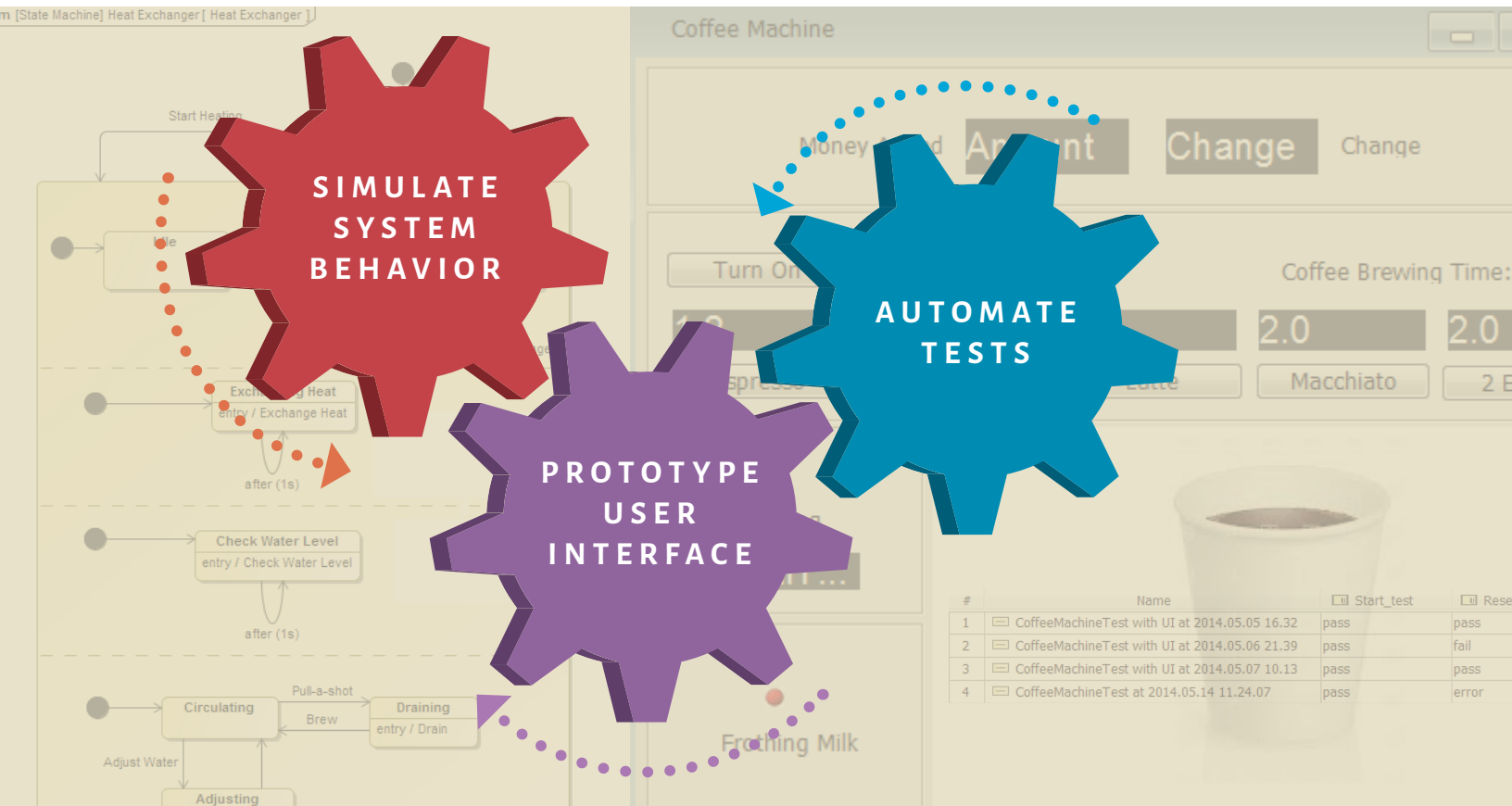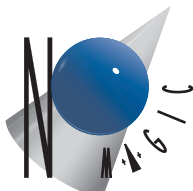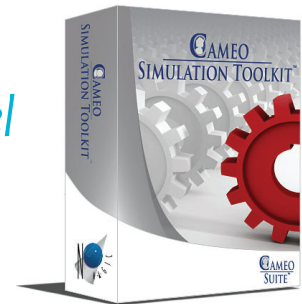# No Magic

Simulate — don't prototype

Gain system understanding using Cameo® Simulation Toolkit from No Magic, a complete tool for model simulation

SIMULATE SYSTEM BEHAVIOR

PROTOTYPE USER INTERFACE

AUTOMATE TESTS

Simulation Solution Overview

Bring your software, hardware, and data models to life via model simulation and execution with the Cameo® Simulation Toolkit

MBSE Ecosystem

Why Simulation?

