SYSTEMS ENGINEERING
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Systems Engineering Research Center (SERC)

System Architecture Forum
Transforming Systems Engineering through Model Centric Engineering

Research Collaborators:
Stevens Institute of Technology
Georgetown University
Georgia Tech
Massachusetts Institute of Technology
University of Maryland
University of Massachusetts
Sponsors:
US Navy (NAVAIR) and US Army (ARDEC)

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Agenda

- Part I – Research Context and Surrogate Pilot
  - —Want to provide a way for Industry and Government to follow our effort and provide feedback
- Part II – Bob Hathaway
- Part III – Benjamin Kruse

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Research Tasks and Collaborator Network

RT-48
- Mark Blackburn (PI), Stevens
- Rob Cloutier (Co-PI) - Stevens
- Eirik Hole - Stevens
- Gary Witus – Wayne State

RT-118
- Mark Blackburn (PI), Stevens
- Rob Cloutier - Stevens
- Eirik Hole - Stevens
- Gary Witus – Wayne State

RT-141
- Mark Blackburn (PI), Stevens
- Mary Bone - Stevens
- Gary Witus – Wayne State

RT-157
- Mark Blackburn (PI), Stevens
- Mary Bone - Stevens
- Roger Blake - Stevens
- Mark Austin – Univ. Maryland
- Leonard Petnga – Univ. of Maryland

RT-170
- Mark Blackburn (PI), Stevens
- Mary Bone - Stevens
- Deva Henry - Stevens
- Paul Grogan - Stevens
- Steven Hoffenson - Stevens
- Mark Austin – Univ. of Maryland
- Leonard Petnga – Univ. of Maryland
- Maria Coelho (Grad) – Univ. of Maryland
- Russell Peak – Georgia Tech.
- Stephen Edwards – Georgia Tech.
- Adam Baker (Grad) – Georgia Tech.
- Marlin Ballard (Grad) – Georgia Tech.

RT-168 – Phase I & II
- Mark Blackburn (PI), Stevens
- Dinesh Verma (Co-PI) – Stevens
- Ralph Giffin
- Roger Blake - Stevens
- Mary Bone – Stevens
- Andrew Dawson – Stevens (Phase I)
- Rick Dove
- John Dzielski, Stevens
- Paul Grogan - Stevens
- Deva Henry – Stevens (Phase I)
- Bob Hathaway - Stevens
- Steven Hoffenson - Stevens
- Eirik Hole - Stevens
- Roger Jones – Stevens
- Benjamine Kruse - Stevens
- Jeff McDonald – Stevens (Phase I)
- Kishore Pochiraju – Stevens
- Chris Snyder - Stevens
- Gregg Vesonder – Stevens (Phase I)
- Lu Xiao – Stevens (Phase I)
- Brian Chell (Grad) – Stevens
- Luigi Ballarinni (Grad) – Stevens
- Harsh Kevadia (Grad) – Stevens
- Kunal Batra (Grad) – Stevens
- Khushali Dave (Grad) – Stevens
- Rob Cloutier – Visiting Professor
- Robin Dillon-Merrill – Georgetown Univ.
- Ian Grosse – Univ. of Massachucetts
- Tom Hagedorn – Univ. of Massachusetts
- Todd Richmond – Univ. of Southern California (Phase I)
- Edgar Evangelista – Univ. of Southern California (Phase I)

RT-176
- Kristin Giammaro (PI) – NPS
- Ron Carlson (Co-PI), NPS
- Mark Blackburn (Co-PI), Stevens
- Mikhail Auguston, NPS
- Rama Gehris, NPS
- Marianna Jones, NPS
- Chris Wolfgeher, NPS
- Gary Parker, NPS

RT-195
- Mark Blackburn (PI), Stevens
- Mary Bone - Stevens
- Ralph Giffin - Stevens
- Bob Hathaway- Stevens
- Benjamin Kruse - Stevens
- Russell Peak – Georgia Tech.
- Stephen Edwards – Georgia Tech.
- Adam Baker (Grad) – Georgia Tech.
- Marlin Ballard (Grad) – Georgia Tech.
- Donna Rhodes - MIT
- Mark Austin – Univ. Maryland
- Maria Coelho (Grad) – Univ. Maryland

