A Few Words First

Audio Connection – Please mute phone (*6 toggle) – or your GM left-side name

All phone connections will be muted during the presentation. Save your comments and questions for Q&A and/or put them in the GlobalMeet chat window.

Upcoming Meetings (see events on Chapter home page for event registration):

- **Jan 10: Chapter-Arranged on-line self-paced SEP Course, runs long as you need.**
- **Jan 16: Free Chapter-Sponsored SEP Exam at UTEP (El Paso)**
- **Feb 8: Winter Social at Gruet Winery 5:00-7:00 pm.**
- **Mar 13: Evidence-Based Approach to Implementing the New INCOSE Systems Engineering Competency Framework.**
  Dr. Don Gelosch, Director, SE Programs, Worcester Polytechnic Institute.
- **Apr 4: Free NRAO Tour and free SEP Exam, day before the Summit.**
- **Apr 5-6: Socorro Systems Summit.**
- **Apr 10: Strategies for Complex Systems Development: Program Management and Systems Engineering – Tina Srivastava, MIT**

CSEP Courses by *Certification Training International:*
Course details (with more locations and dates)
Upcoming Course Schedule (somewhat nearby):
2019 Feb 11-15 | San Francisco, CA
2019 Aug 12-16 | Austin, TX

First slide, not recorded but retained in pdf presentation.

And Now - Introductions

Enchantment Chapter Monthly Meeting

9 January 2019 – 16:45-18:00 MT

Risk and Opportunity Management in an MBSE with SysML Environment

Brian Selvy, CEO, CTO, and Co-founder of Nymbysys LLC, bselvy@nymbysys.com

Abstract: Today's well known and utilized SysML tools and platforms that deliver exceptional capability in systems engineering typically do not offer an intuitive and effective means for capturing and modeling risks and opportunities. Modeling these elements, their properties, and interactions/traceability to other Systems Engineering artifacts is yet another pillar of a holistic Systems Engineering methodology that can make or break the success of any program. While it may be easy to modify existing elements to provide a static identification of risk and opportunity attributes within any given model, much more thought and care needs to be employed to generate a methodology that includes analysis of the time-phased, evolving aspects of R/O management. Only then can the attribute data related to potential risks and opportunities be analyzed sufficiently to make technical and programmatic decisions, and a full model-based system-level understanding of a project is incomplete without it. This presentation will fully define the problem of ignoring risks and opportunities in a complete MBSE employment and will describe a set of custom SysML extensions and a methodology that meets typical project needs. A few examples for how to create static and dynamic model elements for identifying, analyzing, and predicting the probabilistic impact of these potential events will be presented, as well as means of tailoring the rigor and scope of a model-based risk & opportunity program to the needs of an organization based on project size, complexity, and stakeholder demands.

Download slides today-only from GlobalMeetSeven file library or anytime from the Library at www.incose.org/enchantment

NOTE: This meeting will be recorded

Today's Presentation

Things to Think About

How can this be applied in your work environment?

What did you hear that will influence your thinking?

What is your take away from this presentation?

Speaker Bio

Brian Selvy is CEO, CTO, and Co-founder of Nymbysys LLC, a Model Based Systems Engineering consultancy and training company focused on assessing clients' needs and tailoring nimble, effective, and efficient solutions to their unique criteria, taking into account company size, past MBSE experience, project size and complexity, and customer expectations and requirements.

Mr. Selvy has 15 years of experience in Systems Engineering and has been an avid practitioner of Model Based Systems Engineering (MBSE) for the last 7+ years. He has held senior systems engineering and management positions at Space Exploration Technologies (SpaceX), Pratt and Whitney Rocketdyne, Paragon Space Development Corporation, the Large Synoptic Survey Telescope (LSST), and World View where he currently serves as the Systems Engineering Manager in addition to his role at Nymbysys.

Mr. Selvy has developed tooling extensions, architecture and methodology solutions to complex problems that lacked an apparent “out of the box” solution. He holds a Bachelor of Science degree in Aerospace Engineering, Cum Laude, from California Polytechnic State University, San Luis Obispo and a Masters of Science degree in Systems Architecting and Engineering from the University of Southern California. He has obtained the Object Management Group Certified Systems Modeling Professional (OCSMP) certification and has won awards from No Magic and the Association of Universities for Research in Astronomy (AURA) for his modeling work. He has also been recognized by as a “40 under 40” award winner for the Tucson metro area.

Risk and Opportunity Management

in an MBSE with SysML Environment

Brian Selvy
CEO & CTO
Nymbysys LLC

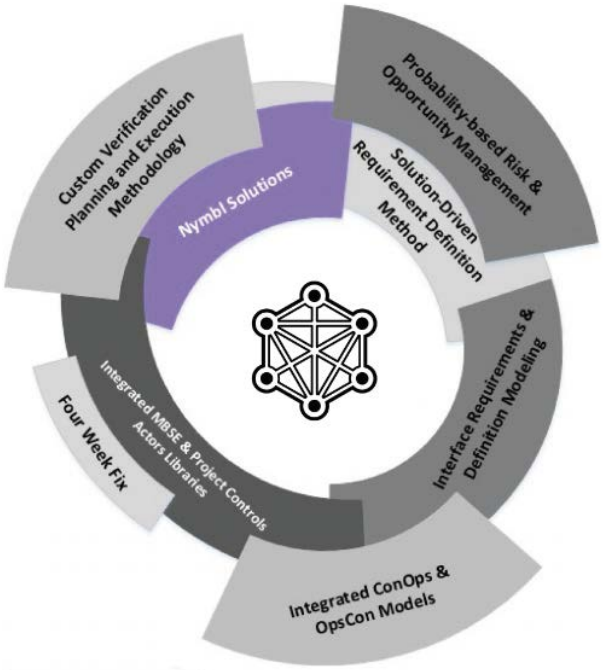
nymbysys

Nimble . Elegant . Solutions

INCOSE Enchantment Chapter Presentation – January 9, 2019

About Nymbysys

- Nymbysys was founded in 2017 as an MBSE consultancy & training company.
- Focused on meeting customer's needs by providing nimble, effective and efficient solutions taking into account:
  - Company size
  - Past MBSE experience
  - Project size and complexity
  - Customer expectations and requirements
- Custom extensions, processes, and methodologies