The value of a simulation is to gain system understanding without manipulating the real system, either because it is not yet defined or available, or because it cannot be executed directly due to cost, time, resources, or risk constraints. Simulation is typically performed on a model of the system.

At No Magic, we believe simulation is the new prototype.

Modeling Environment

Cameo Systems Modeler™ is an industry-leading cross-platform collaborative Model-Based Systems Engineering (MBSE) environment, which provides smart, robust, and intuitive tools to define, track, and visualize all aspects of systems in the most standards-compliant SysML models and diagrams. The environment enables systems engineers to:

- Run engineering analysis for design decisions evaluation and requirements verification
- Continuously check model consistency
- Track design progress with metrics

System models can be managed in remote repositories, stored as standard XMI files, or published to documents, images, and web views to address different stakeholder concerns.

Core Functions of Cameo® Simulation Toolkit

Co-simulation

act [Activity] Cosimulation [Cosimulation]

input → inputValue → [MATLAB]
outputValue → inputValue → [Maple]
outputValue → inputValue → [JavaScript]
outputValue → output
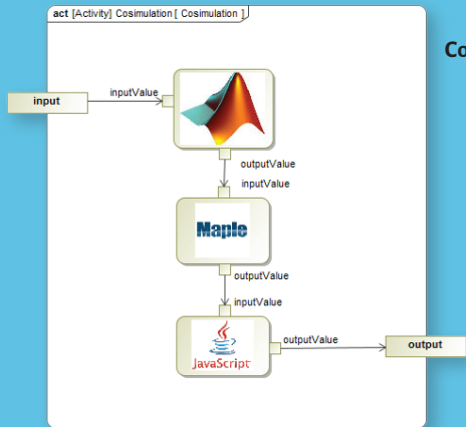
Rollup Pattern Calculation

Cost Rollup

Name	Type	Multiplicity	Value
keyboard	Block Keyboard	1	5.0
touchpad	Block Touchpad	1	3.0
i/o.1	Block I/O	1	8.0
ram	Block RAM	1	10.0
cache	Block Cache	1	1.0
memory.1	Block Memory	1	11.0
register	Block Register	1	0.0
graphics card	Block Graphics Card	1	0.0
cpu.1	Block CPU	1	4.0

Total Cost for Laptop is 23.0

OK   Cancel

Use Case Execution

uc [Package] Use Cases [Prepare for Drive]

«system context» Power Source Context

Driver — Charge vehicle — Gas Station Assistant
Driver — Fill up gas tank — Gas Station Assistant

Driver: Charge vehicle | Fill up gas tank
Gas Station Assistant: Fill up gas tank | Charge vehicle

Model-Based Testing

class StopWatchTest with UI [Test Configuration]

Test Configuration
System Under Test
Test Components

watch : StopWatch
Timer
data — control
Timer

conductor : TestConductor
time1 : Integer
time2 : Integer

arbiter : Arbiter
getVerdict(expr : Boolean) : VerdictKind
reset_test : VerdictKind
start_test : VerdictKind

Trade Study

Criteria
Classifier: Engine trade study ... Scope (optional): results ... Filter:

Add New Add Existing Delete Remove From Table Show Columns Export

#	Name	Alternatives	Winner	Most Powerful Engine
1	ets at 2014.04.30 15.19	gas : GasEngine; diesel : DieselEngine; hybrid : HybridEngine	hybrid : HybridEngine	200.0
2	ets at 2014.04.30 16.24	gas : GasEngine; diesel : DieselEngine	gas : GasEngine	190.0

