

Presentation at Annual SERC Research Review

Nov 10, 2010

College Park, Maryland

v1.1

Overview of Systems Engineering Research at Georgia Tech

Russell Peak and Doug Bodner
(presenters)

Carlee Bishop, Tommer Ender, Tom McDermott
Leon McGinnis, Chris Paredis, Bill Rouse
(other main contributors)

Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE NOV 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE Overview of Systems Engineering Research at Georgia Tech				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Stevens Institute of Technology, Systems Engineering Research Center (SERC), 1 Castle Point on Hudson, Hoboken, NJ, 07030				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the 2nd Annual SERC Research Review Conference, 9-10 Nov 2010, College Park, MD. SERC is sponsored by the Department of Defense. U.S. Government or Federal Rights License					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	unclassified	unclassified	Same as Report (SAR)	46	

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- Summary

Georgia Tech Fun Facts



1885

Founded in Atlanta

Faculty

5 Professors

5 Shop Supervisors

Students

129 undergrads in Mechanical Engineering



1903

First full-time football coach

John Heisman



1948

Renamed *Georgia Institute of Technology*

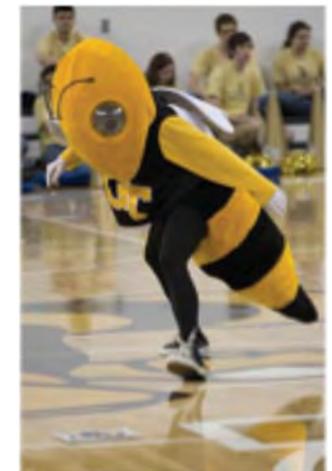


1996

Served as Olympic Village for 10,000+ athletes/staff



Mascots



Georgia Tech Statistics

Students

- undergrad: ~12,000
 - grad: ~8,000
 total: ~20,000

engineering: ~11,000

The Princeton Review 100 Best Value Colleges for 2010

STUDENTS				
12,533	70%  30% 			
undergrad enrollment	male female			
ADMISSIONS				
10,258	→ 61%	42%	EARLY	→ NR NR
applicants	admitted	enrolled	ADMISSIONS	applicants accepted
3.75	avg. high school gpa	reading math writing	600 = 650 = 590 =	minimum TOEFL
27	ACT range	SAT ranges		NR computer NR paper NR online
0	36	200	800	
FINANCIAL INFO				
\$6,070	\$24,480	\$10,096	\$1,000	\$1,436
in-state annual tuition	out-of-state annual tuition	room & board	avg. book expenses	required fees
\$7,601	\$6,977	48%	\$20,881	
avg. need-based grant	avg. need-based loan	grads who borrowed	average indebtedness	
ACADEMICS		POST-GRAD		
14:1	student to faculty ratio	20.3	to medical school	23.3
3%	classes taught by TAs	2.3	to business school	7.5
			to law school	

<http://www.usatoday.com/news/education/best-value-colleges.htm>

^{*} NR = Not reported

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Professional Masters in Applied Systems Engineering

www.pmase.gatech.edu

The degree program:

- Targeted to working professionals (5+ years experience)
- Convenient format combining distance learning and onsite interactions
- An applied degree taught from an enterprise view
- Relevant tools for solving real world problems



The PMASE Curriculum

Core Curriculum

- ASE 6001: Fund in Modern SE
- ASE 6002: Sys Design & Analysis
- ASE 6003: M&S for SE
- ASE 6004: Leading SE Teams
- ASE 60X5: Advanced Topics in SE
 - SysML
 - HSI
- ASE 6006: SE Lab

SE Processes & Techniques

Integrated SE Mgt

SE Tools, Standards, Languages

Domain Specific Engineering

Complex Systems

Complex Systems Curriculum

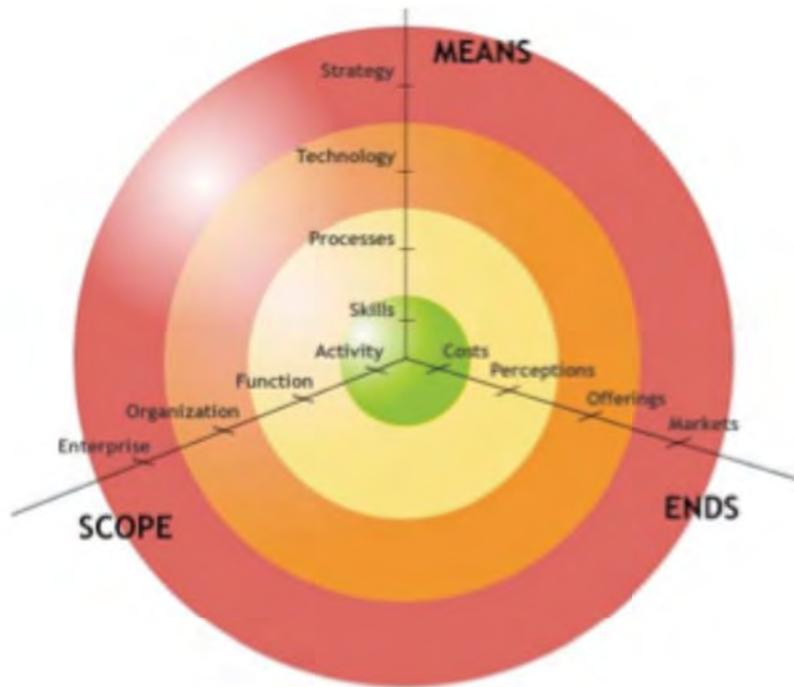
- ASE 61X1: Domain Elective in Synthesis & Analysis
 - Vehicles
 - Sensors
 - Info Systems
 - HSI
- ASE 6102: SOS & Architectures
- ASE 6103: Lifecycle & Integration
- ASE 6104: Complex Systems Capstone

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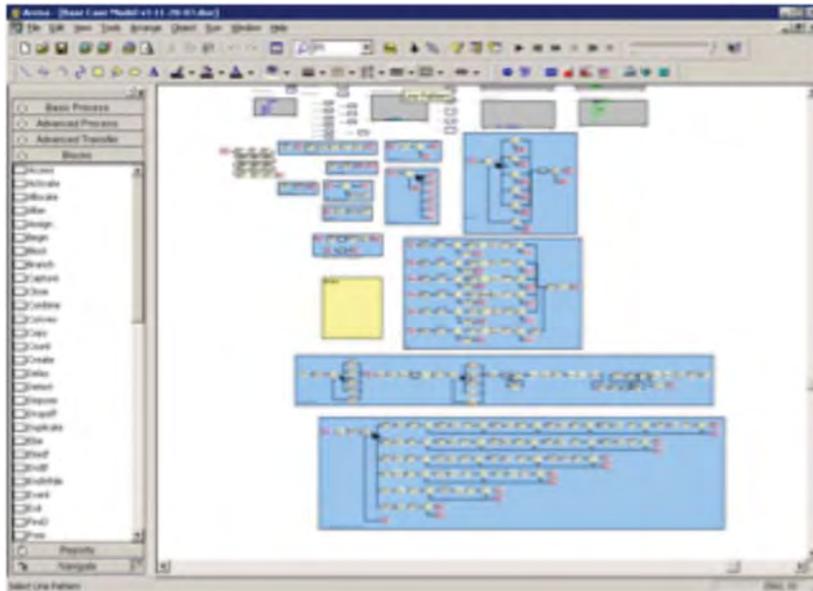
See also our work
in RT16 and RT25 →

Tennenbaum Institute



- Interdisciplinary research
- Understand and enable fundamental change of private and public sector enterprises
- Defense acquisition
- Services
- Energy
- Enterprise integration
- Global manufacturing
- Health care