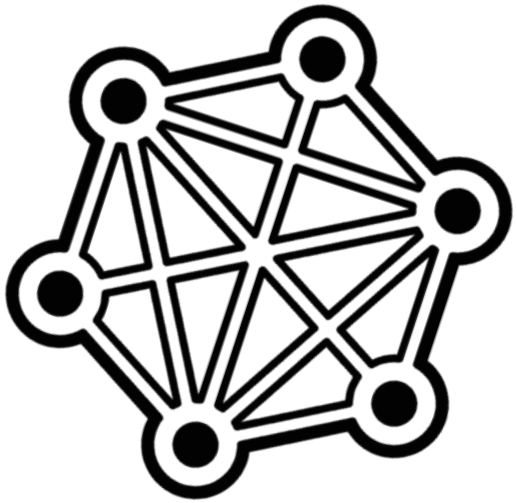
nymbysys

Nimble . Elegant . Solutions

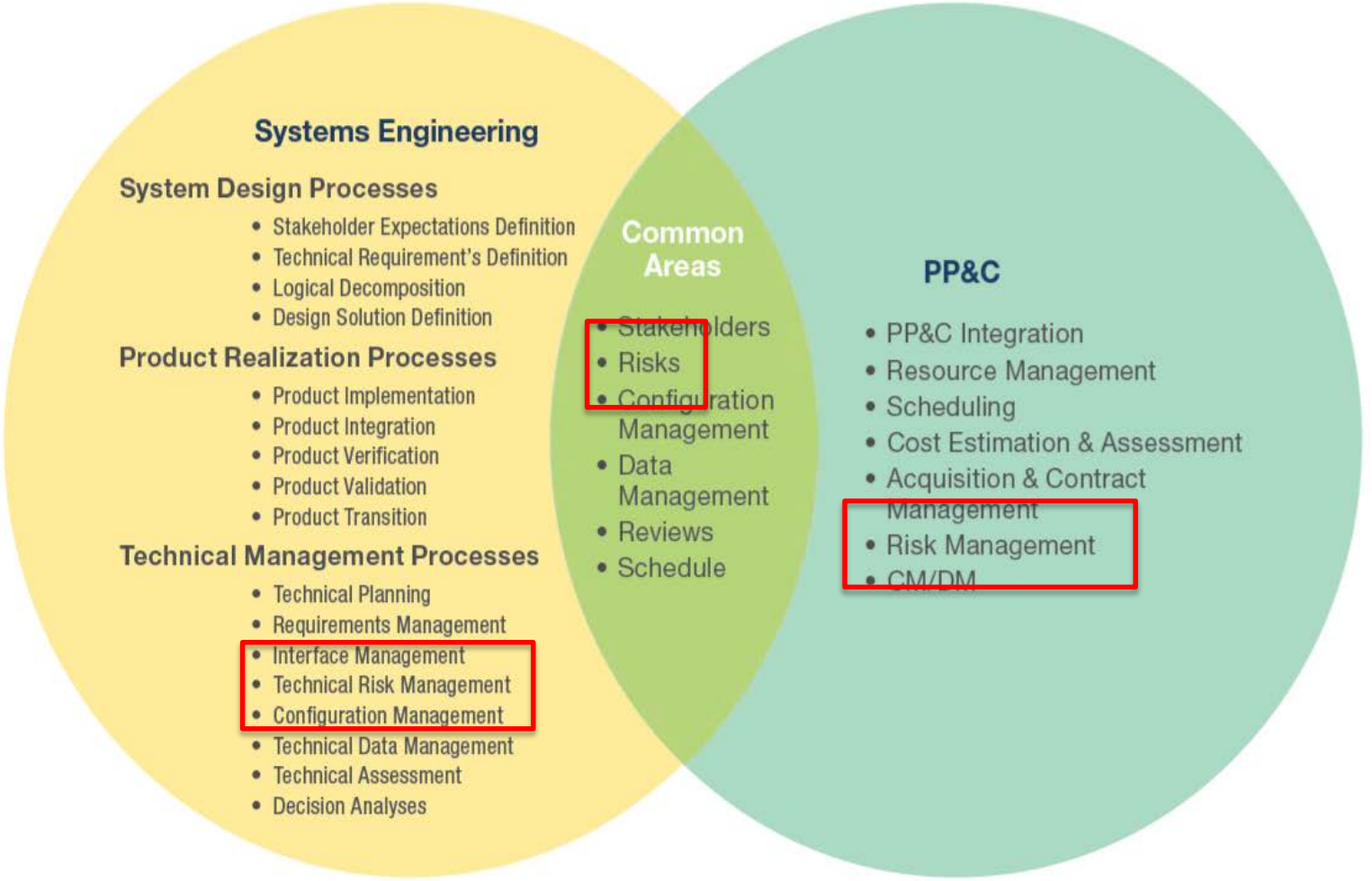
What Is Known

Given: Risk and Opportunity management is essential to every systems engineering application

- It follows that a robust application in the MODEL BASED SE environment should integrate risk/opportunity management elements as seamlessly as possible



SE – PP&C Venn Diagram



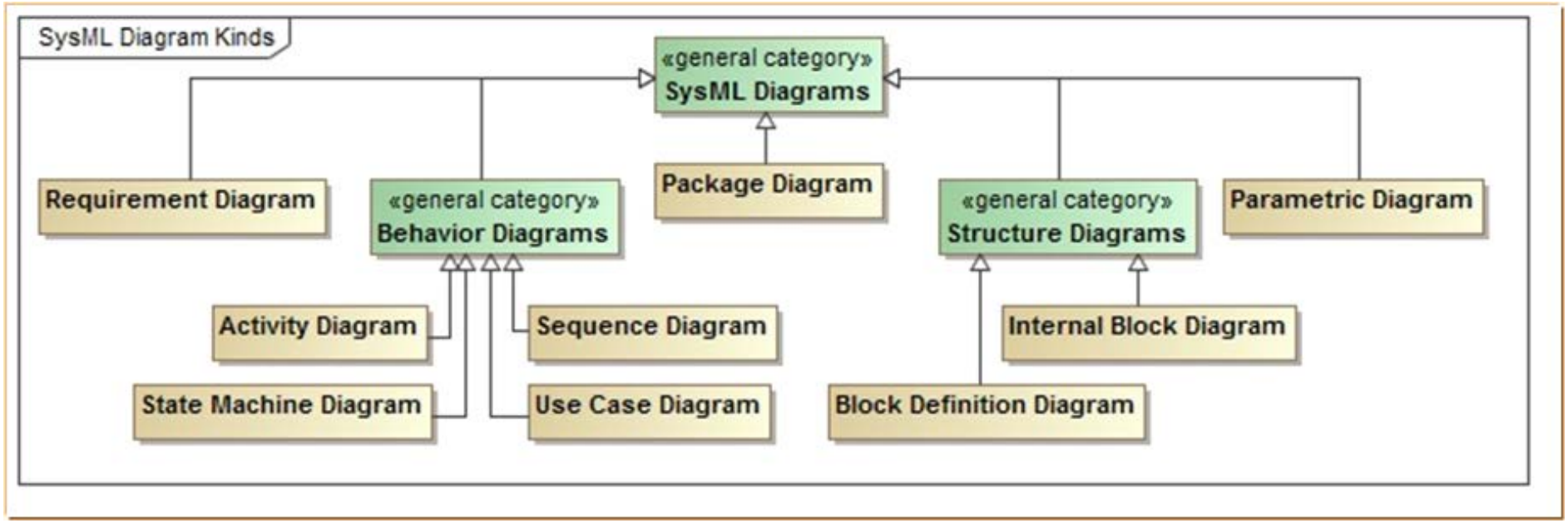
(from NASA Systems Engineering Handbook, SP-2016-6105 Rev2, pg. 5)

What are those elements?