Requirements Verification Table

	Gross Weight : Lbs	Speed : Mph	Number Of Wheels : Integer	Stopping Distance : Ft	Required Stop Distance : Ft	SD Verification : Verdict Kind	: Weight Constraint	: SD Constraint
2								
3	2800	65	4	178.9119253	176.548697	fail	pass	fail
4	3300	65	5	168.6883867	176.548697	pass	fail	pass
5	3200	65	4	204.4707718	176.548697	fail	pass	fail
6	2700	65	4	172.5222137	176.548697	pass	pass	pass
7	2700	65	4	172.5222137	176.548697	pass	pass	pass
8	3500	65	4	223.6399066	176.548697	fail	fail	fail
9	2700	65	4	172.5222137	176.548697		pass	pass

Analysis & Simulation Benefits

For Software Engineers

· Automatically validate requirements
· Visual debugging
· Simulate & prototype a real UI

For Systems Engineers

· Automatically validate requirements
· Perform trade studies
· Use rollup patterns for greater insight

Already using advanced Simulation tools? This solution is different.

Model-Based Systems Engineering or (MBSE) is not an evolution but a *revolution*—moving from siloed, document-based methods to a model-based approach. Many simulation solutions focus on specific aspects of MBSE, such as hardware (PLM/CAD), software, and data (Maple, MatLab/Simulink), but do not provide a comprehensive view.

Using the extendable model execution framework based on OMG fUML and W3C SCXML standards, engineering teams now have a definitive expression for their requirements, system architecture, and behavior that encompasses both hardware and software. Cameo Simulation Toolkit enables MBSE methods by bridging the gap of software, hardware, and data models, bringing them together in one cohesive, standard environment. With Cameo Simulation Toolkit, your team will realize even greater returns from your existing and future simulation investments.

User Interface Prototyping

With Cameo Simulation Toolkit, model execution is used to monitor values and inject signals via a debugger. However, a better approach is to connect system behavior to realistic mockups of the intended user interface.

Cameo Simulation Toolkit unleashes the power of the MagicDraw User Interface diagram by constructing and running true Java Swing UI. Users can easily drop classes on frames, parts on panels, signals on buttons, properties on labels, and sliders on checkboxes to relate UI components and system properties. Users can drop pictures directly from a web browser or a file system to use as part of the UI or to represent different dynamic system states.
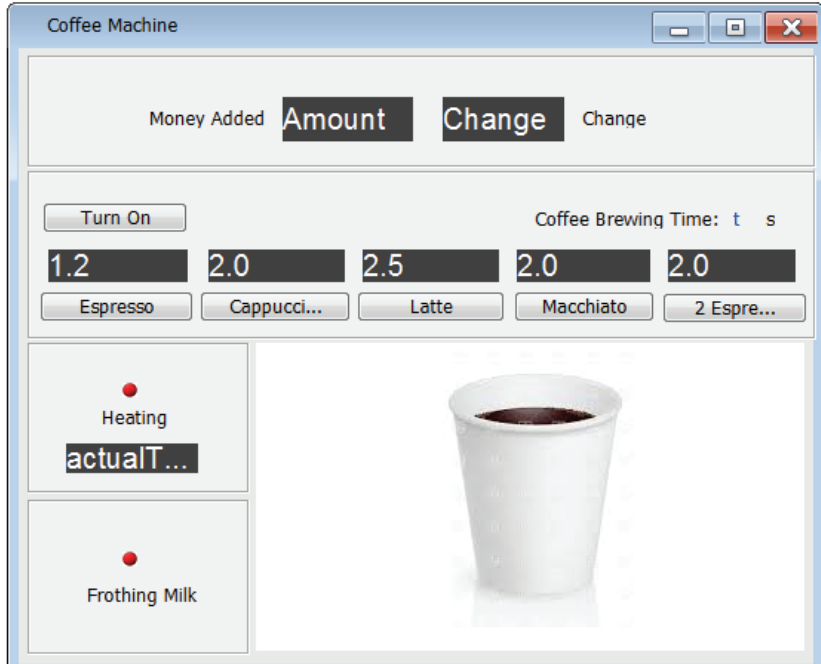
Additionally, realistic system mockups can be generated using our open API to connect third-party tools or libraries.

Coffee Machine sample from Cameo Simulation Toolkit

Setting the standard in model simulation

What sets the Cameo Simulation Toolkit apart from other simulation tools is that it follows the OMG® standards for fUML, W3 SCXML, and Parametric diagrams. This means you will never be boxed in or isolated when developing and simulating your models.

