
INCOSE Space Systems Working Group MBSE Challenge Project

Prove-out MBSE Methodology
on a CubeSat

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Team Composition

Aerospace Students and Professors

JPL and NASA Engineers

Engineers and Software Developers from
Commercial Modeling and Simulation Tool Providers

Telecons most Fridays at 1pm east coast time

Meeting materials and links to meeting recordings in Google docs

Email me to be included on the email reflector list



SSWG Challenge Project

INCOSE MBSE
Challenge Project
[Initiated in 2007](#)

INCOSE SSWG
[2007-2010](#)

Phase 0

Modeled a Space System
in SysML

Hypothetical FireSat -
SMAD

MBSE CubeSat Project

Phase 1 [1]

CubeSat Framework
Preliminary RAX Model

Phase 2 [2]

RAX Behavior Modeling
Power, Comm, State

[Recent Efforts \(Phase 3\)](#)

Enterprise Modeling
for CubeSats [3]

RAX CubeSat Model
Trade Studies [4]

[Current Efforts \(Phase 4\)](#)

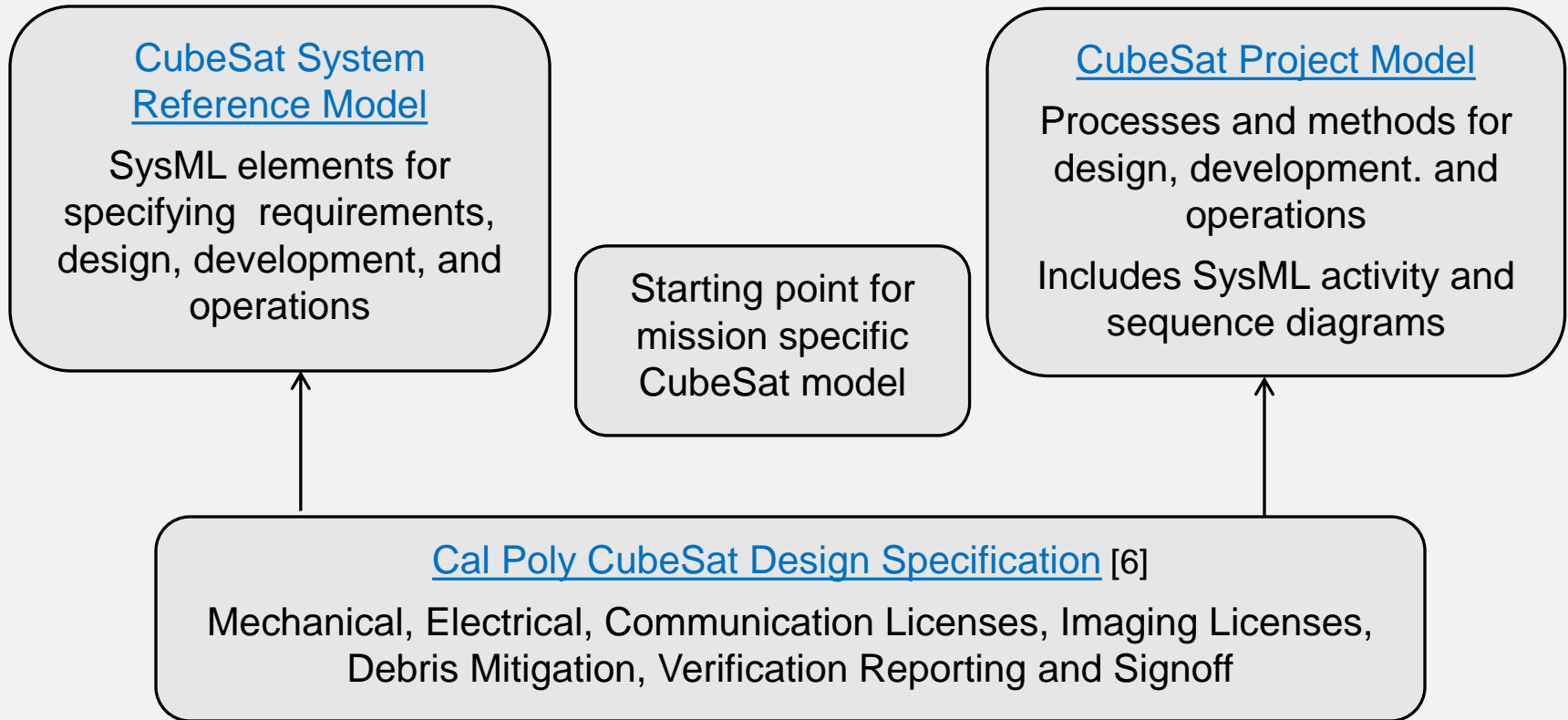
Develop a CubeSat
MBSE Reference
Model [5]