- Risk AND opportunity accounted for
- Complete stakeholder access
- Enable systematic data-based decision
  - i.e. Risk and Opportunity management fully integrated and traced to other elements and views
  - Tracking over time

SysML out-of-the-box

- Nine fundamental diagrams



SysML out-of-the-box

Successful MBSE needs:

- Language + Tool + Methodology

- SysML out-of-the-box is deficient (no mention of R/O modeling) but can be extensible

We will cover Language Extensions & Methodology

Definitions

RISK - An event that, if it occurs, adversely affects the ability of project to meet its outcome objectives [1]

OPPORTUNITY - Risk, but for favorable/beneficial outcomes

[1] - from Garvey at https://www.mitre.org/publications/systems-engineering-guide/acquisition-systems-engineering/risk-management]

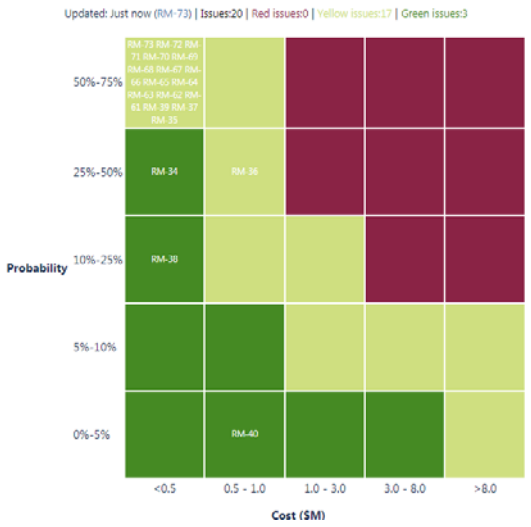
Traditional R/O Mgt Planning

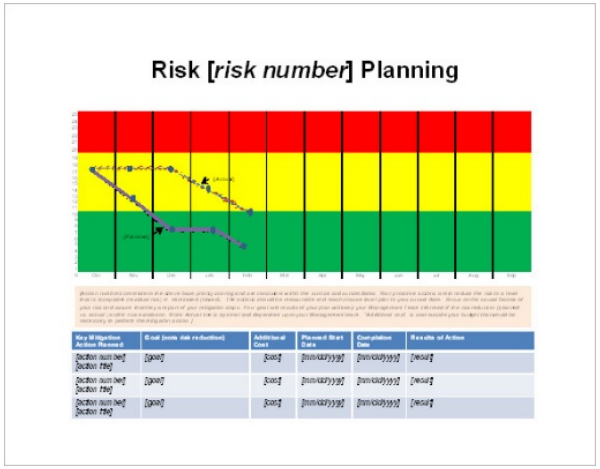
Develop a Risk Management Plan

- Identify the level of interest
- Address entire life-cycle
- Stakeholders, participants, senior leadership
- Describes methodology, specify tool(s)
- Establish a process cadence

Fundamental Process Steps

- Document Based Approach:
  - Risk/Opportunity Identification
  - Impact Assessment
  - Prioritization Analysis
  - Handling Approaches (i.e. Mitigation Planning)
  - Continuous Tracking/Iteration





SysML Low Hanging Fruit

- Illustrate level of interest (block diagramming)
- Left-hand of “Vee” is addressed well (“as-specified” definition)
- Hold and analyze parameters / values as needed (parametric properties and diagram)
- Strong relationship mapping (traceability and behaviors)
- Stakeholder access / one truth (“one fact in one place” [2])
- Interface with many tools (API and extensions)
- Retain decisions through notes
- Export documentation for planning, auditing, delivery