OMG fUML

www.omg.org/spec/FUML

Semantics of a foundational subset for executable UML models (fUML)

A virtual machine for executing UML activities for verification. Supports structural and behavioral semantics of systems through a subset of the UML metamodel.

W3 SCXML

www.w3.org/TR/scxml

State Chart XML (SCXML): State machine notation for control abstraction

A generic execution environment based on Harel state charts. Useful for event-driven systems, control systems, view navigation, and system interactions. Can be used for code generation.

Parametrics

www.omgsysml.org

Part of the OMG Systems Modeling Language

SysML Constraint blocks specify physical properties of a system or system performance expectations. Model simulations can evaluate and track parameters—size, weight, speed, power, temperature and others—throughout the system lifecycle. Some tools integrate with external math solvers.
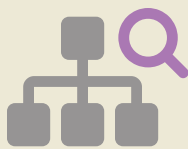
With Cameo Simulation Toolkit— simulate, don't estimate

Automatic Requirements Verification

Save time and reduce errors with **Automatic Requirements Verification.** Cameo Simulation Toolkit instantly alerts users when a requirement breaks with a constraint. Feel secure knowing your requirements are met.

Trade Studies

Be confident and remove doubt when selecting the most balanced technical solution using a **Trade Study.** Cameo Simulation Toolkit runs trade studies by testing criteria against your decision model, finding the optimal solution.

Co-Simulation

Enhance your model by integrating existing mathematical functions from third-party advanced solvers. **Co-Simulation** is simple: just drag and drop functions from Maple, MatLab/Simulink, and Mathematica, and add them to your system blocks.

Time Duration Analysis

Improve your simulation and project results by accounting for change over time. Use **Time Duration Analysis** to account for time duration between messages, actions with delays, and total activity time.

Model Based Testing

Ensure results by testing early and often. Build test cases and simulate them against the model using **Model Based Testing.** Now users have one source of truth, from requirements to design, all the way through to simulated test cases.

Mass/Power/Cost Rollup
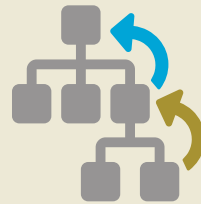
Cameo Simulation Toolkit extends the Rollup Pattern Wizard to easily calculate totals for analyzing **Mass, Power, and Cost.** These calculations can also run recursively to instantly check against constraints, verifying that results are within expected ranges.