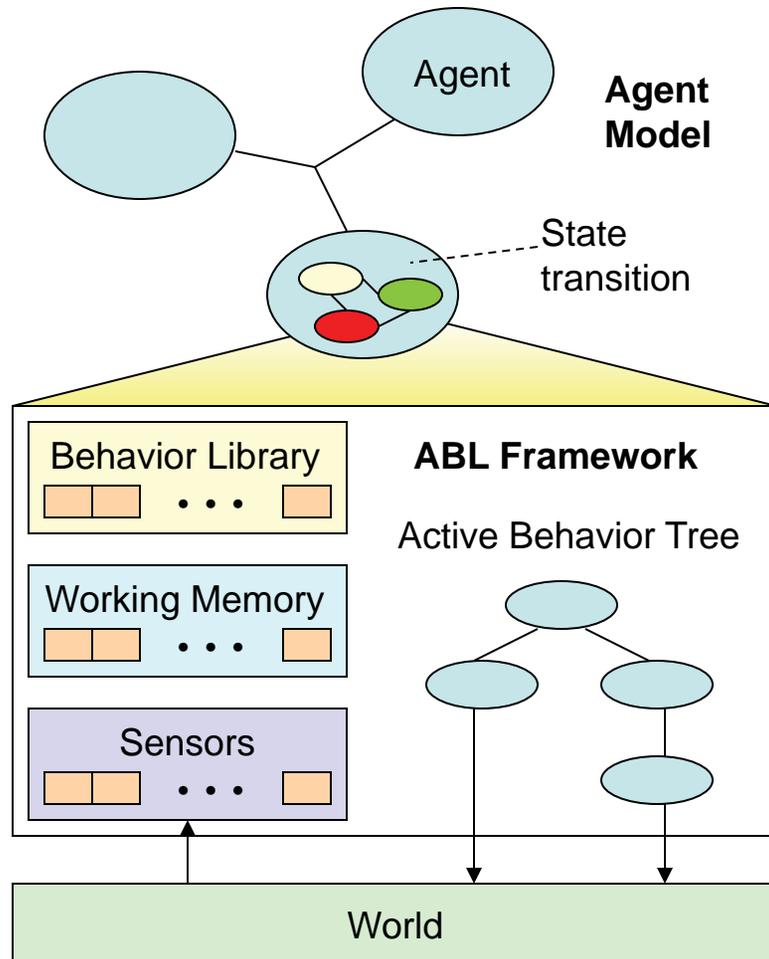
Defense Acquisition



Weapons systems progress through the acquisition lifecycle, including sustainment. The impacts on cost, schedule performance and risk are compiled.

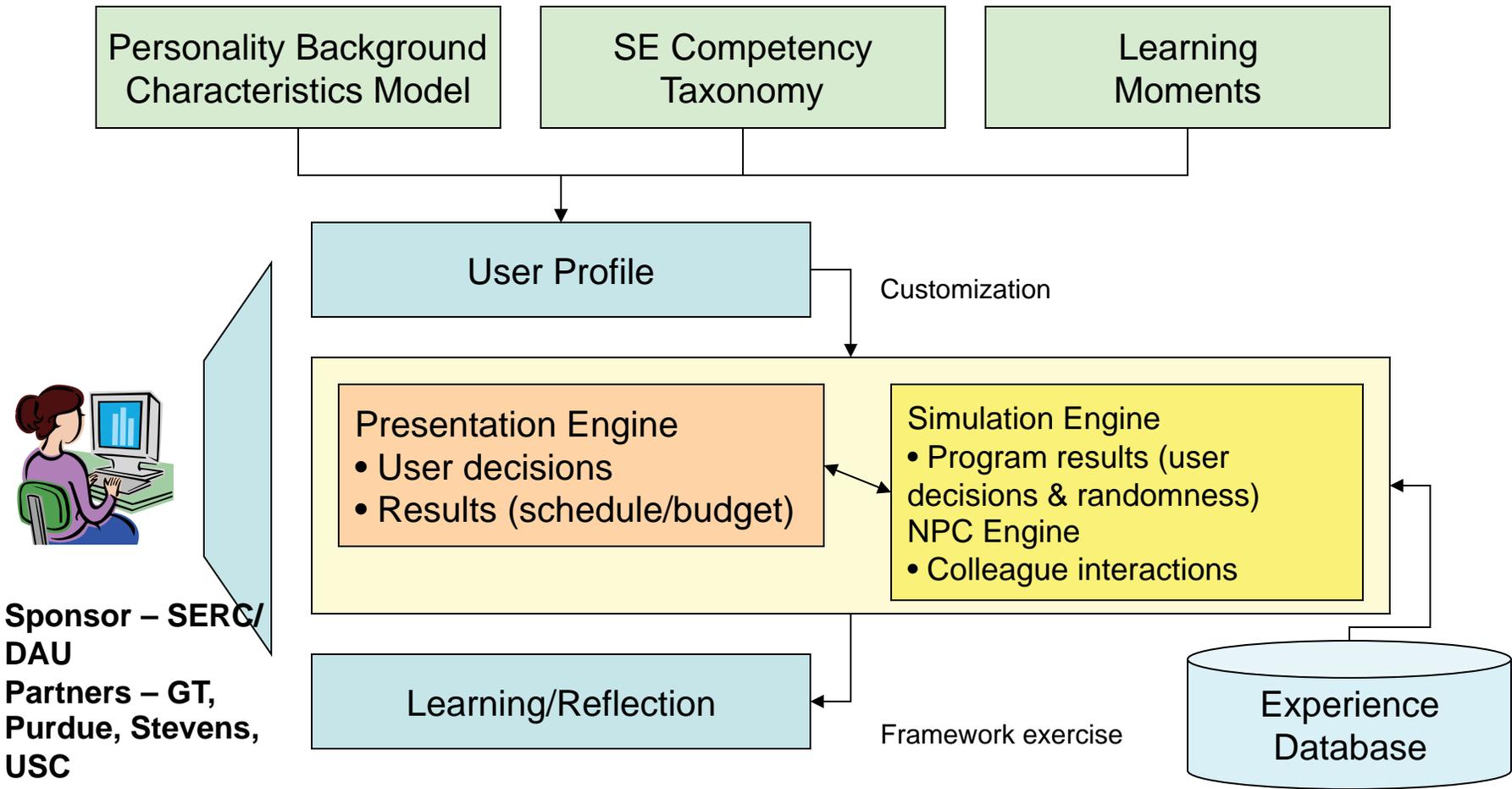
- Goal – investigate relationships between evolutionary acquisition, system modularity and production level
- Findings
 - Evolutionary acquisition tends to reduce program costs but increase enterprise costs
 - Modularity tends to increase development cost and decrease sustainment cost
 - High modularity tends to lower overall acquisition cost and mitigates the overall cost associated with high production
- Sponsor – Navy/NPS