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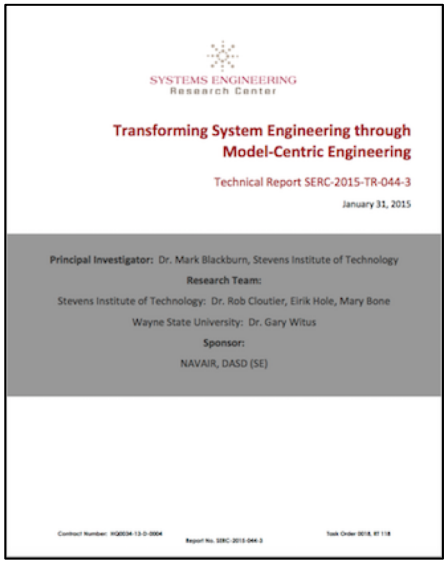
Historical Perspectives and Resources

- Resources
  - Technical reports link: http://www.sercuarc.org/researcher-profile/mark-blackburn/
  - Comprehensive briefing: http://www.sercuarc.org/publications-papers/presentation-systems-engineering-transformation-through-model-centric-engineering-past-why-present-what-and-future-how/

NAVAIR: RT-141 Phase I & II – Global Scan Advanced Approaches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Transforming System Engineering through Model-Centric Engineering

Technical Report SERC-2015-TR-044-3

January 31, 2015

Principal Investigator: Dr. Mark Blackburn, Stevens Institute of Technology

Research Team:

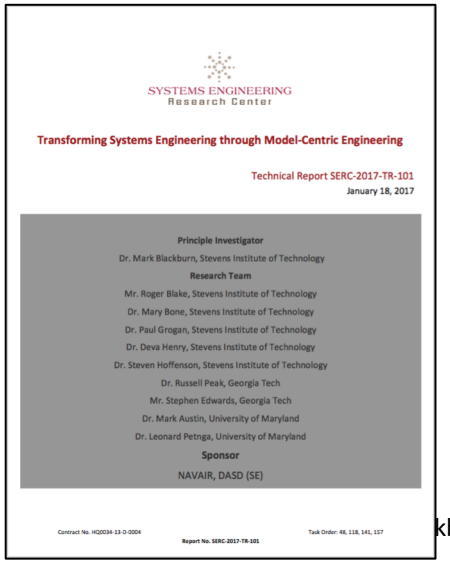
Stevens Institute of Technology: Dr. Rob Cloutier, Eirik Hole, Mary Bone

Wayne State University: Dr. Gary Witus

Sponsor:

NAVAIR, DASD (SE)

NAVAIR: RT-157 Phase III – SE Transformation (SET) Initiated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Transforming Systems Engineering through Model-Centric Engineering

Technical Report SERC-2017-TR-101

January 18, 2017

Principle Investigator

Dr. Mark Blackburn, Stevens Institute of Technology

Research Team

Mr. Roger Blake, Stevens Institute of Technology

Dr. Mary Bone, Stevens Institute of Technology

Dr. Paul Grogan, Stevens Institute of Technology

Dr. Deva Henry, Stevens Institute of Technology

Dr. Steven Hoffenson, Stevens Institute of Technology

Dr. Russell Peak, Georgia Tech

Mr. Stephen Edwards, Georgia Tech

Dr. Mark Austin, University of Maryland

Dr. Leonard Petnga, University of Maryland

Sponsor

NAVAIR, DASD (SE)

ARDEC: RT-168 Phase I & II - Synergistic Research


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Transforming Systems Engineering through Model-Centric Engineering