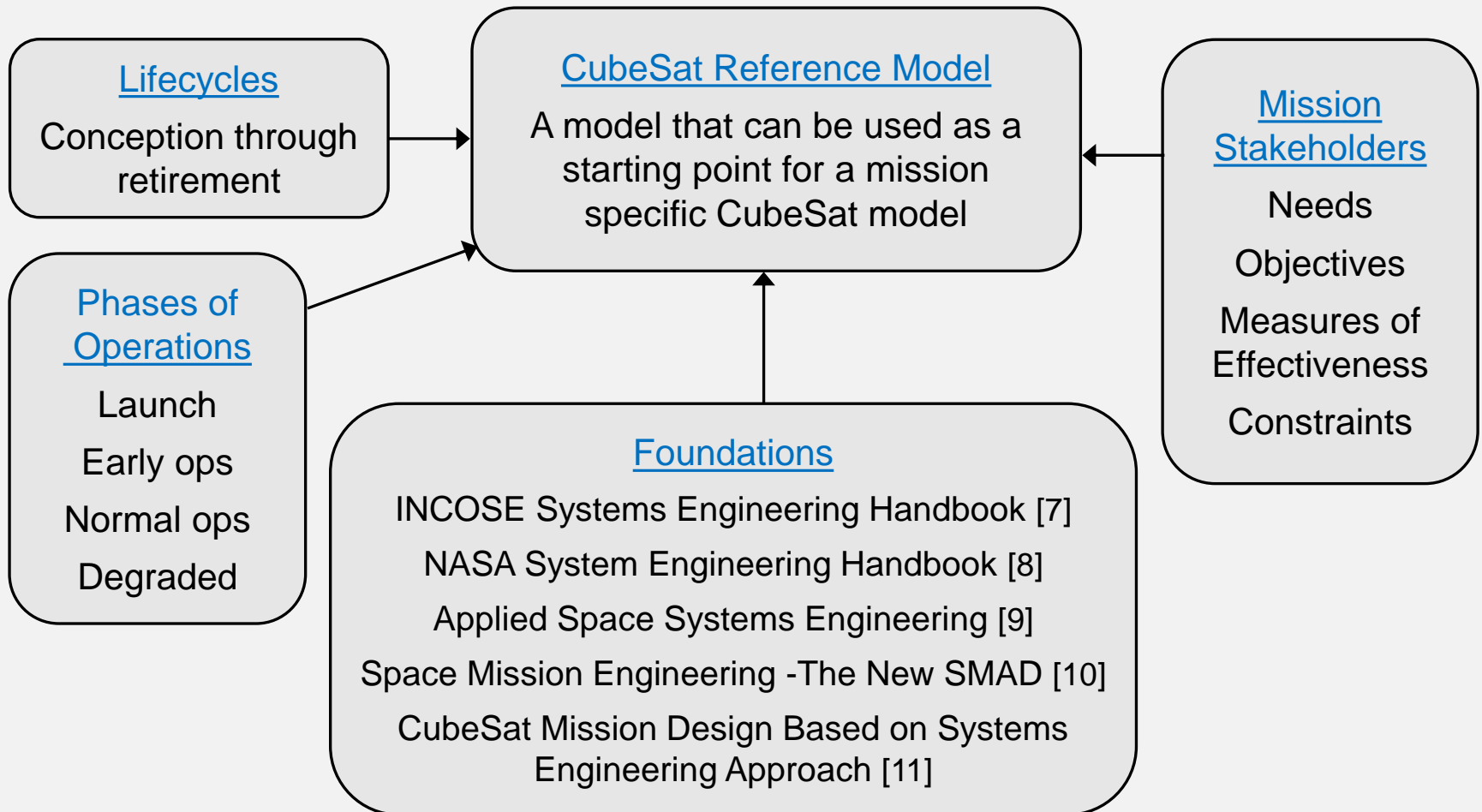
Tools

- No Magic
 - Magic Draw: Graphical SysML modeling tool
 - Cameo Simulation Toolkit: Time-step execution of behavior models
- InterCAX
 - Pararamagic: Plug-in module for MagicDraw - wraps external models
 - Systems Lifecycle Management (SLIM): Version control and config mgt
- Analytical Graphics
 - Systems Tool Kit: Simulation and visualization of spacecraft behavior
- Phoenix Integration
 - Model Center: Graphical environment for creating simulation workflows by integrating of simulation models including STK scenarios.
 - MBSE Analyzer: Execution of parametric diagrams