[2] - from Deligatti *SysML Distilled*

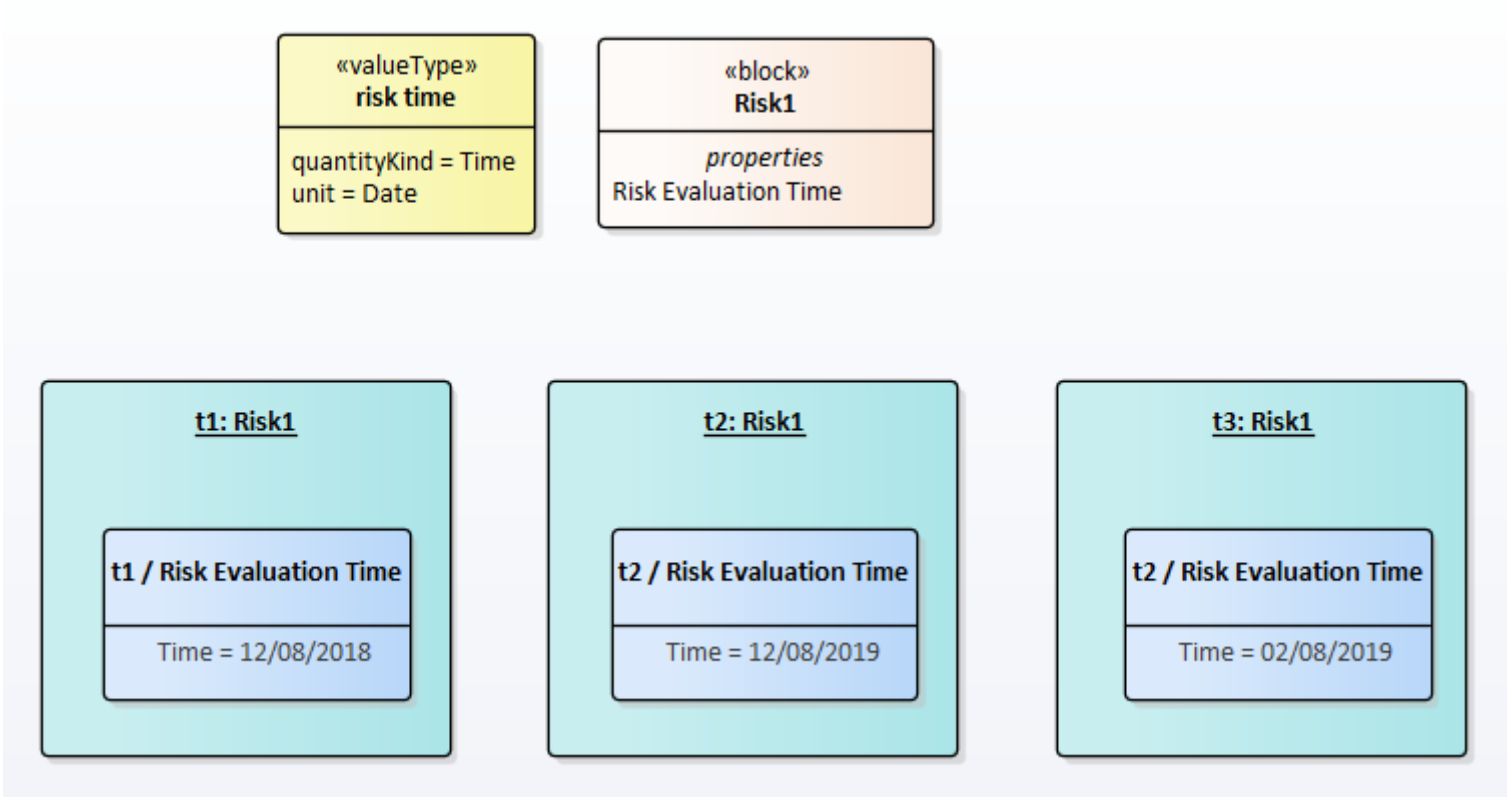
SysML Challenge #1

- Dynamic tracking of time-based events
  - Affects precise assessment of impact
  - Affects precise definition of disposition
  - Affects precise tracking and iteration
- Consider: Instance specification
  - Probably cumbersome
- Consider: Versioning of model
  - No built-in query of each version

SysML Challenge #1

- Dynamic tracking of time-based events
  - Affects precise assessment of impact
  - Affects precise definition of disposition
  - Affects precise tracking and iteration
- Consider: Instance specification
  - Probably cumbersome
- Consider: Versioning of model
  - No built-in query of each version

Instance Specification Usage

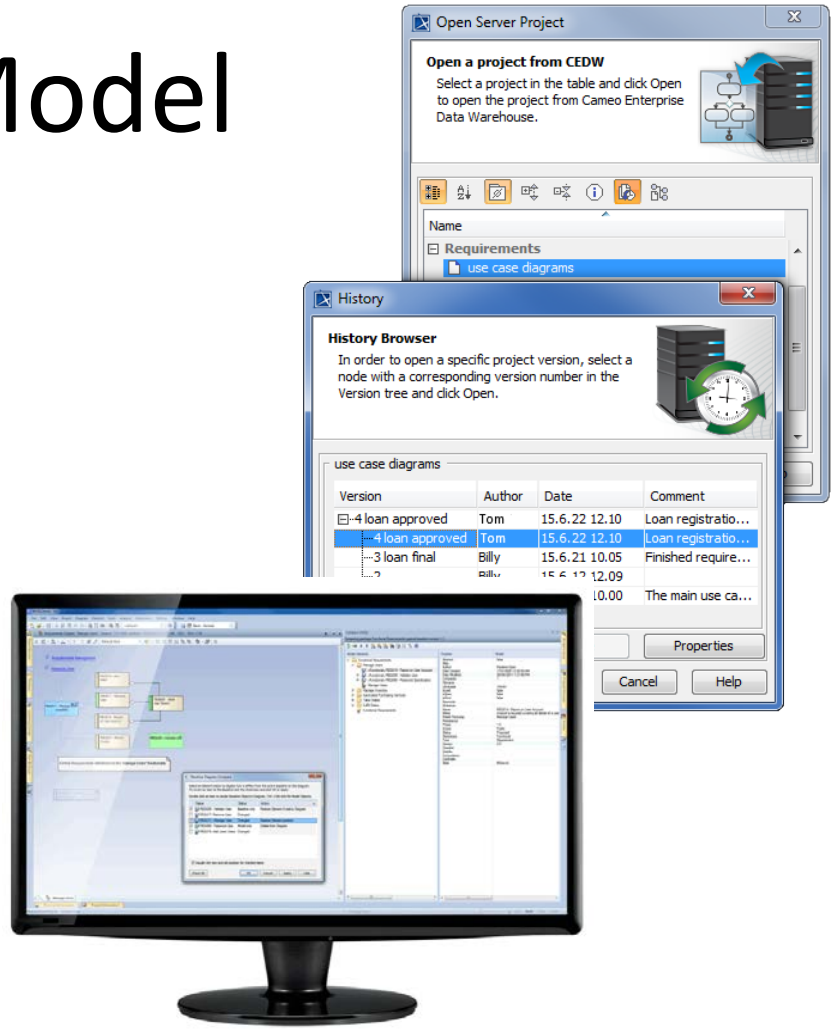


SysML Challenge #1

- Dynamic tracking of time-based events
  - Affects precise assessment of impact
  - Affects precise definition of disposition
  - Affects precise tracking and iteration
- Consider: Instance specification
  - Probably cumbersome
- Consider: Versioning of model
  - No built-in query of each version

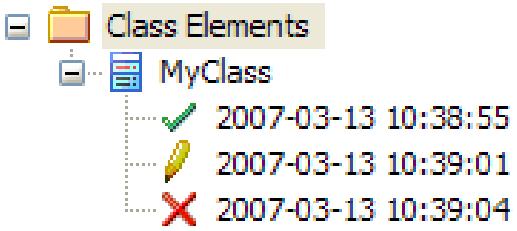
Versioning of a Model

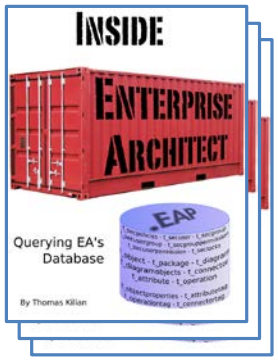
- Some tools allow for versioning of elements or of projects/models themselves
- Allows for tracking of history of changes to elements vs. time in a database.
- Some allow for visualization of two versions
- Most tools do not have a built-in means of querying values across multiple model versions and plotting