A013 Final Technical Report SERC-2017-TR-110

Update: August 8, 2017

Principal Investigator: Mark Blackburn, Stevens Institute of Technology

Co-Principal Investigator: Dinesh Verma, Stevens Institute of Technology

Research Team

Georgetown University: Robin Dillon-Merrill

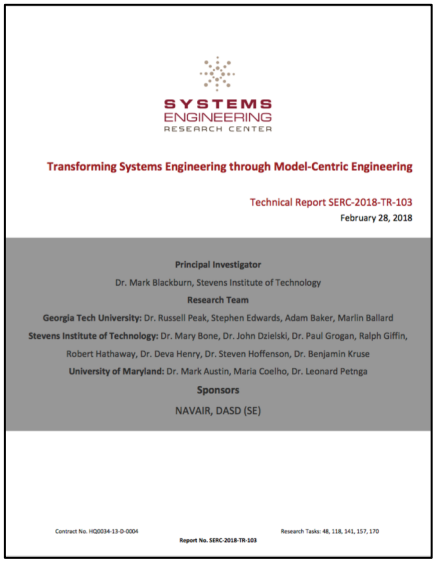
Stevens Institute of Technology: Roger Blake, Mary Bone, Brian Chell, Andrew Dawson, John Dzielski, Rick Dove, Paul Grogan, Steven Hoffenson, Eirik Hole, Roger Jones, Jeff McDonald, Kishore Pochiraju, Chris Snyder, Lu Xiao

University of Southern California: Todd Richmond, and Edgar Evangelista

Sponsor:

U.S. Army Armament Research, Development and Engineering Center (ARDEC), Office of the Deputy Assistant Secretary of Defense for Systems Engineering (ODASD(SE))

NAVAIR: RT-170 Phase IV - SET Planned and in Execution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Transforming Systems Engineering through Model-Centric Engineering

Technical Report SERC-2018-TR-103

February 28, 2018

Principal Investigator

Dr. Mark Blackburn, Stevens Institute of Technology

Research Team

Georgia Tech University: Dr. Russell Peak, Stephen Edwards, Adam Baker, Marlin Ballard

Stevens Institute of Technology: Dr. Mary Bone, Dr. John Dzielski, Dr. Paul Grogan, Ralph Giffin, Robert Hathaway, Dr. Deva Henry, Dr. Steven Hoffenson, Dr. Benjamin Kruse

University of Maryland: Dr. Mark Austin, Maria Coelho, Dr. Leonard Petnga

Sponsors

NAVAIR, DASD (SE)

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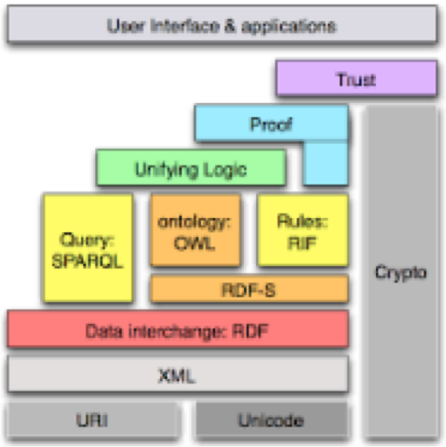
Research Thrusts

Semantic Web Technologies



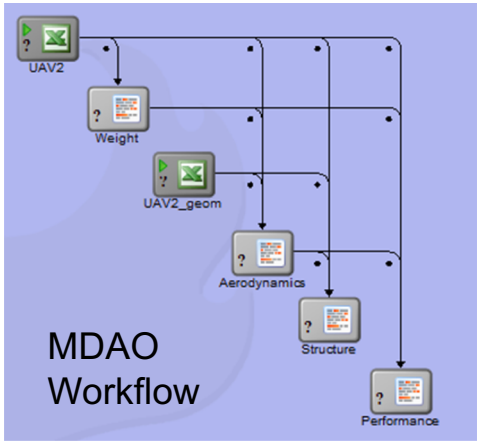
Underlying technologies for reasoning about completeness and consistency **Across Domains** in modeling tool agnostic way

Enforces **Modeling Methods**

Modeling Methodologies

Guides proper usage to ensure **Model Integrity** (trust in model results) for decision making

