BRINGING MATHEMATICAL CAPABILITIES TO SYSML WITHIN MAGICDRAW

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Outline

- SysML/MagicDraw
- Problem
- Proposed Solutions
- Team Solution
- Future Work
SysML / MagicDraw

- General purpose modeling language
- Extension of Unified Modeling Language (UML)
- Supports specification, analysis, design, verification, validation of systems

- Visual Tool to use SysML = MagicDraw
Example: Rocket Rollup
Example: Rocket Systems
Example: Work Breakdown Structure
Problem

• Current analysis implies waiting for someone else to do their own part before you can do your own part of the analysis

• SysML is good Modeling, but not Analysis

• You can SHOW how analysis should be done, but not actually DO analysis

• There are other tools out there to interface with MagicDraw and do math
Example: WBS Parametric Diagram
# Proposed Solutions

<table>
<thead>
<tr>
<th>Description</th>
<th>Tool</th>
<th>Math Engine</th>
<th>ParaMagics</th>
<th>Cameo Sim</th>
<th>Jenny's Plugin</th>
<th>(J)Python Plugin/Script</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1) DECISION STATEMENT:</strong> Recommend the best tool for computations that can integrate with current and future SysML models for...</td>
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<table>
<thead>
<tr>
<th><strong>(2) LIST CRITERIA</strong></th>
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<td><strong>WANTS</strong></td>
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<td><strong>(3) WEIGHT</strong></td>
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<tr>
<td>Flexibility</td>
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<tr>
<td>Operability</td>
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<td>10</td>
<td>1</td>
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<tr>
<td>Results Validation</td>
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<td>20</td>
<td>5</td>
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<tr>
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<td>2</td>
<td>50</td>
<td>4</td>
<td>40</td>
<td>30</td>
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<tr>
<td>Adaptability to Growing Needs</td>
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<td>3</td>
<td>10</td>
<td>1</td>
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<td>10</td>
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<tr>
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<tr>
<td>Ease of Integration</td>
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<tr>
<td>Appropriateness</td>
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<td>2</td>
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<table>
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<th><strong>(4) OPTIONS</strong></th>
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<th>2a</th>
<th>3</th>
<th>4</th>
<th>6</th>
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<tbody>
<tr>
<td><strong>(5) CALCULATE HIGHEST WEIGHTED SCORE</strong></td>
<td>450</td>
<td>220</td>
<td>270</td>
<td>220</td>
<td>260</td>
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</table>
Cameo Simulation Toolkit

- Can watch math execute
  - Equivalent to a trace
- Causal Relationships
- Works on already linked diagram
  - Single port to port connections
(J)Python Code

- Uniquely suited to a particular model
  - Changes to model require new code (sometimes)
- Demands strict adherence to naming conventions – brittle
- Robust in terms of actual math capabilities
  - Sympy works with Python but not Jython as of yet
Summary

- Needed a tool to do math in SysML
- Completed a trade study of likely candidates
- Tested out the two highest ranking candidates [(J)Python and Cameo]
- Concluded that the (J)Python scripts offer more flexibility than Cameo
Future Work

- Integrate parametric diagrams with Jython script
- Integration with other solvers
  - Mathematica, etc.
- Sympy with Jython
Thanks!

- Frank Dekens : Mentor
- Todd Bayer : Co-Mentor
- Chris, Bjorn, Seung, Louise, Doris and the MEA team
Questions?