Model-based Systems Engineering (MBSE) Initiative
Ontology Action Team

INCOSE MBSE Workshop

21-22 January 2012

Jacksonville, Florida

Henson Graves

INCOSE
International Council on Systems Engineering

What's New

- OAT participation in OntologySummit2012
- Integrating Reasoning With SysML

OAT participation in Ontology Summit2012

- The OntologySummit is an annual event spanning several months culminating in an actual meeting in first quarter
- It is co-sponsored by Onolog, NIST, NCOR, NCBO, IAOA, BCO_NITRD, ….
- This year integration with Systems Engineering is a major topic stated as: “Ontology solutions for Systems Engineering”
- I am serving as a co-champion for two tracks relating to systems engineering

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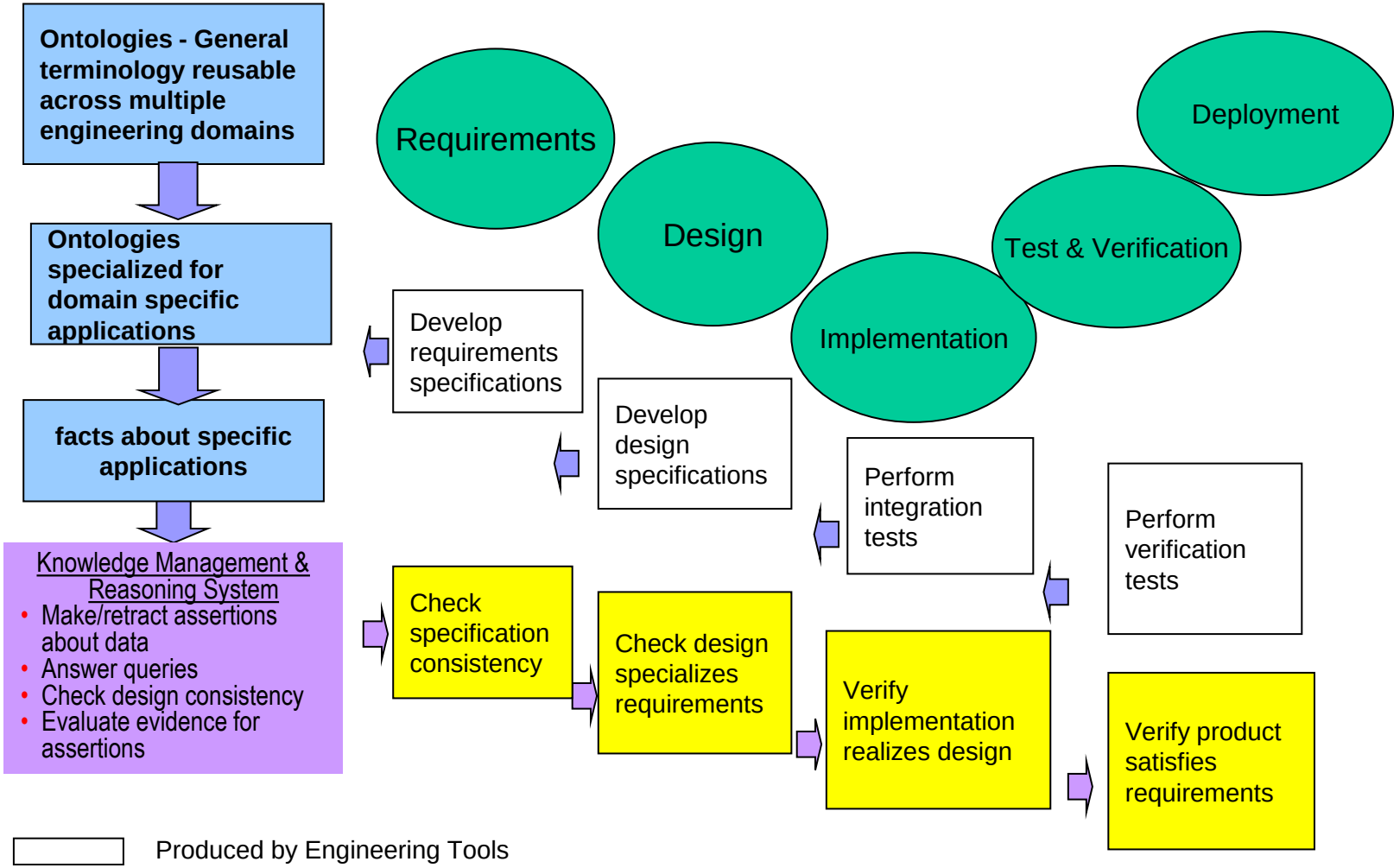
Topics Seeking Ontology Help On

- Potential for Upper Ontologies as MetaData model to organize and manage engineering data
- Use of ontology for modeling composite structures
- Development of specific hierarchies of domain ontologies for inclusion in SysML modeling
- Use of ontology results to construct good modeling principles for SysML modeling