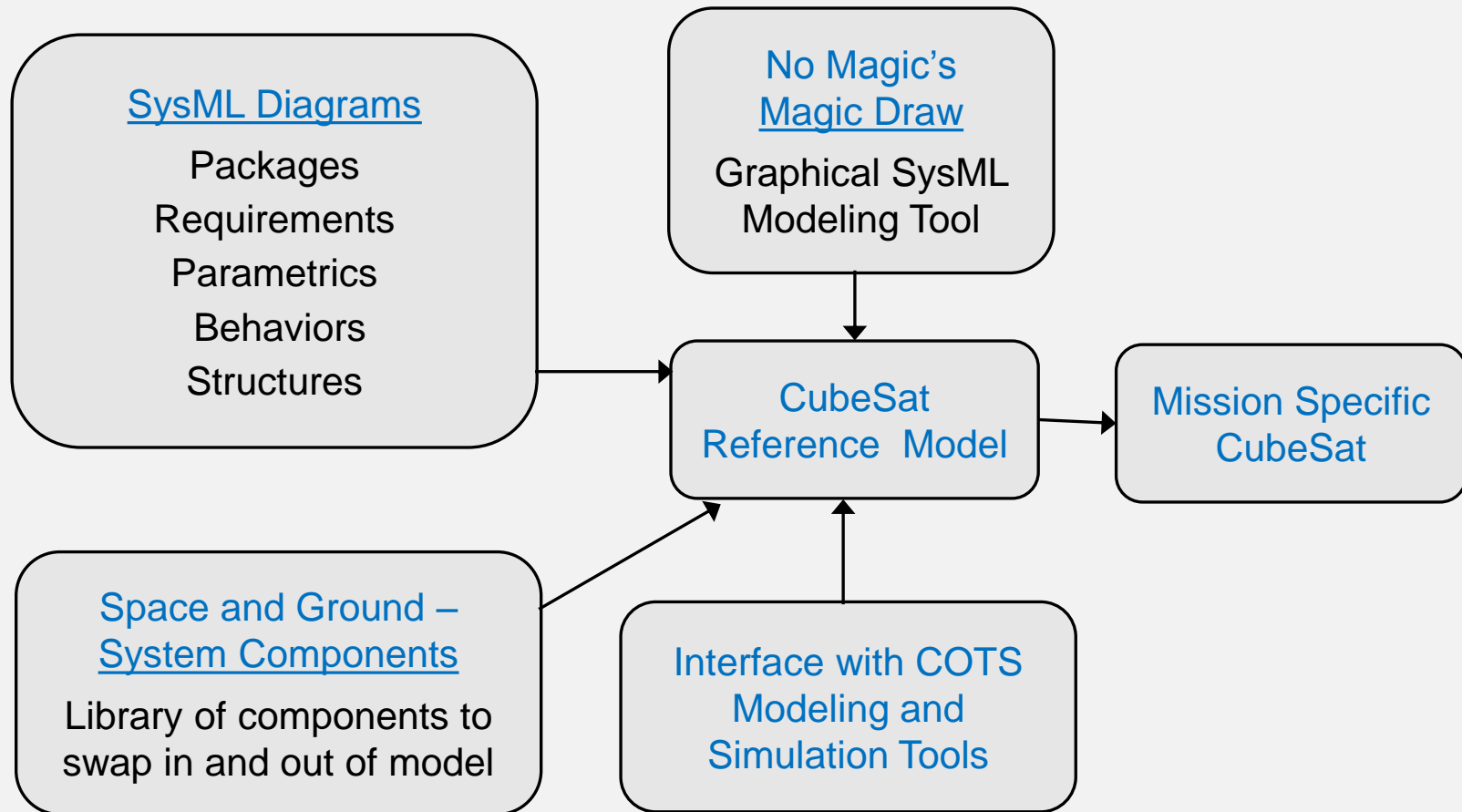
CubeSat Reference and Project Models



CubeSat Reference Model - Scope



CubeSat Reference Model – Eventual End State



Next Steps

- Determine the level of model definition at each of the lifecycle stages
- Create models for the concept and development lifecycle stages
- Provide the models to team members at JPL, NASA, AFIT, aerospace corporations, and universities



References

- [1] S. Spangelo, D. Kaslow, C. Delp, B. Cole, L. Anderson, E. Fosse, B. Gilbert, L. Hartman, T. Kahn, and J. Cutler, “Applying Model Based Systems Engineering (MBSE) to a Standard CubeSat,” in *Proceedings of IEEE Aerospace Conference*, Big Sky, MT, March 2012.
- [2] S. Spangelo, L. Anderson, E. Fosse, L Cheng, R. Yntema, M. Bajaj, C. Delp, B. Cole, G. Soremekun, D. Kaslow, and J. Cutler, “Model Based Systems Engineering (MBSE) Applied to Radio Explorer (RAX) CubeSat Mission Operational Scenarios,” *Proceedings of IEEE Aerospace Conference*, Big Sky, MT, March 2013.
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- [4] D. Kaslow, G. Soremekun, H. Kim, S. Spangelo, “Integrated Model-Based Systems Engineering (MBSE) Applied to the Simulation of a CubeSat Mission”, *Proceedings of IEEE Aerospace Conference*, Big Sky, MT, March 2014.
- [5] D. Kaslow, L. Anderson, S. Asundi. B. Ayres, C. Iwata, B. Shiotani, R. Thompson, “Developing a CubeSat Model-Based System Engineering (MBSE) Reference Model – Interim Status”, *Proceedings of IEEE Aerospace Conference*, Big Sky, MT, March 2015.

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- [7] *INCOSE Systems Engineering Handbook*, v. 3.2.2, October 2011, INCOSE-TP-2003-002-03.2.2.
- [8] *NASA Systems Engineering Handbook*, rev. 1, December 2007, NASA/SP-2007-6105 Rev1.
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- [11] S. Asundi and N. Fitz-Coy, “CubeSat Mission Design Based on Systems Engineering Approach,” *Proceedings of IEEE Aerospace Conference*, Big Sky, MT, March 2013.