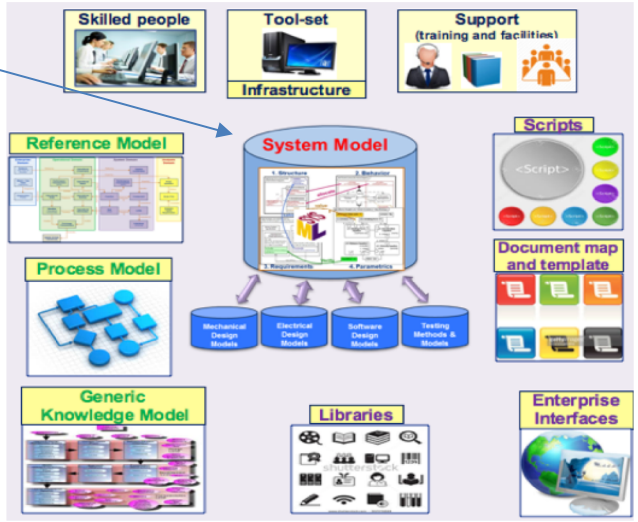
Multidisciplinary Design, Analysis and Optimization MDAO



Provides optimization analysis **Across Domains** to support KPP and alternatives trades at mission, system, & subsystem levels

Digital System Model:
Single Source of Truth
(***Authoritative Source of Truth***)

Integrated Modeling Environment



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Graphical CONOPS Scenario for Skyzer UAV Mission

Surrogate Pilot Overview

- Mission: Collaboration between Government and Industry in Model-based Acquisition under SET Framework
- Goal: Execute SET Framework to Assess, Refine, and Understand a New Paradigm for Collaboration in Authoritative Source of Truth (AST)
- Objectives (non exhaustive):
  - Formalize experiment to answer questions about executing SET framework using Surrogate Contractor (SC)
  - "Government team" creates mission, system (& other) models, "generates specification/RFP," & provides acquisition models to SC as Government Furnished Information (GFI)
  - SC refines GFI reflects corrections/innovations with physical allocation views with multi-physics-based Initial Balanced Design
  - Simulate continuous virtual reviews and derive new objective measures for assessing maturing design in AST
  - Demonstrate visualizations for real-time collaboration in AST
  - Demonstrate and document methods applied
  - Investigate challenging areas and research topics in series of pilots

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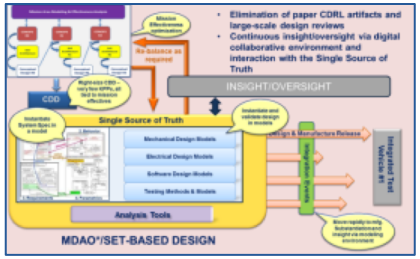
Status: Use Cases for Surrogate Pilot and Experimental System (Skyzer)



Surrogate Pilot Use Cases (UC)

Collaboration in Authoritative Source of Truth UC

Objectives to Assess SE Framework

How we Collaborate in AST

Skyzer is Experimental System using Authoritative Source of Truth (AST)

Project Plan UC

Mission Model UC

System Model UC

Contractor(s) System Model(s) UC

Contractor Design Model UC

Source Section UC

Mission Models
System Models
Based on Standards

RFI

RFP

GFI

Proposal Extends GFI

Proposal for Design Models must be able to demonstrate aspects for Producability Decisions involving **Multi-physics**