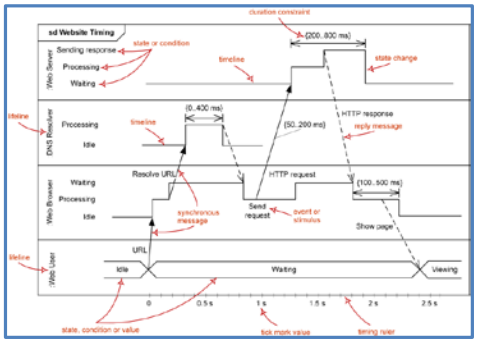


Potential Solutions

- Auditing (Sparx Enterprise Architect)
  - List of differences (creation, edit, deletion)
  - Lack of built-in plotting capabilities in most tools
- Direct database queries & plotting in external tool (Excel)
- UML Timing Diagrams
  - Not part of SysML, so most SEs are not familiar with these







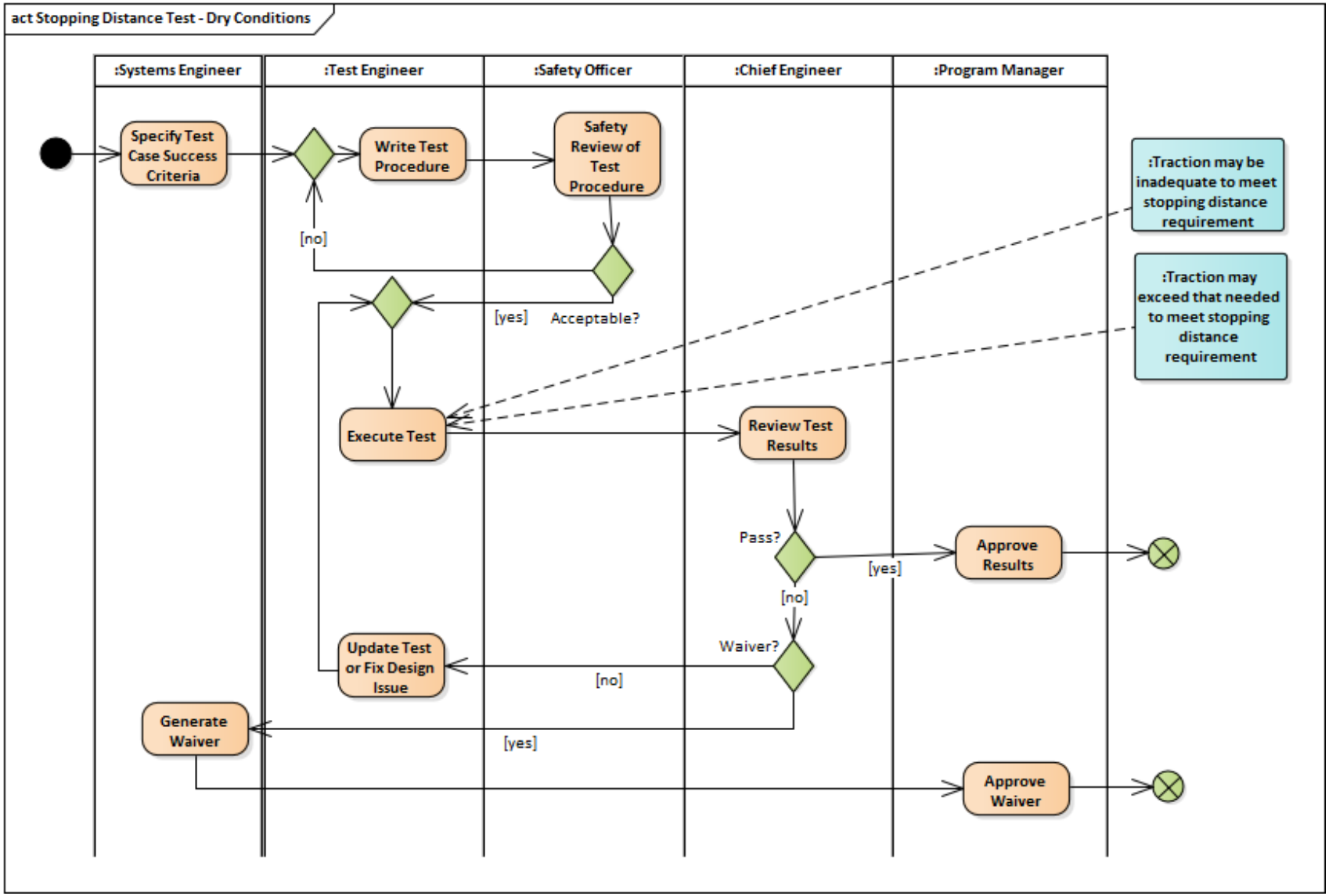
SysML Challenge #2

- Assigning specific roles
  - Affects life cycle of individual risk (what not how)
  - Muddies the decision making process
- Consider: Actors and activities in swimlanes
  - Defines but doesn’t execute
- Consider: Tool specific solutions
  - Each behaves and performer differently

SysML Challenge #2

- Assigning specific roles
  - Affects life cycle of individual risk (what not how)
  - Muddies the decision making process
- Consider: Actors and activities in swimlanes
  - Defines but doesn’t execute
- Consider: Tool specific solutions
  - Each behaves and performer differently

Swimlanes in SysML



SysML Challenge #2

- Assigning specific roles
  - Affects life cycle of individual risk (what not how)
  - Muddies the decision making process
- Consider: Actors and activities in swimlanes
  - Defines but doesn't execute
- Consider: Tool specific solutions
  - Each behaves and performs differently