Modeling and simulation resources for everyone from beginners to experts

Visit **www.blog.nomagic.com** where you can find:
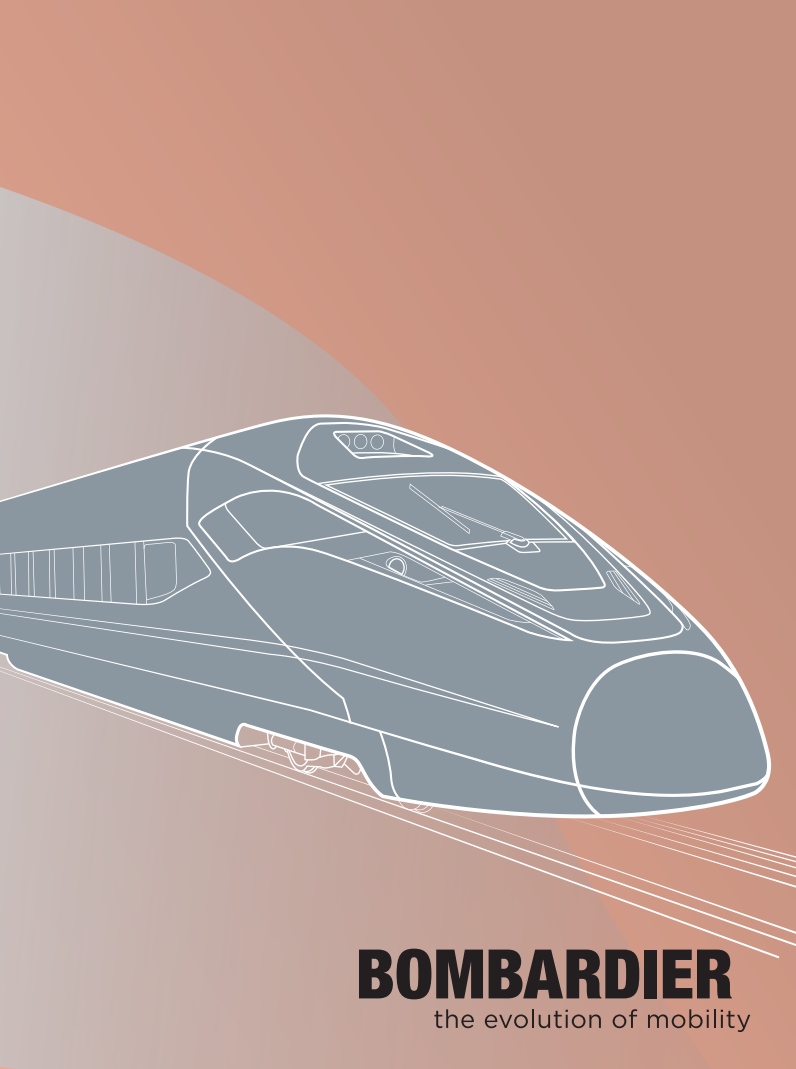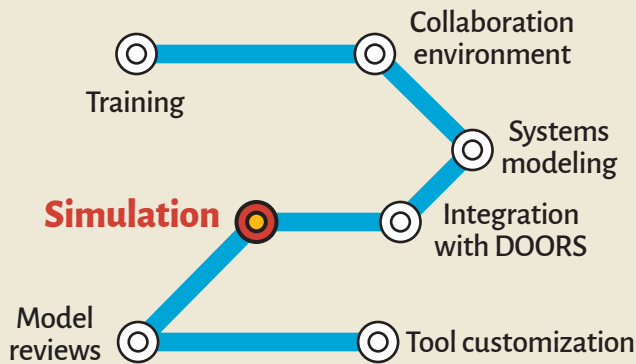
white papers

webinars

case studies

presentations

news and announcements

viewlets

MBSE and Simulation for
Bombardier Transportation

Bombardier Transportation, a global leader in rail technology, utilizes an MBSE approach and model simulation to continue delivering innovative products and services and setting new standards in sustainable mobility.