Defense Acquisition and Organizational Simulation

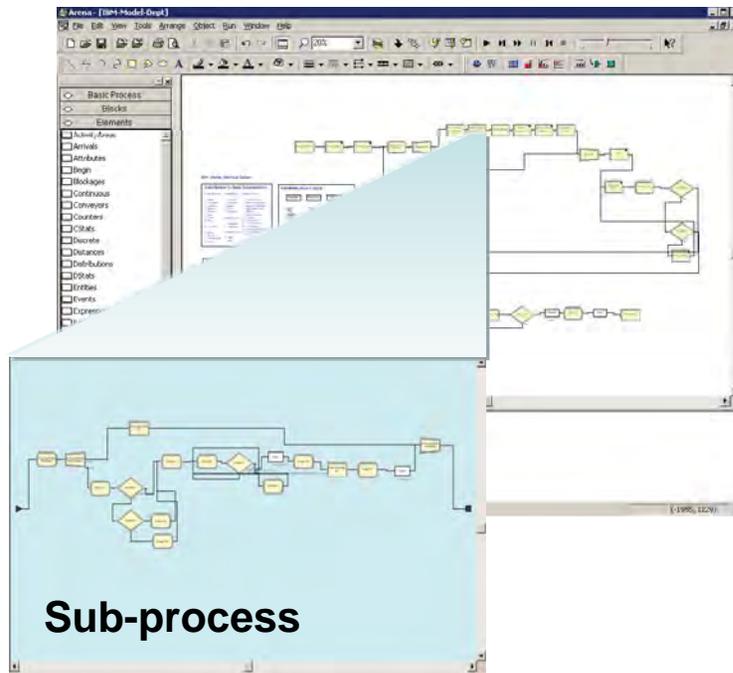


- Goal – represent organizational phenomena in simulation models (agent-based, discrete-event, system dynamics)
- Incorporate interactive computing concepts (character programming and drama management)
- Application to Predator acquisition:
 - Multi-actor decisions
 - Lead service selection
 - Military utility determination
- Sponsor – Air Force

Defense Acquisition and Systems Engineering (RT-16)



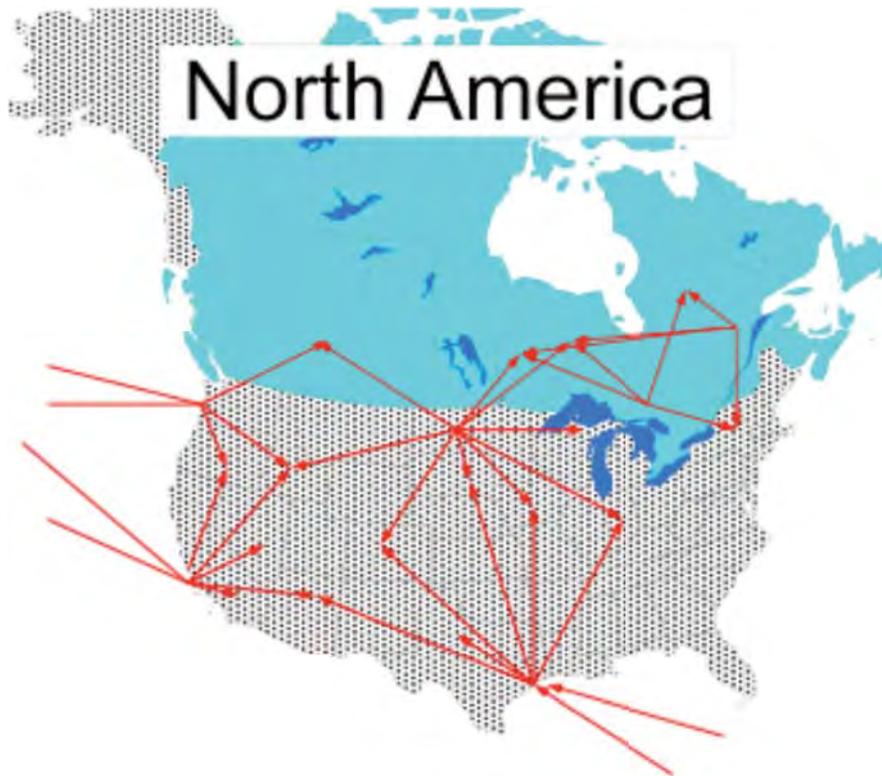
Services



Requirements and designs are represented as information artifacts that evolve and change as they traverse processes

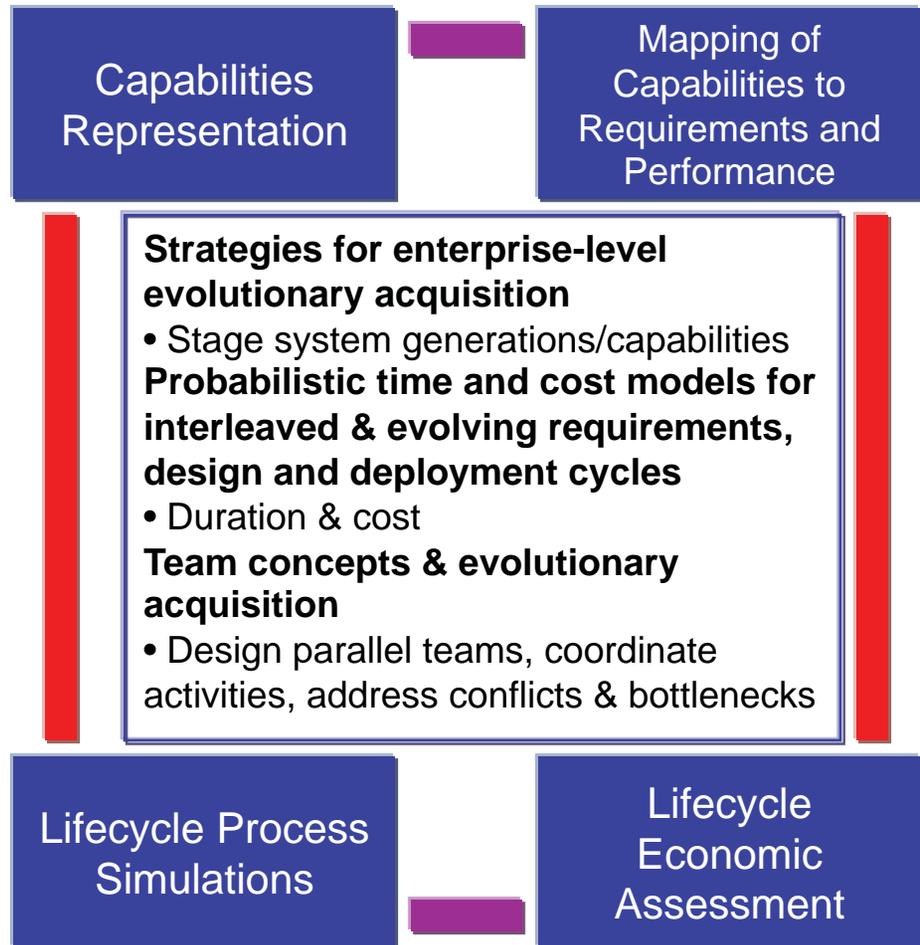
- Services constitute a majority of GDP
- Engineering design as a service – computer servers
- Time to market is key
- GT modeled and simulated computer server design processes
- Organizational designs and skill level mixes have a major impact on service effectiveness
- Sponsor – IBM

Energy



- Wind energy systems integrators face major cost issues in transport of components
- Multiples of \$100M annually
- GT developed an optimization tool for sourcing and transport of components
- Spreadsheet-based with trade-offs between usability and speed
- 10-15% cost reduction on sample runs vs. manual approach
- Sponsor – GE Energy

Enterprise IT Integration (RT-25)



- Enterprises face new challenges, requiring new capabilities
- This involves integration of new capabilities
- How are these translated in a disciplined manner to IT requirements
- This occurs in an evolutionary environment
- Need for tools
 - Represent capabilities and requirements
 - Facilitate experimentation and what-if analysis
- Sponsor – SERC
- Partners – GT and USC