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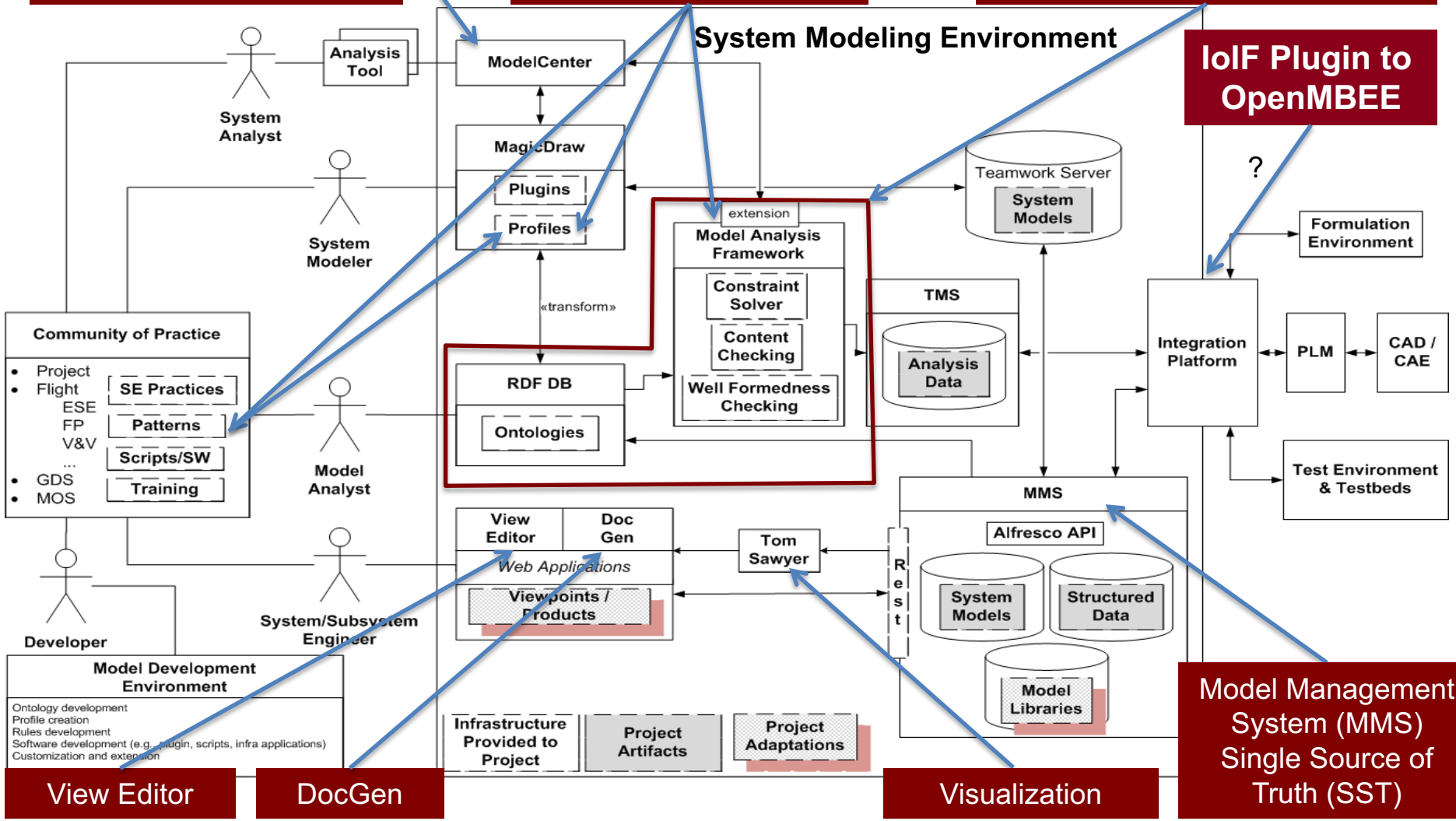
CONCEPT Working: for Integrating Technologies into OpenMBEE through IoIF

Multidisciplinary Design, Analysis, and Optimization (MDAO) platform

SE Modeling Patterns formalized as Ontologies

Semantic Web Technologies support Continuous Checks and Model Measures



View Editor

DocGen

Visualization

Model Management System (MMS) Single Source of Truth (SST)

*An Integrated Model Centric Engineering (IMCE) Reference Architecture for a Model Based Engineering Environment (MBEE), NASA/JPL, Sept, 2014.

