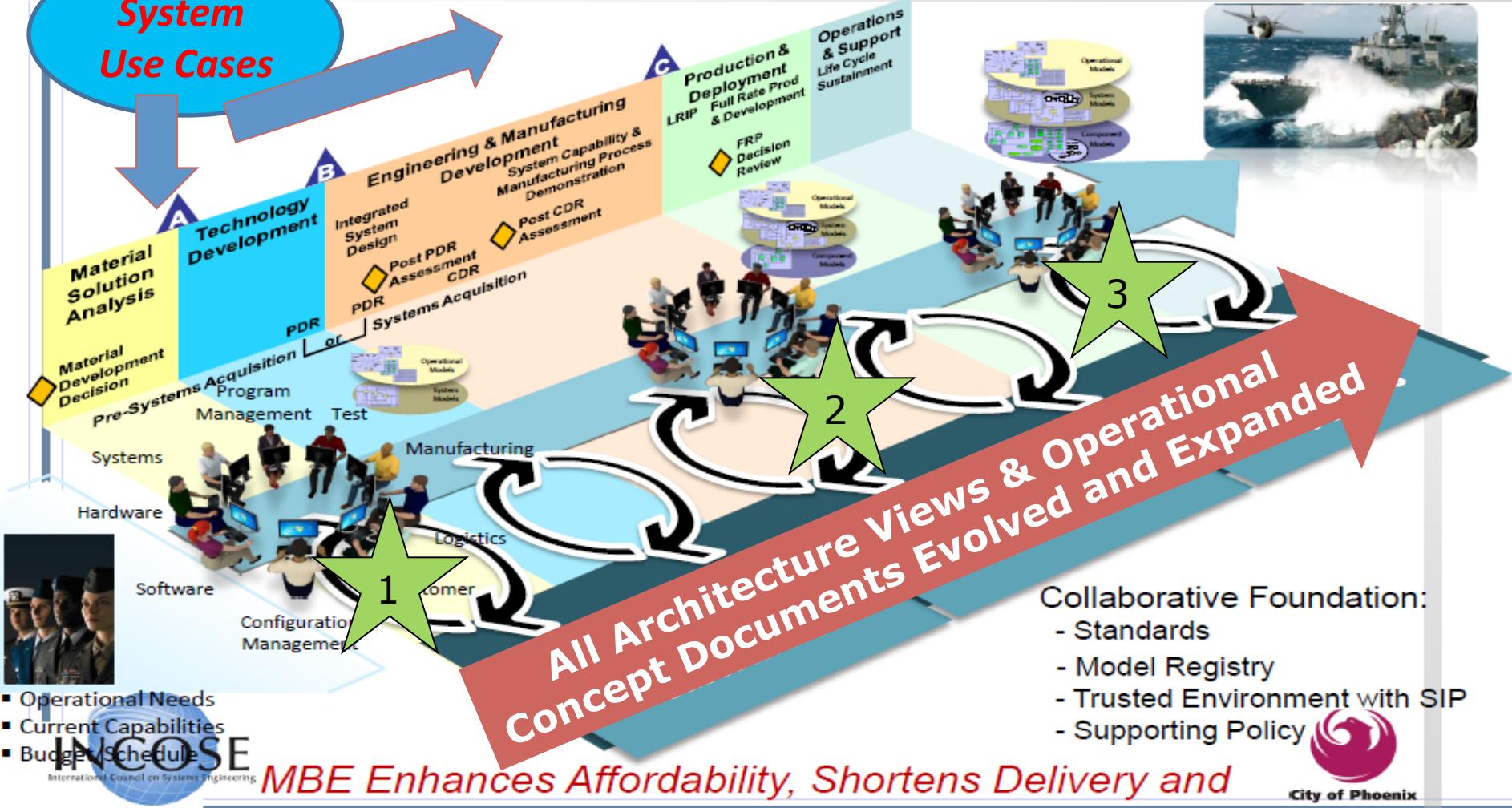


International Workshop
28 Jan – 2 Feb 2011
Phoenix, AZ, USA
DRAFT



MBE To-Be State

System
Use Cases

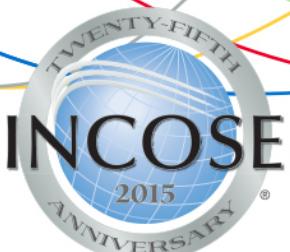


Collaborative Foundation:
- Standards
- Model Registry
- Trusted Environment with SIP
- Supporting Policy