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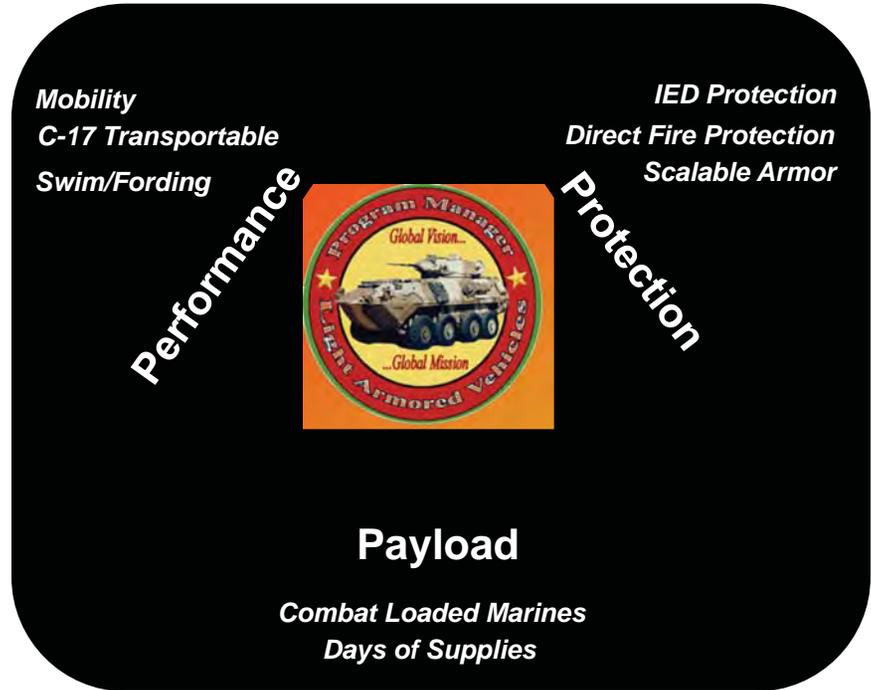
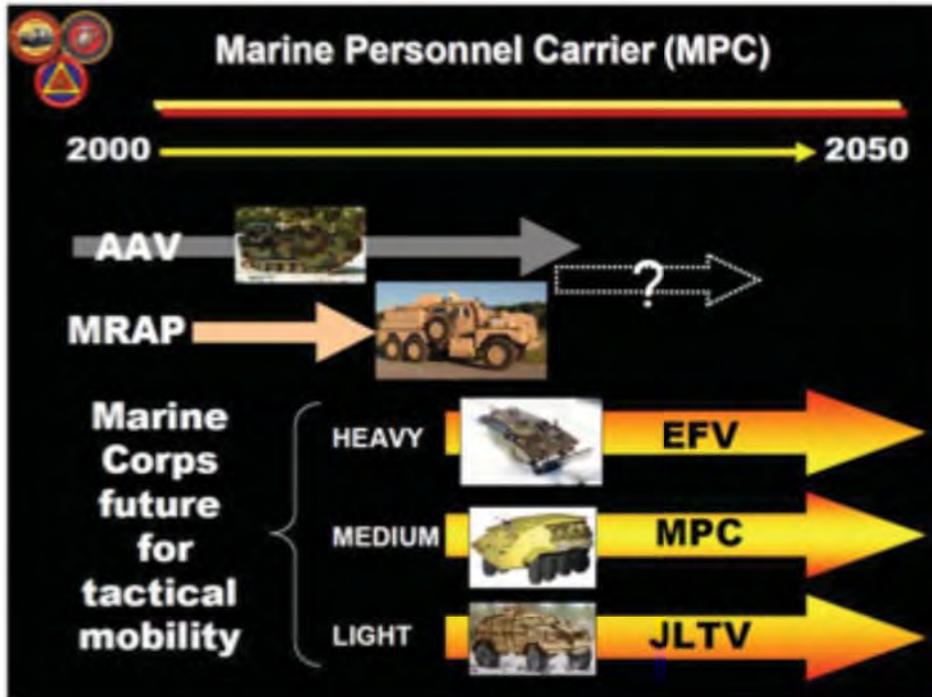
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Decision-makers afforded novel real-time, panoramic view of trade-offs and parametric sensitivities via advanced visualization features

Research conducted on capability-focused and inverse design to identify solutions that meet dynamic requirements

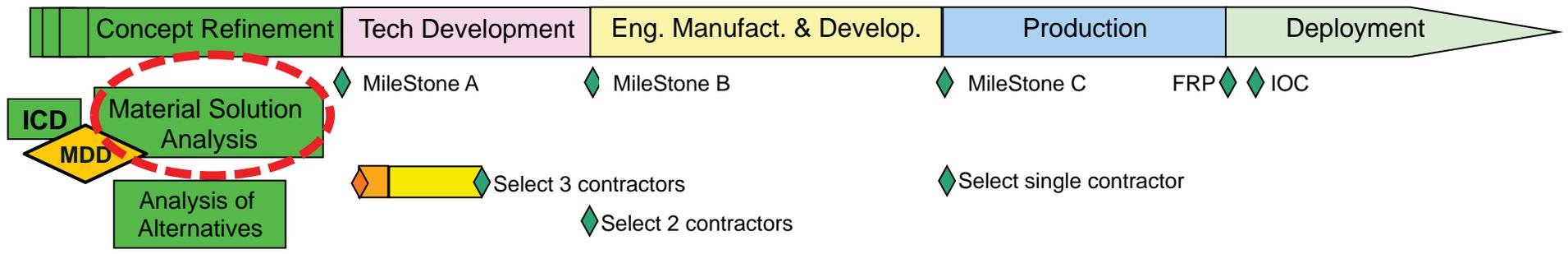


Real-time collaboration and decision making in a secure environment to solve real-world problems



performance payload

protection

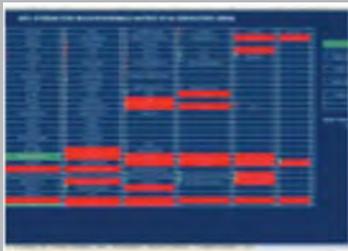


Requirements Definition
 Current toolset used to analyze selected mobility requirements and associated costs

Source Selection
 Current toolset may be used to assist source selection planning

- Outcomes**
- Better defined requirements with enabling performance
 - Getting proposals that are closer to our goals, reducing risk to cost and schedule
 - Guidance towards source selection

Sub-system Technology Selection Tool



Compare and prioritize technology

Vehicle Performance Generation Tool (VPGT)



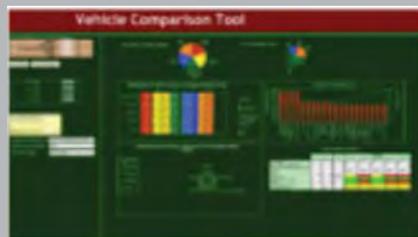
Generate valid design solutions

Statistical Data Analysis

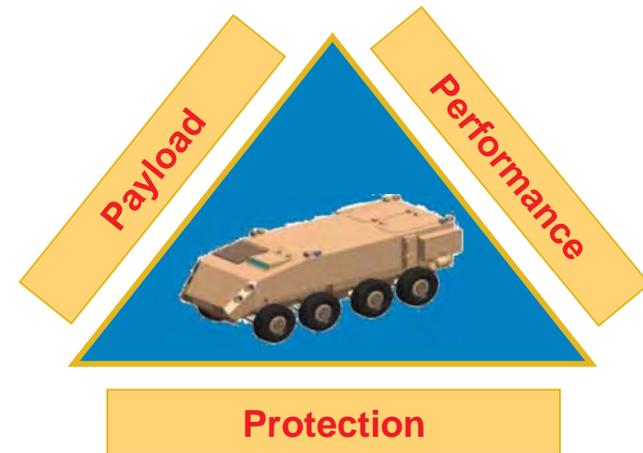


Design space exploration

Vehicle Comparison Tool (VCT)