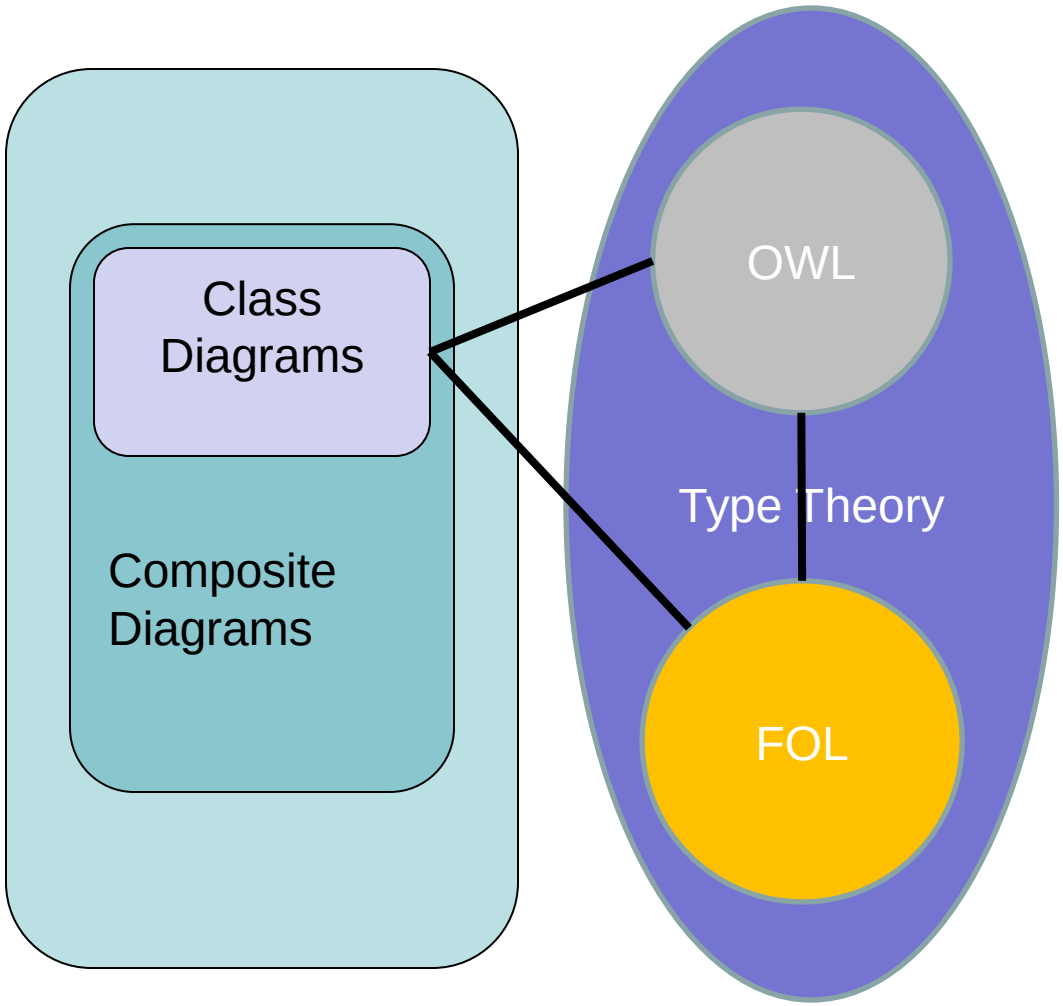
Vision For Integration of Reasoning With System Engineering



… with great potential for reducing work and rework

Significant Research Results On Embedding SysML into Logics

SysML
- Classes & properties
- Composite structure
- Behavior



OWL
- Classes & properties correspond to a fragment of FOL
- Decidability
- Rich class constructors
- Individuals

First Order Logic
- Quantifiers
- Nary-predicates
- Functions

Type theory
- Contains a higher order logic
- Set theory like abstraction

Reasoning Use Case Development

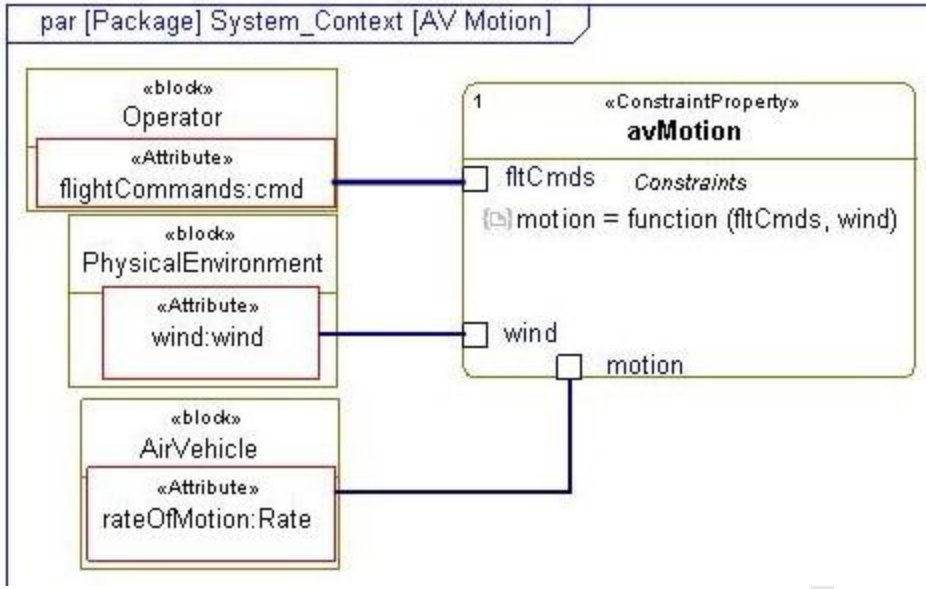
- Maintaining design consistency
  - Verifying adding component invalidates design
- Verifying design instances satisfy specified capability
  - Verifying aircraft loiter capability
  - Verifying target recognition capability

Use case 1: Maintaining Design Consistency During Development

- Components get added to designs during the course of design development, e.g. a pump
- May make the system design become invalid if design constraints are violated
- These problems are not apparent from manual model inspection
- Working with computer scientists to produce examples and feasibility studies

Use Case 2: Verifying System Capability for Target Recognition

- Using proposed design solution to decompose into component solutions
- Find physics and device assumptions needed to verify conclusion
- Preliminary analysis of reasoning issues



Plans Forward

- Continue prototyping reasoning use cases
- Hopefully the OntologySummit2012 will produce material that can be used in MBSE context
- Looking for members for OAT willing to take on responsibilities for tasks