City of Phoenix

Manpower Resources



- **ROI is very high when using highly trained SEs, Process (e.g. Lean SS) and similar Stakeholder focused experts**
- **Focus on working with Stakeholders to develop SysUCDs, Scenarios, Info and supporting Architecture models**
- **Support Stakeholders- LC Concept Documents, etc.**
- **Number of experts dependent on project size, complexity, etc. (e.g. 1/4 time to teams of 20+)**
- **Support duration dependent on size, complexity, LC phase, etc.**
- **SE/process support throughout the system's Life Cycle to address change (upgrades, interfaces, changing requirements, user rolls, model updates, etc.)**

Each Stage/Milestone of a Development



- **Requirements and Architecture Models Evolve Together**
 - They must be **Totally consistent with each other**
 - Supporting documents are essential for written text
- **Operational Concept Documents (CONOP, OCD, etc.)**
 - Must be updated to capture **ToBe System Use Cases, Detailed Scenario Descriptions, and supporting Sequence & other Diagrams/models**
- **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,
 - Acquisition Strategy

Get it Right in the First Stages : Ex. Questions to Answer/Check List



- Did the Team do All OOSEM “Analyze Stakeholder Needs” Activities?
- Did the Team Develop the SysUCs’ Purpose, Scope, Objectives, Goals with the Stakeholders?
- Did the Team Develop & Fully Document Actors/Users, Use Cases, Scenarios and Sequence Diagrams with the Stakeholders during each phase? (e.g. Concept Documents)
 - 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 and fully address the Stakeholders’ Short Comings/Gaps, Goals/Objectives?
- Are the Requirements and Integrated Architecture Models Mapped Exactly to each other and the Use Cases,& Concept Documents?
- 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. 25th anniversary annual INCOSE international symposium Seattle, WA July 13 - 16, 2015

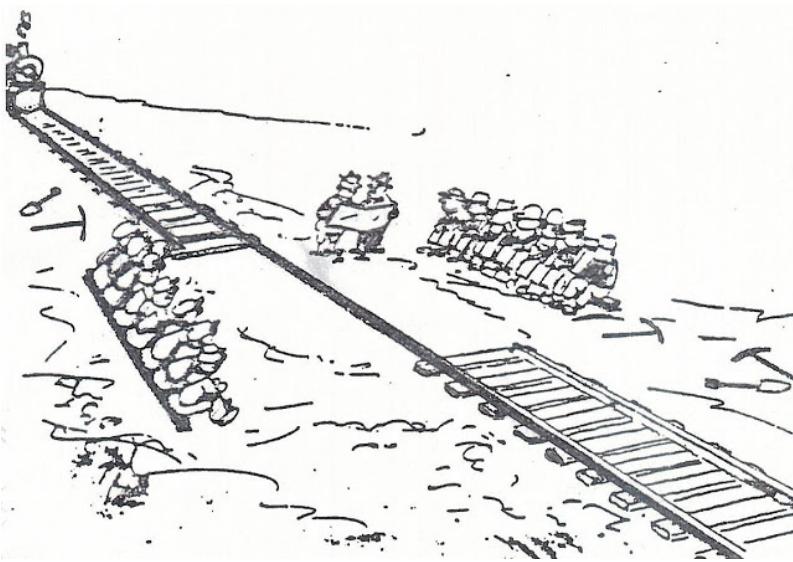
“Get It Right in the First Stages” Summary/Conclusions



- **Assure the SysUCDs, Scenarios, Sequence & Integrated Architecture Models are developed/defined Completely**
- **Initial Architect Development Activity is within the Stakeholder Needs Analysis (Define Enterprise Use Cases,)**
- **Documenting SysUCs, Scenarios, Seq & Arch Models in an Operational Concept Document (e.g. CONOP) is critical to:**
- **Effective Decision Making & Risk Reduction at Key LC Milestones**
- **Develop First Stage Questions and Check List, Verify at Milestones**
- **Use & Evolution of the Operational Documents to Disposal**
- **Assuring various LC teams understand Stakeholders' Needs & Expectations (i.e. the Concept Documents)**



Examples of NOT Doing it Right in the First Stage



I know they say a bad workman always blames his tools but - a faulty PLUMBLINE???