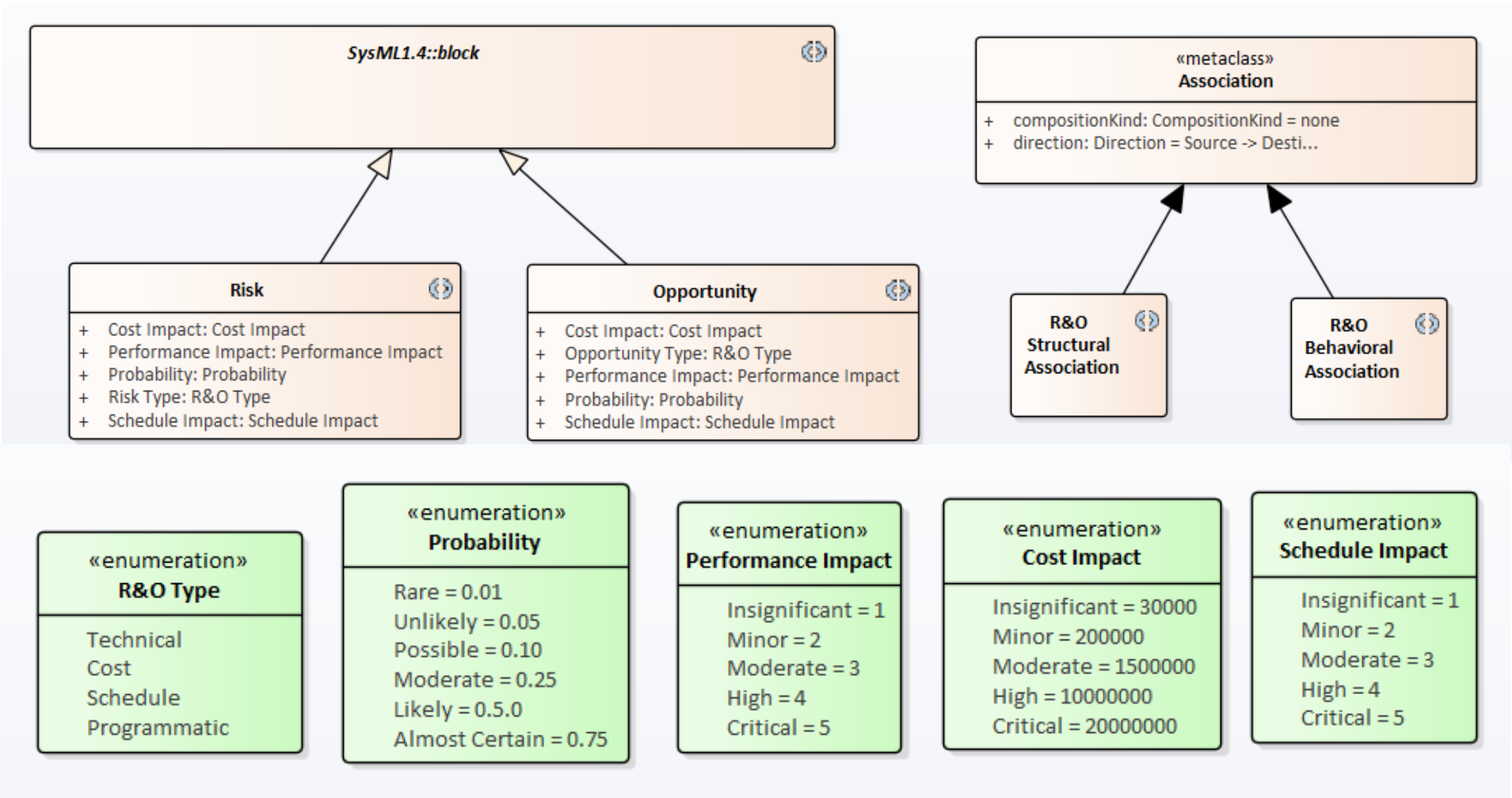
Tool Specific Example

Roles and Responsibilities

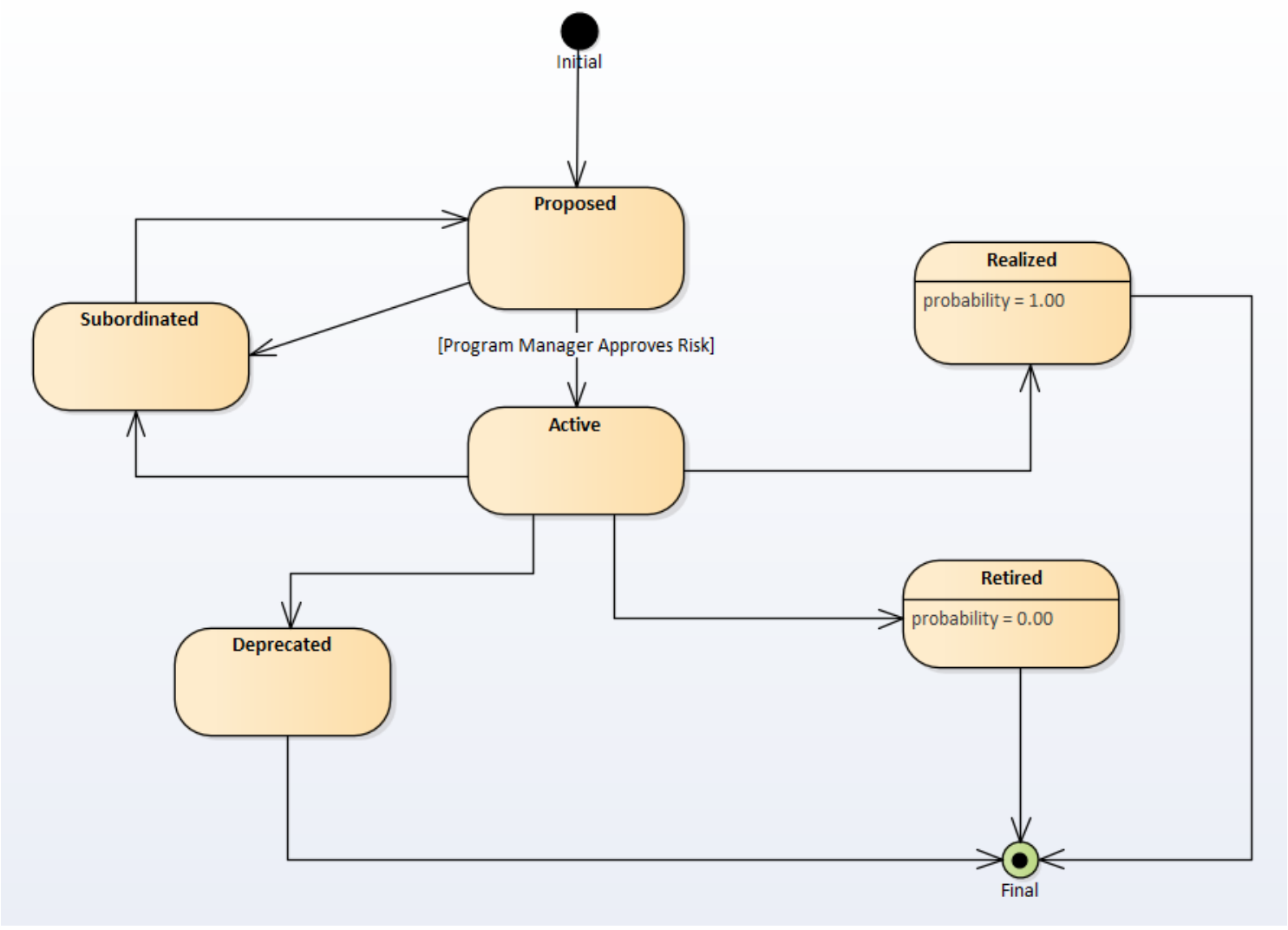
Role	Responsibilities	See also
Business Analyst	Create high-level models of business processes.	Business Analyst
Software Architect	Map functional requirements, perform real time modeling of objects, design the Deployment model and detail the deliverable components.	Software Architect
Software Engineer	Map Use Cases onto Class diagrams, detail the interactions between Classes, define the system deployment and define software Packages.	Software Engineer
Developer	Perform round trip code engineering, including reverse engineering of existing code and generation of code from Class elements.	Developer
Project Manager	Assign resources to elements, measure risk and effort, estimate project sizes, and manage element status, change control and maintenance.	Project Manager
Tester	Create test scripts against elements in the modeling environment.	Tester
Implementation Manager	• Track and assign maintenance-related items to elements within Enterprise Architect • Rapidly capture and keep records of maintenance tasks such as issues, changes, defects and tasks • Trace the maintenance of the items and processes involved in system deployment	Implementation Manager
Technology Developer	Create customized additions to the functionality already present within Enterprise Architect.	Technology Developer
Database Developer	Develop databases, including modeling database structures, importing database structures from an existing database and generating DDL for rapidly creating databases from a model.	Database Developer