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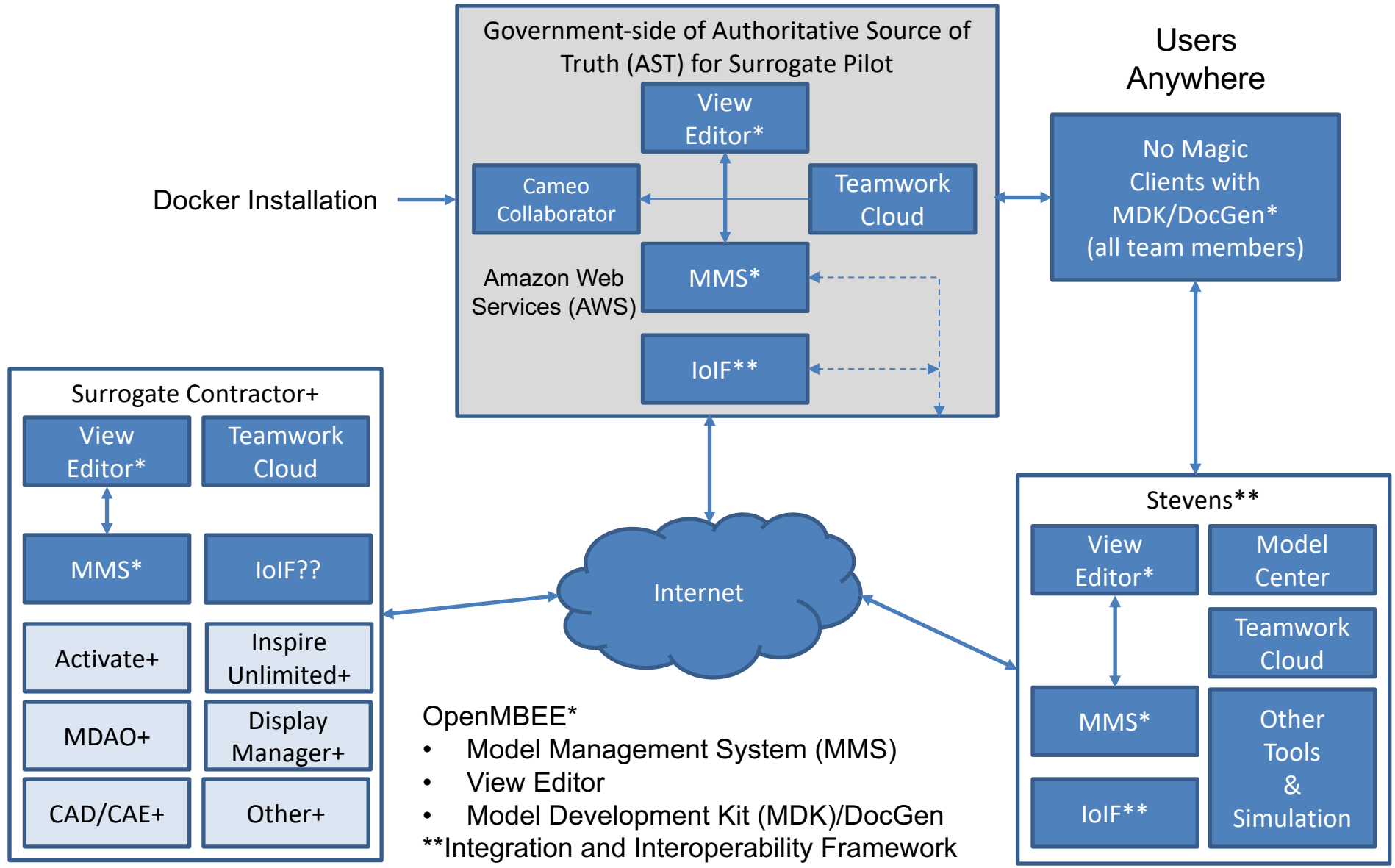
Elements of Authoritative Source of Truth



