Project MTIP Team Introduction

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Agenda

• Definitions
• Problem Overview
• Approach to MBSE Tool Integration
• Examples
• Code Base and Usages
• Demo
• What’s Next?
Definitions: Ontology, Metamodel, SysML, UML

• Ontology
  – Defines entities and relationships
  – Helps introduce a sharable and reusable knowledge but can also add new knowledge about the domain.

• Metamodel
  – A set of rules that define valid construction of a model
  – Allows a model to be checked for syntactic correctness using rules and constraints defined by the metamodel

• Systems Modeling Language (SysML) Metamodel
  – A general-purpose graphical modeling language for specifying, analyzing, designing and verifying complex systems
  – Provides graphical representation with a semantic foundation for modeling system requirements, behavior, and structure.

• Unified Modeling Language (UML)
  – A standardized modeling language consisting of an integrated set of diagrams, developed to help system and software developers for specifying, visualizing, constructing and documenting the artifacts of systems.
Definitions: Cameo, Sparx EA, XML, XMI

• Cameo Systems Modeler
  – A collaborative Model-Based Systems Engineering (MBSE) environment, which provides robust, and intuitive tools to define, track, and visualize all aspects of systems in the most standard-compliant SysML models and diagrams.

• Sparx Enterprise Architect (EA)
  – A collaborative modeling design and management platform based on UML and related standards

• eXtensible Markup Language (XML)
  – A markup language designed to store and transport data.

• XML Metadata Interchange (XMI)
  – An XML-based integration framework for the exchange of models, and, more generally, any kind of XML data.
  – Used in the integration of tools, repositories, applications, and data warehouses.

• Huddle Unified Data Schema (HUDDS)
  – Allows data to be easily shared between different plugins while still adhering to a custom set of semantics.
  – More human readable than XMI
Integration of MBSE Tools
Problem Overview
Cameo and Sparx EA Interoperability

- Commercial tools are not sufficient to work with models that do not fall within UML standards

- XMI import/export is the current standard interchange format between MBSE tools.

- XMI format adheres to UML standard and does not account for additional architectures.

- SysML specific data is not transferred between tools
  - Only UML4SysML elements are transferred correctly

Current XMI standard insufficient for transferring SysML models
Sparx EA ↔ Cameo
Approach to Tool Integration for SysML Metamodel

- **Project Goal**
  - Create software plugins and exchange standards to enable 1-to-1 translation from Sparx EA to Cameo and back
  - Create a way for SysML models to be exchanged freely between tools

- **Implementation Approach**
  - Metamodel Mapping
    - Map SysML metamodel in Sparx EA and Cameo to a common schema
    - Data imported/exported via plugins using Huddle Unified Data Schema (HUDS) V2 XML format

- **Current Capabilities**
  - Transfers SysML models from Sparx EA into Cameo and back
    - Includes all elements, relationships and diagrams
Diagram Types
Organization of the SysML Metamodel

- Block Definition Diagram
- Internal Block Diagram
- Activity Diagram
- State Machine Diagram
- Package Diagram
- Parametric Diagram
- Requirement Diagram
- Sequence Diagram
- Use Case Diagram

Graphic nodes and paths for diagram types listed above are supported in MTIP plugin translation
Each element has its own data block. Each data block consists of type, id, attributes, and relationships required during MTIP plugin translation.
**Block Definition Diagram Package Structure**

- **Diagrams**
  - Block Definition Diagram
- **Elements**
  - Port
  - Full Port
  - Proxy Port
  - Flow Port
  - Interface Block
  - Flow Specification
  - Constraint Block
  - Domain
  - Subsystem
  - External
  - System
  - System Context
  - Value Type
  - Enumeration
  - Signal
  - Instance Specification
  - Interface
  - Property
- **Relationships**
  - Interface Realization
  - Generalization
  - Association Block
  - Directed Association
  - Directed Aggregation
  - Directed Composition
  - Association
  - Item Flow
  - Usage

Side by side comparison of project browser/containment tree of a translated model in EA (left) and Cameo (right)
**Block Definition Diagram**

*Sparx EA ↔ Cameo*

- Block Definition Diagram

- Diagram information captured by the plugins:
  - *Which elements and relationships appear on the diagram*
  - *Position of the elements on the diagram*

*Path styling, colors, and other formatting not translated*
Activity Diagram

Cameo

Sparx EA
Classifiers and Types

Classifiers captured as seen in part property classified by Payload Subsystem block. Shows inherited ports.
Projects Benefiting from MTIP Plugins

• Metamodel support
  – Establishing a metamodel for corporate-wide use
  – Developing tooling to check for consistency and to ease use of a standardized metamodel

• Exporting behavioral data for simulation
  – Translating structural and behavioral diagrams based on a mission into an external tool’s simulation scenario templates

• Mapping to reference models
  – Exporting a Government Reference System Model in SysML from a collection of ASOTs including enterprise model in SysML, requirements, conceptual design, etc.

• Interfacing with classification tool
  – Aerospace project that is developing a capability to apply classification markings to a model’s elements and relationships based on rules derived from Security Classification Guides

• Supporting SysML model translations for in-tool simulations
  – Brought existing simulation ran with Sparx EA’s simulation engine into Cameo for team to run using Cameo’s Simulation toolkit
Code Base and Usage

Overview

<table>
<thead>
<tr>
<th>Cameo Plugin</th>
<th>Sparx EA Plugin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apache License 2.0</td>
<td>Apache License 2.0</td>
</tr>
<tr>
<td>Written in Java</td>
<td>Written in C#</td>
</tr>
<tr>
<td>~13,000 SLOC</td>
<td>~10,000 SLOC</td>
</tr>
<tr>
<td>~400 classes</td>
<td>~50 classes</td>
</tr>
</tbody>
</table>

Installation and Usage

• Cameo Plugin is packaged in compressed (zipped) folder
  – Imported via the Resource Plugin Manager in Cameo Systems Modeler
  – Accessed from the top menu bar of the application

• Sparx EA plugin can be installed directly into the application using installer executable
  – Accessed in the “Specialized” tab in Sparx Enterprise Architect

• Plugins import HUDS V2 XML file created on export of the model
Sample Model Translation Demo Video
Containment Tree Side-by-Side 1
What’s Next?

- Support for additional Metamodels (i.e., UAF, DoDAF, UML)
- Continued adoption and testing through wider userbase
- Joining the OpenMBEE community
Questions?
List of Sources