Enterprise Architect

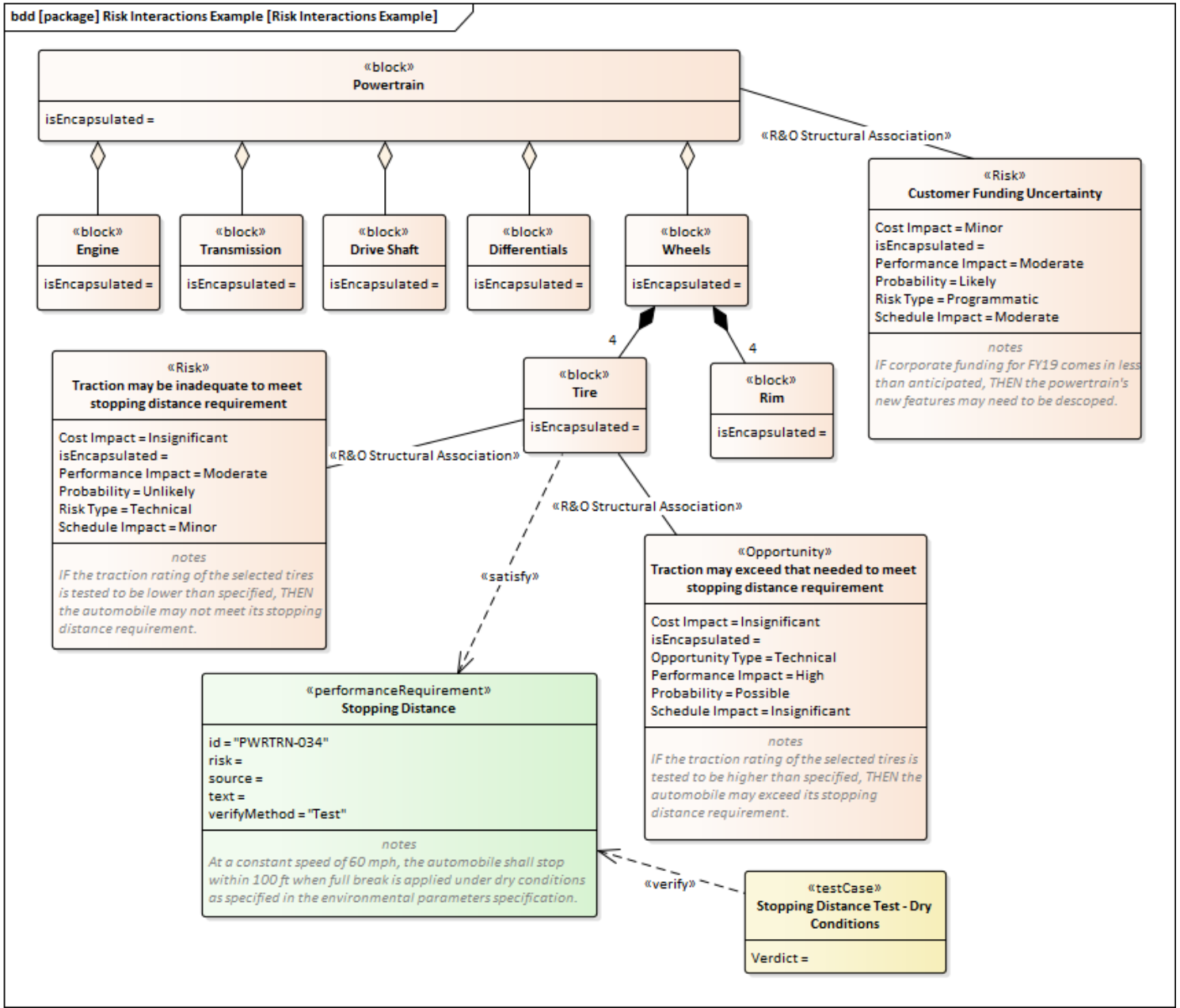
Potential Solution - Profile



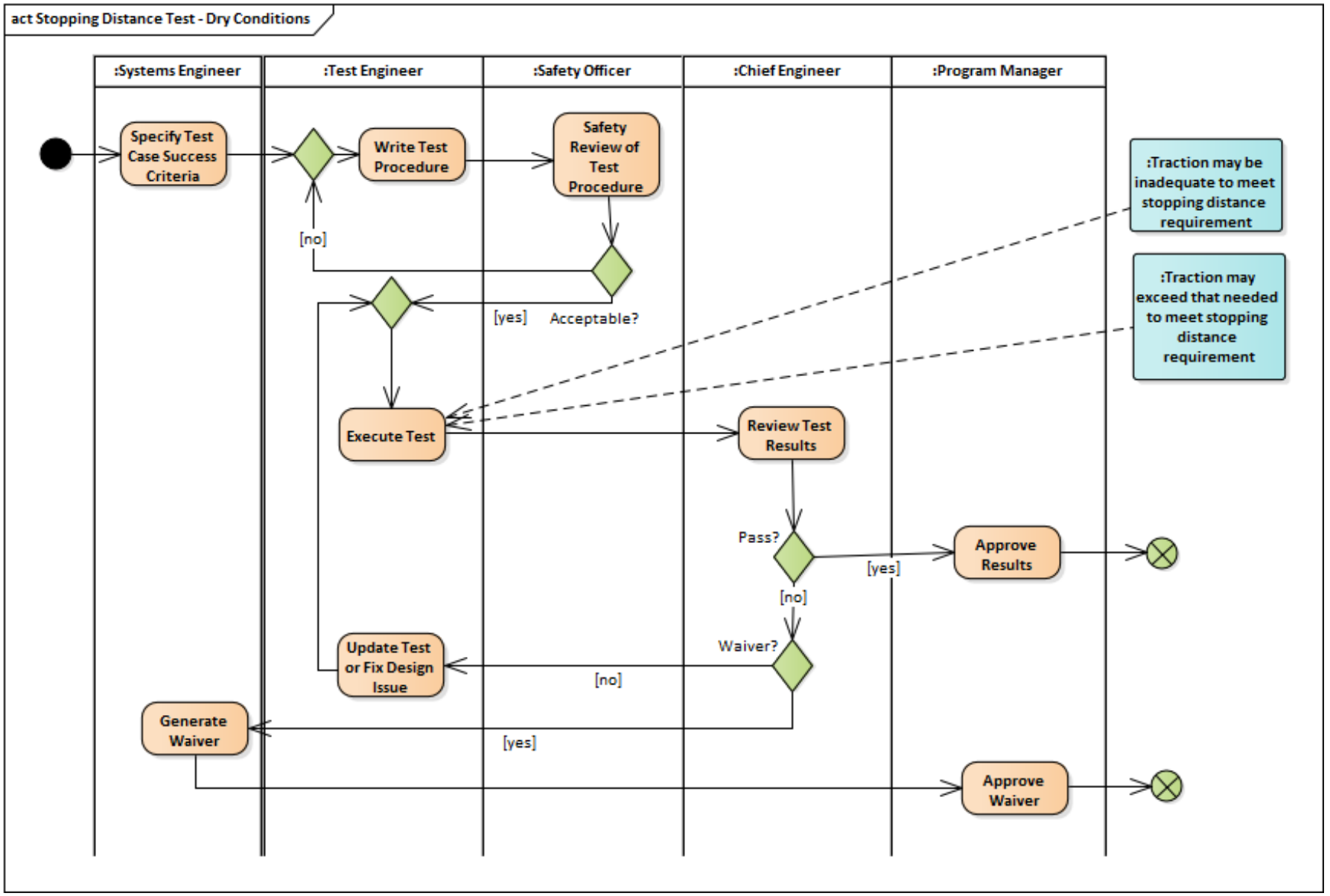
Potential Solution – State Machine



Custom Risk Profile Example (1 of 2)

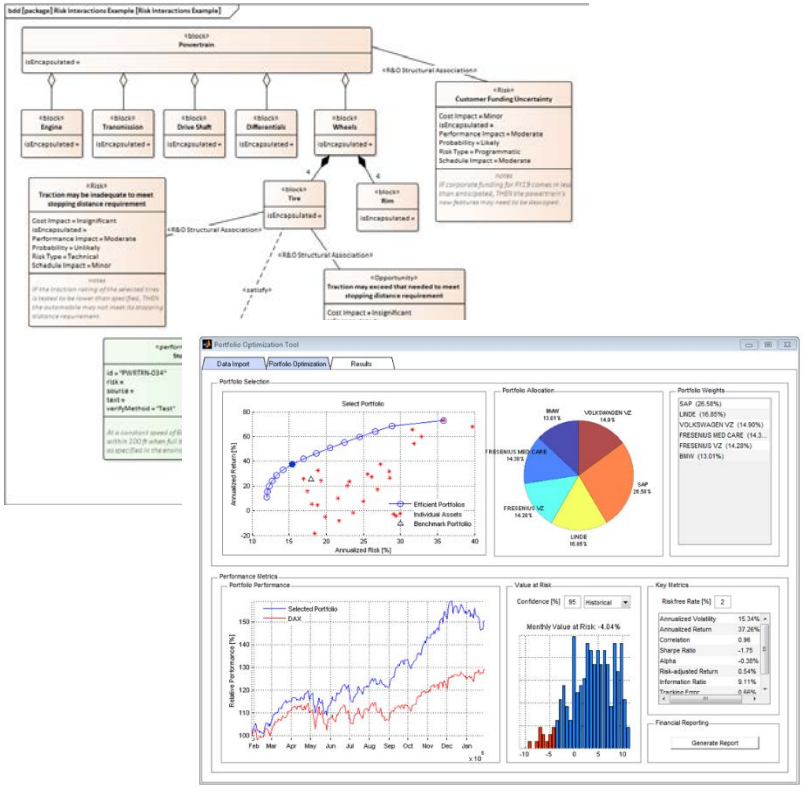


Custom Risk Profile Example (2 of 2)



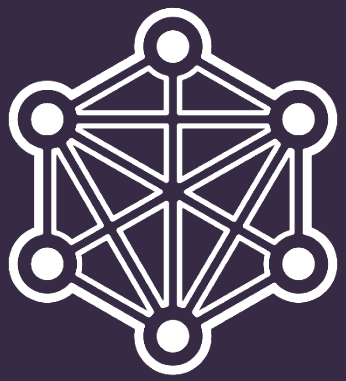
MBEE Solution

- For full end-to-end solutions with up-front definition, time-based tracking, and reporting can be generated
  - Typically require using multiple software tools (Model Based Engineering Environment – MBEE).
  - Take advantage of strong points of each while mitigating weaknesses
- One Example:
  - SysML tool for risk & opportunity element definition (point in time), traceability to other elements for impact analysis, and repository for metadata for use in parametric analyses
  - Risk tool (or math/physics tool such as Mathcad, Maple, openModelica) with open API for time based modeling of risks and Monte Carlo Analyses



Conclusion

- Robust and flexible Risk/Opportunity management is essential for complete MBSE treatment
- SysML out of the box does a lot well, but not enough
- Typical workarounds are tool dependent and inconsistent
- Novel extensions can be employed, are tool independent and consistent



nymbysys

Nimble . Elegant . Solutions

Today's Presentation

Things to Think About

How can this be applied in your work environment?

What did you hear that will influence your thinking?

What is your take away from this presentation?

Please

The link for the online survey for this meeting is

www.surveymonkey.com/r/2019_1_MeetingEval

www.surveymonkey.com/r/2019_1_MeetingEval

Look in GlobalMeet chat box for cut & paste link.

Slide presentation can be downloaded now/anytime from:

The library page at: www.incose.org/enchantment.

Recording will be there in the library tomorrow (maybe).