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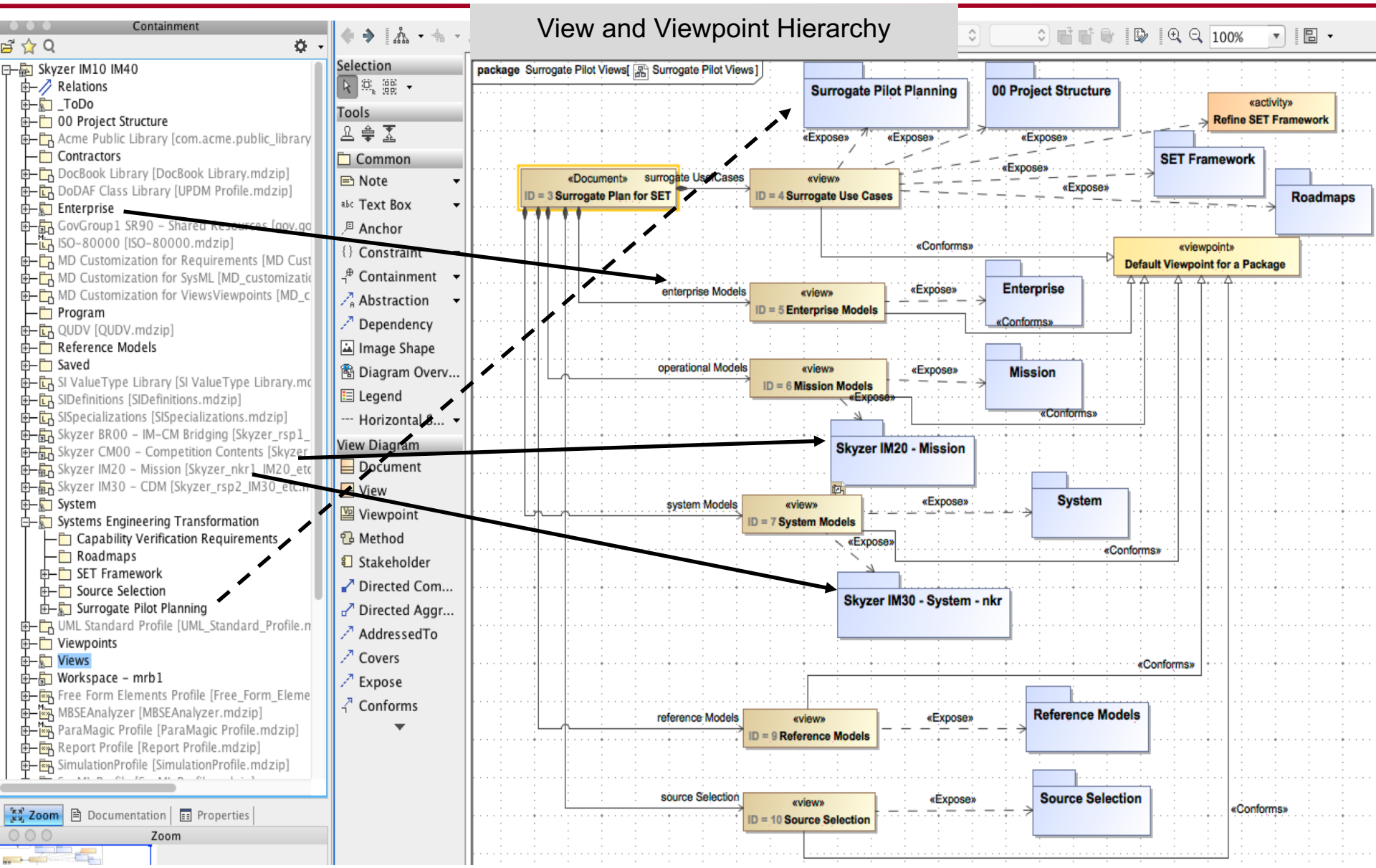
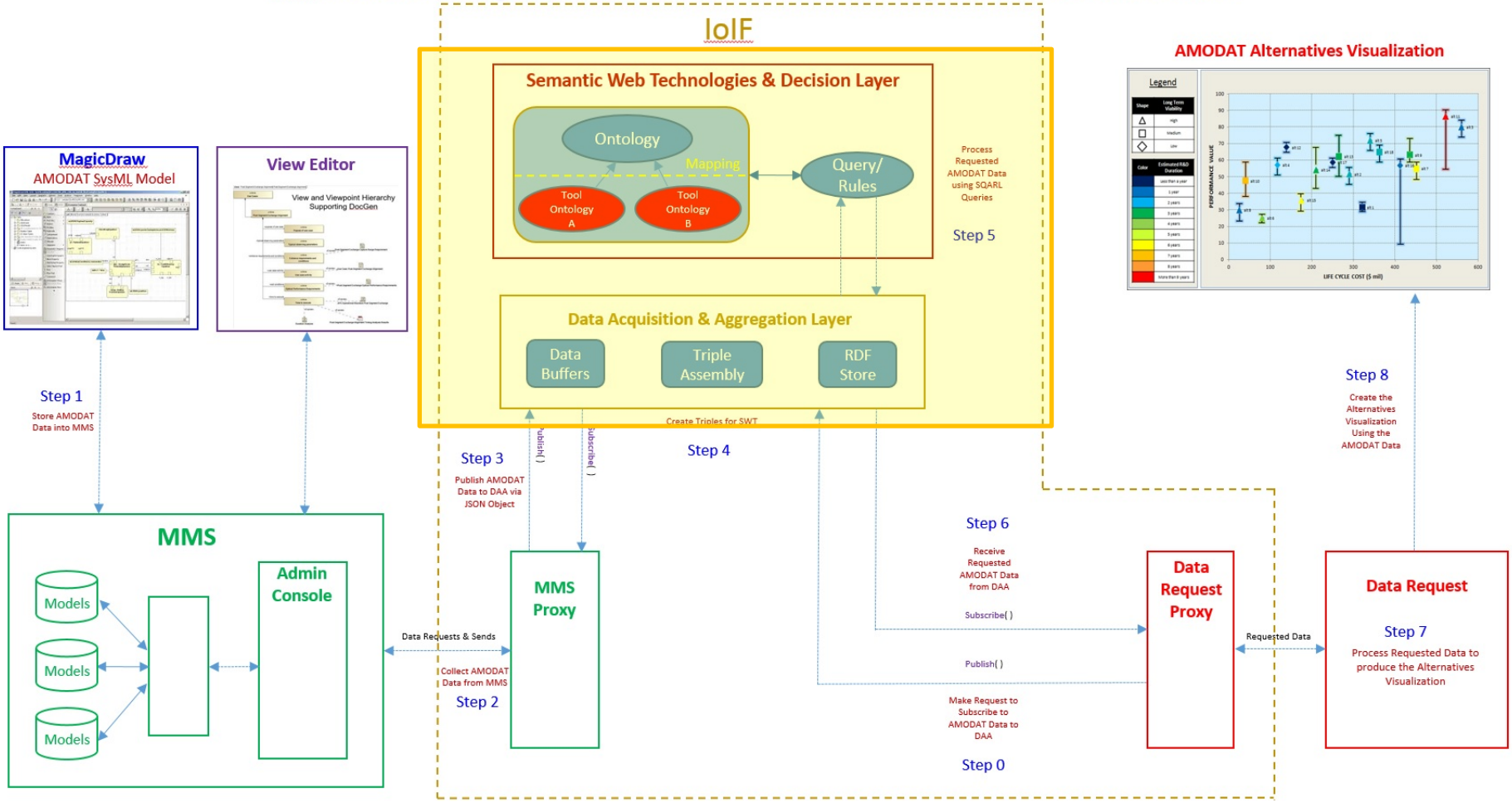
Investigating Methods for Modularizing Models and Associated Model Management



Semantic Web Technologies & Decision Layer

RT168 – High Level Integrating and Interoperability Framework (IoIF) Design & SWT – AMODAT Processing

IoIF with SWT, MagicDraw, View Editor & MMS Configured to Process AMODAT



Looking for Participation and Feedback from Industry and Government

- Models will be available for review on AWS server
- Comments and lessons learned are posted on APAN.org to be opened up to public soon
- Investigating approaches for feedback by Industry and Government

Thank You.


why
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QUESTIONS
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