Challenges

- Systems were too complex
- Collaboration was difficult
- Complexity and difficulty in managing the multitude of artifacts
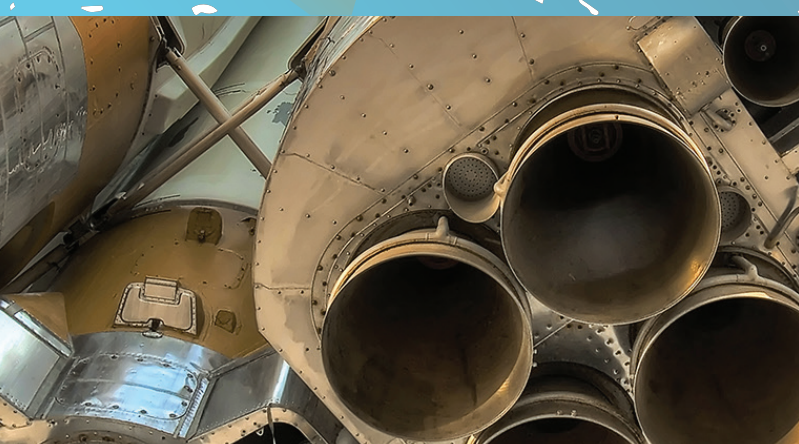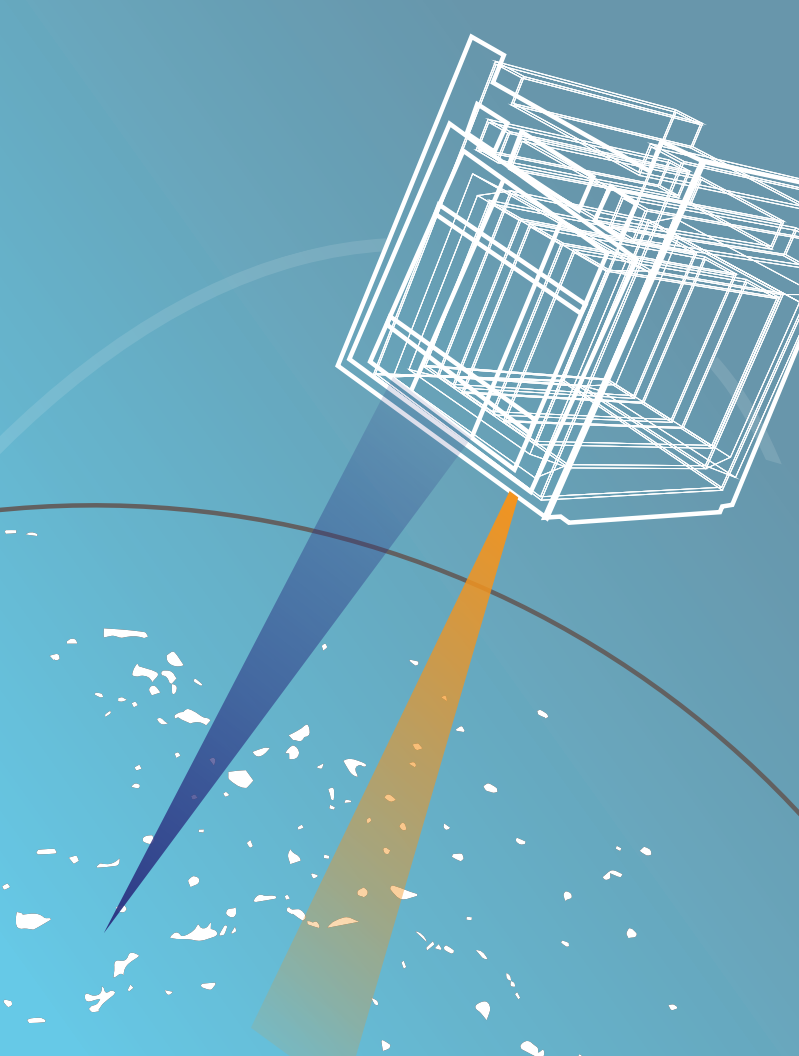
Solutions
Integrated tool chain:

- Requirements in IBM DOORS—interfacing with Cameo® Datahub for requirements synchronization
- Modeling and simulation with MagicDraw® and Cameo® Suite
- Hazard analysis in Isograph Reliability Workbench

Results and looking ahead

- Achieved improved communication via a formalized standard
- Realized the ongoing and long-term investment of adopting MBSE
- Accomplished a fully integrated modeling ecosystem

BOMBARDIER
the evolution of mobility

Collaboration environment

Training

Systems modeling

Simulation

Integration with DOORS

Model reviews

Tool customization

"Although MBSE assists in efficient product lifecycle development, when combined, model execution and simulation improves engineering results while driving real business value."

Mohammad Chami

Modeling Expert at Bombardier Transportation

MBSE Solution for
NASA and INCOSE

Modeling & Simulation of CubeSat Mission

CubeSats are a class of research spacecraft called nano satellites. The cube-shaped satellites

· Are approximately 10 cm long

· Have a volume of about 946 cm³

· Weigh about 1.4 kg

Challenges

· How do satellite states evolve throughout a mission?

· Does the vehicle design/operation meet all mission requirements?

· How do changes in spacecraft mission parameters impact performance and requirements satisfaction?

Solutions

· MBSE

· MBSE Tools
  · **Modeling:** MagicDraw + SysML
  · **Simulation:** Cameo Simulation Toolkit
  · **Integration:** Phoenix Model Center
  · **Analytical Models:** STK and MATLAB

Integrated models and tools are critical to design and plan for these missions.

Results

· 200%-300% reduction in time needed to conduct a trade study

· Achieved requirements verification for full end-to-end missions

· Ability to develop fundamental CubeSat mission system model

· Thorough analysis of mission and design trade-offs

"The Europa team was able to study three distinct mission concepts for the resources usually sufficient to study only one or two, and the high quality of all three studies was lauded by the Hubbard Review Board and by NASA HQ."

Dave Nichols and Chi Lin

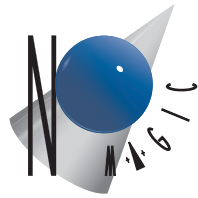*JPL MBSE practitioners at INCOSE International MBSE Workshop 2014*

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