Lean-Agile MBSE
Best Practices & Challenges
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Why Model-Based Systems Engineering (MBSE)?
Key Systems Engineering (SE) Challenges

- Increasingly complex problems and solutions
- Assessment of changes increasingly more difficult
- Lots of big, unreadable documents
- Poorly synchronized data, information & knowledge

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Model-Based Systems Engineering (MBSE)
Models

Model is a type of Descriptive, Analytical, and Hybrid.

Descriptive integrates 1..*

Analytical integrates 1..*

Hybrid

Mission/Solution/System integrates 1..*

Modeling Language 1..* implements UML, SysML, UAF.

Modeling Tool implements DOORS, Rhapsody, Cameo.

Simulation implements over time 1..*
Example of Integrated Models

- **Requirements**
- **Descriptive Models**
  - Create Block Definition Diagram with Attributes
  - Create Requirements Diagram
  - Create Parametric Diagram
- **Analytical Models**
- **Model Integration via ModelCenter®**
- **Analyze until Optimal Solution reached**
- **Perform Trade Studies**

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Uses of Models

- Characterizing an existing mission/solution
- Mission/solution concept formulation, exploration and evaluation
- **Solution design synthesis and requirements flow-down**
- Support for solution integration and verification
- Capture and sharing of mission/solution knowledge
- **Support change impact analysis, as part of on-going solution design evolution**
- Estimate mission/solution costs
- Evaluate mission/solution alternatives
- ** Efficiently produce contract- or compliance-required documentation**
Benefits of MBSE

- Single source of engineering truth
- Increase ability to manage complexity
- Improve communications among stakeholders
- Rapidly analyze the impact of changes
- Improve system architecture, design and quality
- Minimize staff attrition impact

- Enable fast-feedback on requirements and design decisions
- Lower maintenance costs to modify solution design
- Validate problem and solution hypotheses at lower cost
- Identify risks earlier
- Improve productivity through automation and reusability
How do you apply MBSE in SAFe?
Large Solution and Portfolio SAFe Incorporates MBSE

Source: SAFe®
MBSE and SAFe

Explore alternatives and learn faster
Support compliance and impact analysis
Generate documentation
Build model quality in

Source: SAFe®

Requirements Model
Coverage, Impact

System Model
Design, Implementation

Test Model
Coverage, Impact

Domain Models
ECAD  MCAD  Thermal  Aero  Fluid

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Lean-Agile MBSE Best Practices
Incrementally build “just barely good enough” models of the Solution Intent (“as-built” and “to-be”) with each Iteration

- Avoid Big Modeling Up Front (BMUF)

Make solution and its intent dynamic

Keep options open with fixed and variable Solution Intent

Collaboratively develop the Solution Intent

Connect Solution Intents across the supply chain

Create minimal, but sufficient documentation

Source: SAFe®
Definition of Done (DOD) Includes Modeling

**Business Feature F27: Party Limo Live Broadcast**

**Benefit Hypothesis:** Give all of the user’s other friends who were not invited on the Party Limo extreme FOMO

**Acceptance Criteria:**
- The user selects to which social media platforms to broadcast
- Live video from inside the Party Limo is broadcast to selected social media platforms

**Definition of Done for Business Features**
- Acceptance criteria met
- Associated User Acceptance Tests pass in the Staging Environment
- All Regression Tests pass in the Staging Environment with no Category 1 defects
- Associated requirements, architecture and UX models validated
- Compliance documentation updated

**Decompose Business Feature**

**Team Backlog**

**User Stories**
- Exploration Enablers
- Architectural Enablers
- Infrastructure Enablers
- Compliance Enablers
Exploration **Enabler Story S45**: Create a Resource Process Flow diagram for Live Broadcasting from a Party Limo

As a System Architect, I want to create a Resource Process Flow diagram so that I can identify and describe the necessary data flows that are input (consumed) by and output (produced) by each associated Resource involved in Live Broadcasting from a Party Limo.

Acceptance Criteria:
- A Resource Process Flow diagram is created for Live Broadcasting from a Party Limo
  - Compliant with Project Modeling Style Guide
  - Does not generate any errors or warnings against validation suites

**Definition of Done** for Modeling Enablers

- Acceptance criteria met
- Models are created/updated and validated
- Models are peer reviewed by other System Architects and/or the Dev Team
Create Testable/Executable Models

Source: No Magic Documentation

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Utilize Models to Support Set-Based Design

Source: SAFe®
Utilize Models to Support Compliance

- Develop model artifacts to support internal and independent compliance activities (e.g., cybersecurity, privacy, safety)
- Automate the production of required compliance documentation (e.g., plans, reports) from models
Translate Informal Models into Formal Models

Model Storming

Source: No Magic Documentation
Establish Modeling Standards

Use Iteration Retrospectives and Inspect & Adapt workshops to improve modeling standards

Source: No Magic Documentation
Collaborative Modeling

- Create models working in pairs
- Conduct a modeling “jam session” after Iteration Planning with modelers across the Agile Release Train
- Maximize stakeholder participation in identifying, building and validating models
Other General Best Practices

- Ensure models are configuration controlled
- Employ role-based access control to models
- Minimize duplication of model elements
- Model at the lowest security classification possible
- Leverage model glossary
  Maintain traceability between model elements and any source material
- Integrate Lean UX artifacts with models
Lean-Agile MBSE Challenges
Enduring and Emerging Lean-Agile MBSE Challenges

- Culture change
- Leadership buy-in
- Modeling talent scarcity
- Stakeholder availability
- Model integration within and across security classifications
- Modeling integration with agile project management and software development tools
- Adopting emerging modeling standards
- Stakeholder communication
- Modeling across multiple disciplines/domains
- Semantic gaps
- Executable models
- DevSecOps and Software Factories
Large-scale development programs are increasingly employing MBSE

Large organizations are beginning to adopt the Scaled Agile Framework (SAFe®)
  – Provides high-level guidance on adopting MBSE

Within SAFe, leverage proven Lean-Agile MBSE best practices
  – Incrementally plan, develop and validate models
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