Compare valid design solutions



Output : Recommendations for a balanced, achievable requirements document for MPC

Navigate through the possible combinations through:

- A series of technology compatibilities (i.e. some technologies options for one subsystem may not be compatible with technologies in another subsystem)
- Technology filters (i.e. all must be at least a TRL = 8)
- Technologies that will benefit important requirements

MPC INTERACTIVE RECONFIGURABLE MATRIX OF ALTERNATIVES (IRMA)

Swim Capability	Integral Drive	No Swim	Plug-and-Armor Removal	Deal Cooling	Air Bladder
Swim - Propulsion	Propeller	Jet Pod - Shaft Drives	High Thrust Pod - Shaft Drives	Jet - Hydraulic Drives	Jet - Electric Motor Drives
Front Suspension Architecture	SLA (front)	Live Axle (front)	Strut (front)		
Rear Suspension Architecture	SLA	Live Axle	Trailing Arm	Strut	Multi-link
Suspension Actuation - Spring	Coil Springs	Leaf	Torsion Bar	Air Bag	Hydropneumatic
Suspension Actuation - Damper	Passive	2-stage switchable	Continuously Adjustable SV	Continuously Adjustable MR	
Steering	1 & 2	1, 2, & 4	1, 2, 3, 4		
Chassis Systems - Brakes	Hydraulic Brakes	Pneumatic Brakes	Pneumatic over Hydraulic Brakes		
Chassis - Run Flat	Hutchinson	Drive Dynamics			
Chassis - Tires	Michelin XM1	Michelin XZ1	Goodyear-Michelin Tactical		
Powertrain - Main Powerplant	CI - Inline	CI - Vee	Turbine		
Electrical Power Generation	Alternative	Deal Alternator	ISG/ISA		
Electrical Storage Architecture	Lead Acid	Carbon Foam Lead Acid	Ultra Cap		
Powertrain cooling - Radiator	Braced Aluminum Tube	Aluminum Bar & Plate	Copper Braco		
Powertrain Cooling - Charged Air Cooler	Air to Air	Air to Water			
Powertrain Cooling - Oil Cooler	Oil to Air	Oil to Water			
Powertrain Cooling - Fuel Cooler	Fuel to Air	Fuel to Water			
Powertrain Cooling - Condenser	Mechanically Assembled	Braced Tube & Fin			
Powertrain Cooling - Engine Cooling Fan	Hydraulic	Mechanical	Electric		
Thermal Systems - Climate Control	Enhanced R134a	CO2	Alternative Non CO2		
Thermal Systems - Waste Heat Recovery	No Waste Heat Recovery	Thermal Acoustics	Metal Hydrides		
Driveline - Transmission	5 Speed A/T	6 Speed Wide Ratio A/T	7 Speed A/T		
Driveline - Transfer Case	Electric Hybrid Trans	Continuously Variable Trans (CVT)	Integrated Trans/Transfer Case		
Driveline - Differentials	Passive Locking Single Speed Transfer Case	7 Speed Transfer Case - Mechanical Locking	7 Speed Transfer Case - Torque Steering		
Driveline - Hubs	Differential - Open	Small Size Limited Slip (LSO)	Electric Lock	Differential - Torque Vectoring	Torque Vectoring Axle
Driveline - Shafts	Bevel Gear	Bevel Gear Next Generation	Planetary Gears		
TRL	1	2	3	4	5
TRL	7	8	9		

Darker circle indicate technologies within a subsystem group that has the greatest impact on the variability of the highest ranked requirements

Subsystem attributes may have little impact on requirements attributes

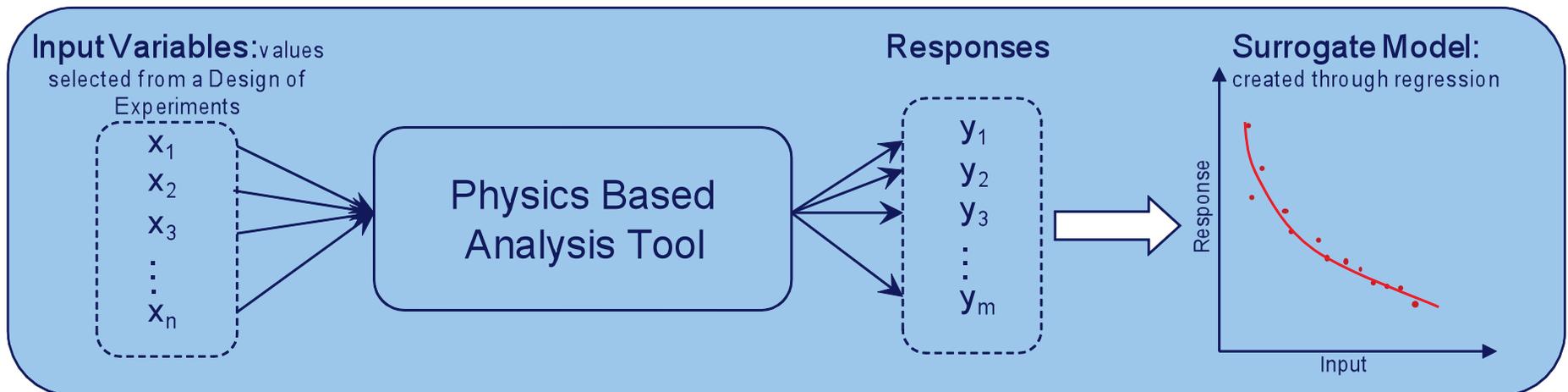
Navigate through the possible combinations through:

- A series of technology compatibilities (i.e. some technologies options for one subsystem may not be compatible with technologies in another subsystem)
- Technology filters (i.e. all must be at least a TRL = 8)
- Technologies that will benefit important requirements

Sub-System		MPC INTERACTIVE RECONFIGURABLE MATRIX OF ALTERNATIVES (IRMA)				
Swim Capability	Integral Drive	No Drive	Partial/Power Reduced	Over Cooling	Air Bladder	
Swim - Propulsion	Propeller	Air Prop. Skirt Drive	High Thrust Prop. Skirt Drive	Air Hydraulic Drive	Air Electric Motor Drive	
Front Suspension Architecture	SLA (front)	Live Axle (front)	Steer (front)			
Rear Suspension Architecture	SLA	Live Axle	Trailing Arm	Steer	Multi-Axle	
Suspension Actuation - Spring	Coil Springs	Leaf	Torsion Bar	Air Bag	Hydroponic	
Suspension Actuation - Damper	Passive	2-stage adjustable	Continuously Adjustable DR	Continuously Adjustable MR		
Steering	1 & 2	1, 2, & 4	1, 2, 3, 4			
Chassis Systems - Brakes	Hydraulic Brakes	Pneumatic Brakes	Pneumatic over Hydraulic Brakes			
Chassis - Run Flat	Run-flat tires	Drive Equipped				
Chassis - Tires	Michelin RMB	Michelin XZL	Specialty Medium Tactical	Specialty Heavy Tactical		
Powertrain - Main Powerplant	CI - Inline	CI - Vee	Turbine	DFRC		
Electrical Power Generation	Alternator	Dual Alternator	ISG/IMA			
Electrical Storage Architecture	Lead Acid	Carbon Fiber Lead Acid	Ultra Cap	SMES	Lithium	
Powertrain cooling - Radiator	Braced Aluminum Tube	Aluminum Bar & Plate	Copper Brass			
Powertrain Cooling - Charged Air Cooler	Air to Air	Air to Water				
Powertrain Cooling - Oil Cooler	Oil to Air	Oil to Water				
Powertrain Cooling - Fuel Cooler	Fuel to Air	Fuel to Water				
Powertrain Cooling - Condenser	Mechanically Assisted	Braced Tube & Fin				
Powertrain Cooling - Engine Cooling Fan	Hydraulic	Mechanical	Electric			
Thermal Systems - Climate Control	Enhanced OTRs	CO2	Alternative Non-CO2			
Thermal Systems - Waste Heat Recovery	No Waste Heat Recovery	Thermal Acoustics	Metal Hydrides	Thermal electric		
Driveline - Transmission	5 Speed A/T	8 Speed Wide Ratio A/T	7 Speed A/T	12 Speed A/T	Automated Manual Trans (AMT)	
Driveline - Transfer Case	Electric Hybrid Trans	Continuously Variable Trans (CVT)	Integrated Trans/Transfer Case			
Driveline - Differentials	Passive Locking Single Speed Transfer Case	7 Speed Transfer Case- Mechanical Locking	7 Speed Transfer Case- Torque Sensing	7 Speed Transfer Case- Electric Locking	Torque Vectoring Transfer Case	
Driveline - Hubs	Differential - Open	Small Slow Limited Slip (LSO)	Electric Lock	Differential - Torque Vectoring	Torque Vectoring Axle	
Driveline - Shafts	Bevel Gear	Bevel Gear Next Generation	Planetary Gears			
TRL	1	2	3	4	5	
TRL	7	8	9			

Vehicle architectures may be selected

Surrogate models



Bringing Modeling & Simulation Forward in the Decision Making Process



MPC VEHICLE PERFORMANCE GENERATION TOOL

Configuration Inputs

Drive Cycle Configuration

Number of Escapes: **Advanced Options**

Passenger Size (Percentage): **Medium**

Platform Configuration

Engine Type: **Advanced Options**

Transmission: **Advanced Options**

Fuel Tank Size (gal): **Advanced Options**

Include S-40 Armor in Cost: **Off**

Tire Selection: **Advanced Options**

MMMI K22 K23 Available? **Yes**

MMMI K22 K23 Available? **Yes**

Arm Systems Configuration

Weapon Station: **Advanced Options**

Charge Space (Days of Supply): **Advanced Options**

% GVW Packaged Growth: **Advanced Options**

- Default Settings
- Advanced Inputs/Outputs
- Save/Load Vehicle
- Export Vehicles to VCT

Armor Density Inputs

Select A-40 Armor Option: **Advanced Options**

Select S-40 Armor Option: **Advanced Options**

Include D7F Armor? **Off**

Save Custom Armor

Force Protection: **Advanced Options**

Road

Roof

Right/Left Sides

Roof

Body

Performance Results

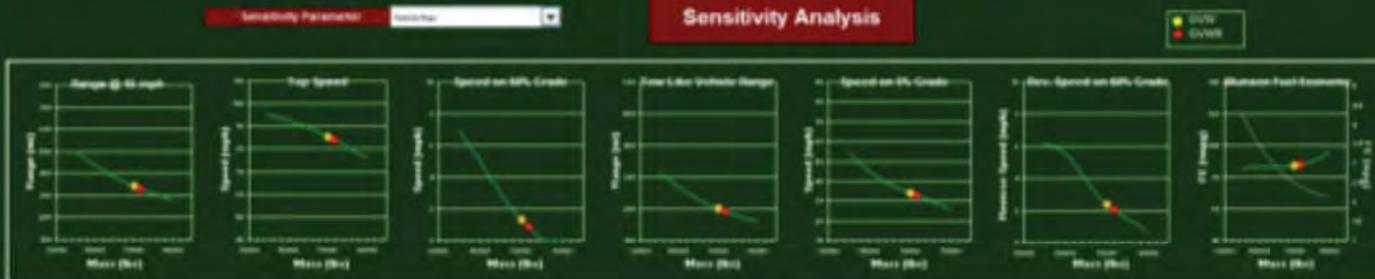
Measure	Value	Pass/Fail	Target
Range at 40 mph (mi)	54.55	Pass	50.00
Speed on 0% Grade (mph)	95.95	Pass	90.00
Top Speed (mph)	95.95	Pass	90.00
Mission-Cycle RE (mpg)	32.23	Pass	30.00
Speed on 50% Grade (mph)	54.44	Pass	50.00
Reverse Speed on 50% Grade (mph)	32.23	Pass	30.00
Tow Like Vehicle Range (mi)	54.44	Pass	50.00
Maximum Side Slope Angle (deg)	32.23	Pass	30.00
NATO Lane Change Speed (mph)	54.44	Pass	50.00
Maximum Lateral Acceleration (g)	32.23	Pass	30.00
10 inch Half Round Speed (mph) at 2.0g	54.44	Pass	50.00
12 inch Half Round Speed (mph) at 2.0g	54.44	Pass	50.00
1.0" RRS max Speed (mph) at 500	54.44	Pass	50.00
1.2" RRS max Speed (mph) at 500	54.44	Pass	50.00
1.5" RRS max Speed (mph) at 500	54.44	Pass	50.00
1.7" RRS max Speed (mph) at 500	54.44	Pass	50.00
1.9" RRS max Speed (mph) at 500	54.44	Pass	50.00
MMMI Jordan Sand V50	54.44	Pass	50.00
MMMI Korea Wet V50	54.44	Pass	50.00
MMMI Germany Dry V50	54.44	Pass	50.00
MMMI V50	54.44	Pass	50.00



Transportability Results

	Air Transport	Ground Transport	Rail Transport	Inter-Sea/ter Shipping	Sea Containers
Carl	Y	Y	Y	Y	Y
Carl-2	Y	Y	Y	Y	Y
Carl-3	Y	Y	Y	Y	Y
GVW	Y	Y	Y	Y	Y
GVW-2	Y	Y	Y	Y	Y
GVW-3	Y	Y	Y	Y	Y

Sensitivity Analysis



Mass and Geometry Results

Passenger Compartment Change vs.

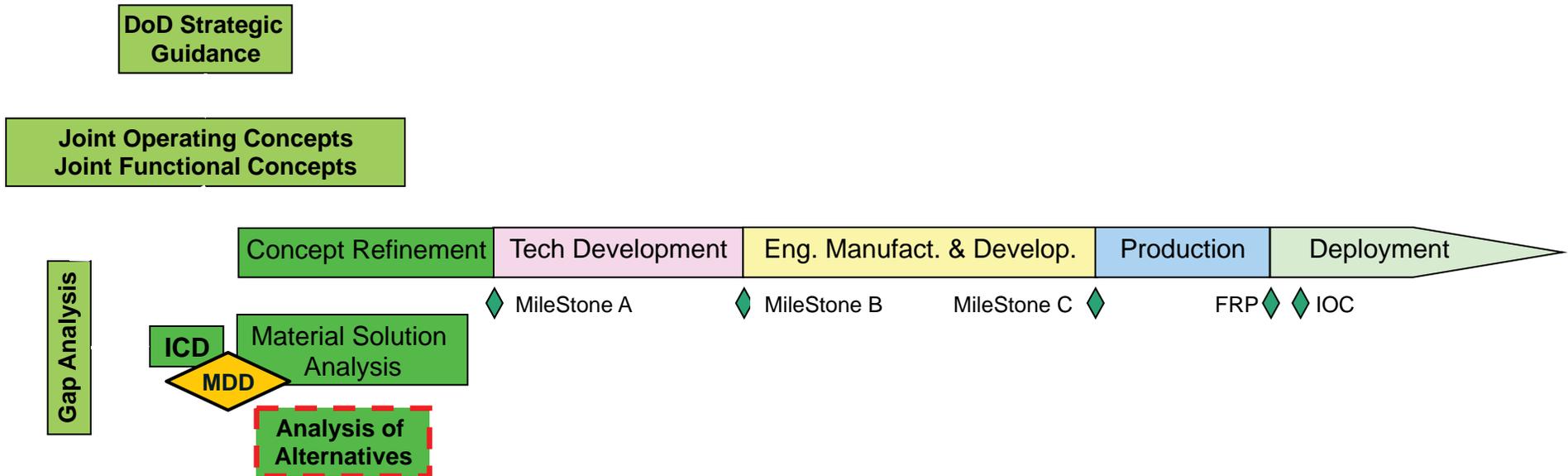
Length	0.00 in
Width	0.00 in
Height	0.00 in

Mass Data

Carl	42340 lb
Carl-2	43294 lb
Carl-3	44177 lb
GVW	39178 lb
GVW-2	37488 lb

Overall Vehicle Dimensions

Length	23.86 ft
Width	8.84 ft
Height	7.25 ft



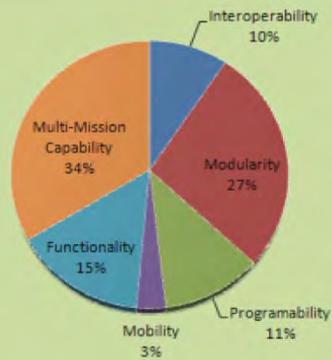
• GTRI IEWS Program Support

- ✓ IEWS Counter RC-IED Technology Discovery
- Pre-AoA planning
- Provide Subject Matter Expertise as necessary

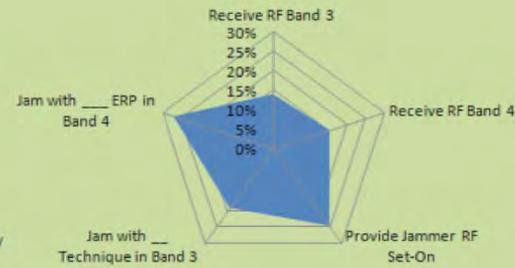
Capabilities



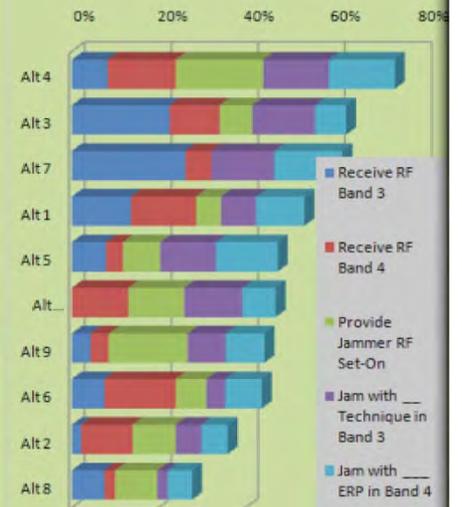
Georgia Tech Research Institute



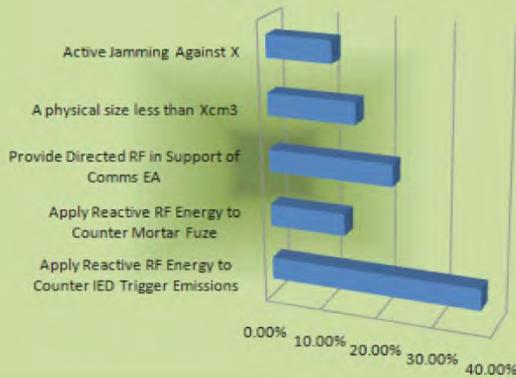
Functions



Alternative Scores



Requirements



Architecture

Antenna Type	Conformal	Directional	Omni-Directional		
# Receive Channels	1	2	3	4	5
# Transmit Channels	1	2	3	4	5
Transmitter	Solid State	Tube			
Transmit Power /	a	b	c	d	e
Technique	ERP	Software Defined Radio			

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See also our work
in RT21 and RT24 →

Model-Based Systems Engineering Using SysML

Excavator Testbed (2007-2009)

Abstract

This presentation highlights Phase 1 results from a modeling & simulation effort that integrates design and assessment using SysML. An excavator testbed illustrates interconnecting simulation models with associated diverse system models, design models, and manufacturing models. We then overview Phase 2 work-in-process including a mobile robotics testbed and associated SysML-driven operations demonstration.

The overall goal is to enable advanced model-based systems engineering (MBSE) in particular and model-based X (MBX) [1] in general. Our method employs SysML as the primary technology to achieve multi-level multi-fidelity interoperability, while at the same time leveraging conventional modeling & simulation tools including mechanical CAD, factory CAD, spreadsheets, math solvers, finite element analysis (FEA), discrete event solvers, and optimization tools.

This Part 1 presentation overviews the project context and several specific components. Part 2 focuses on manufacturing aspects including factory design, process planning, and throughput simulation.

This work is sponsored by several organizations including Lockheed and Deere and is part of the Modeling & Simulation Interoperability Team [2] in the INCOSE MBSE Challenge (with applications to mechatronics as an example domain).

[1] The X in MBX includes engineering (MBE), manufacturing (MBM), and potentially other scopes and contexts such as model-based enterprises (MBE).

[2] <http://www.pslm.gatech.edu/projects/incose-mbse-msi/>

Citations

- RS Peak, CJJ Paredis, LF McGinnis (2009-04) Model-Based SE Using SysML—Part 1: Integrating Design and Assessment M&S. NDIA M&S Committee Meeting, Arlington, Virginia.

- LF McGinnis (2009-04) Model-Based SE Using SysML—Part 2: Integrating Manufacturing Design and Simulation. NDIA M&S Committee Meeting, Arlington, Virginia.

- Main team web page:

- These publications:

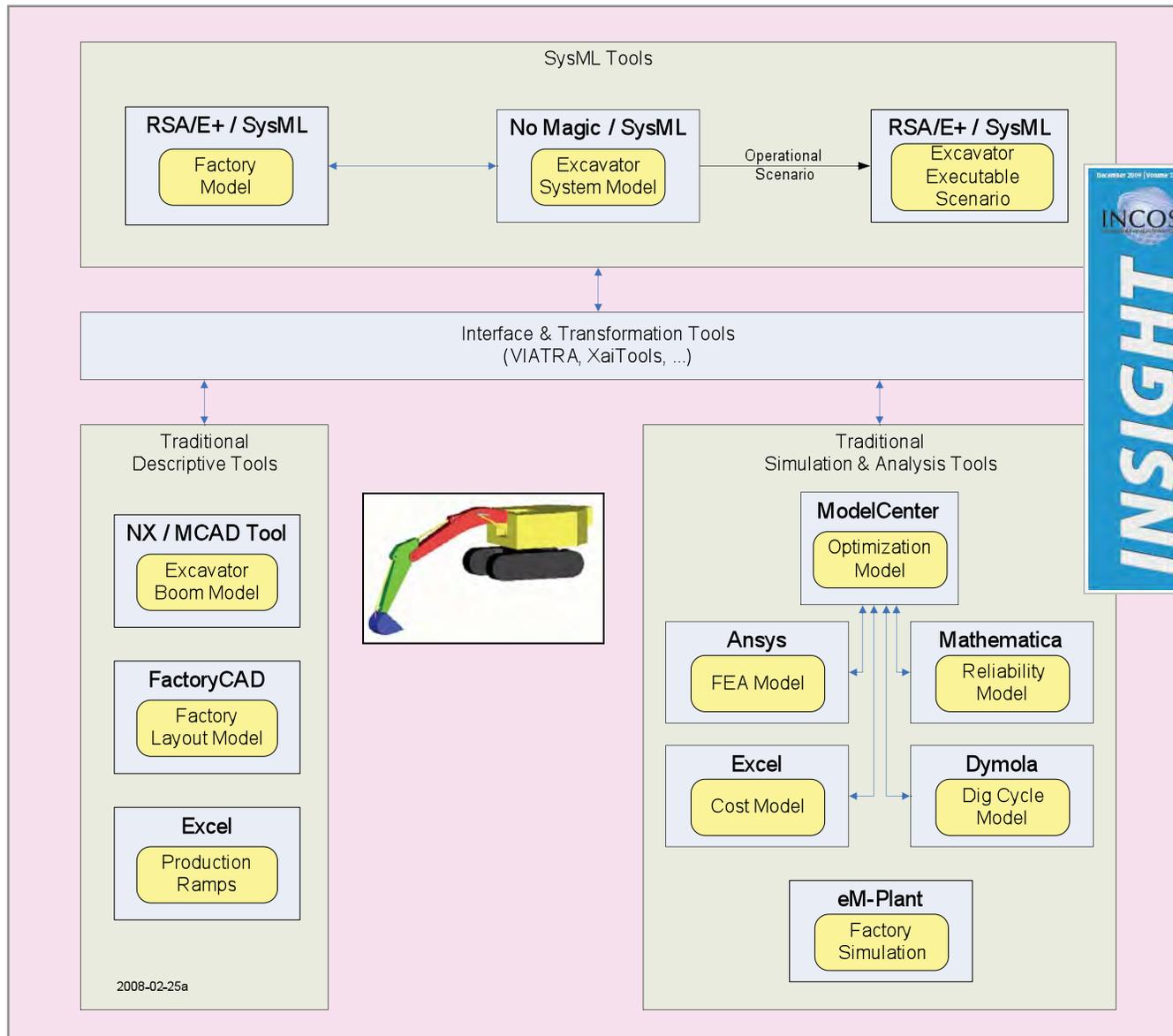
<http://www.pslm.gatech.edu/projects/incose-mbse-msi/> <http://eislab.gatech.edu/pubs/seminars-etc/2009-04-ndia-ms/>

Contact

Russell.Peak@gatech.edu, Georgia Institute of Technology, Atlanta, www.msl.gatech.edu

Excavator Modeling & Simulation Testbed

Tool Categories View



INSIGHT

December 2010 | Volume 12, Issue 4

A PUBLICATION OF THE INTERNATIONAL COUNCIL ON SYSTEMS ENGINEERING

What's Inside

SPECIAL FEATURE
Model-Based Systems Engineering:
The New Paradigm

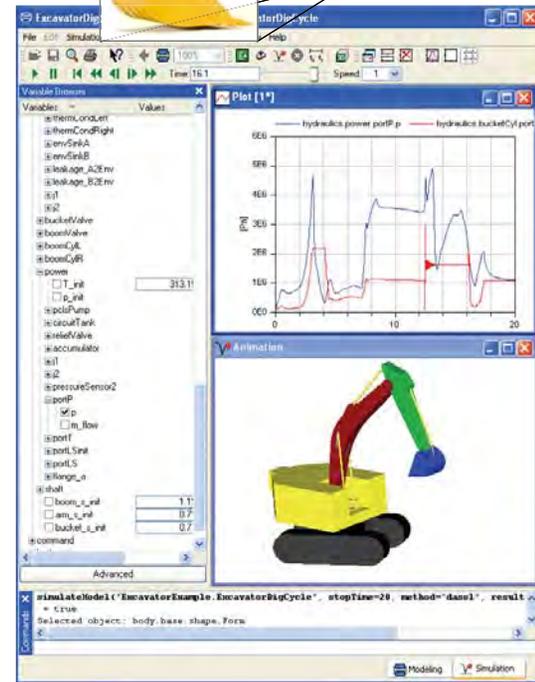
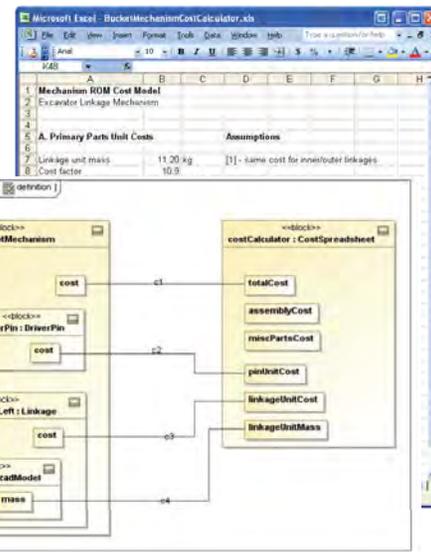
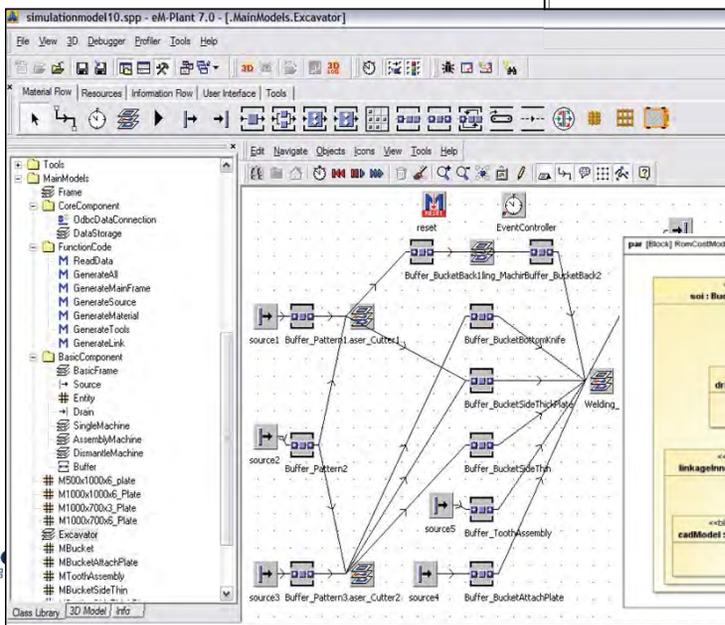
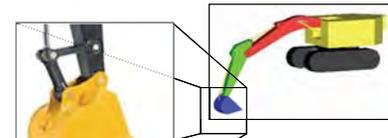
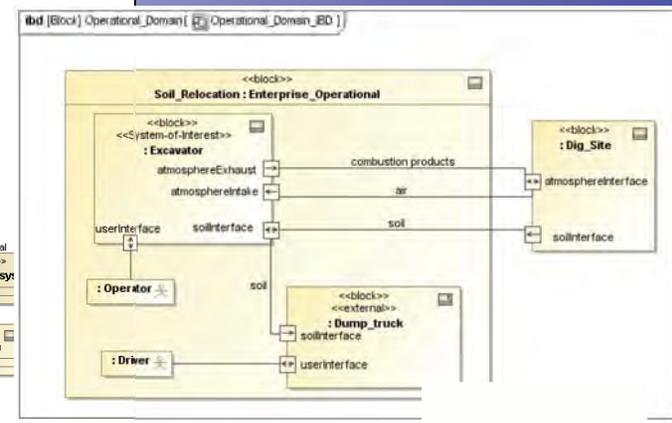
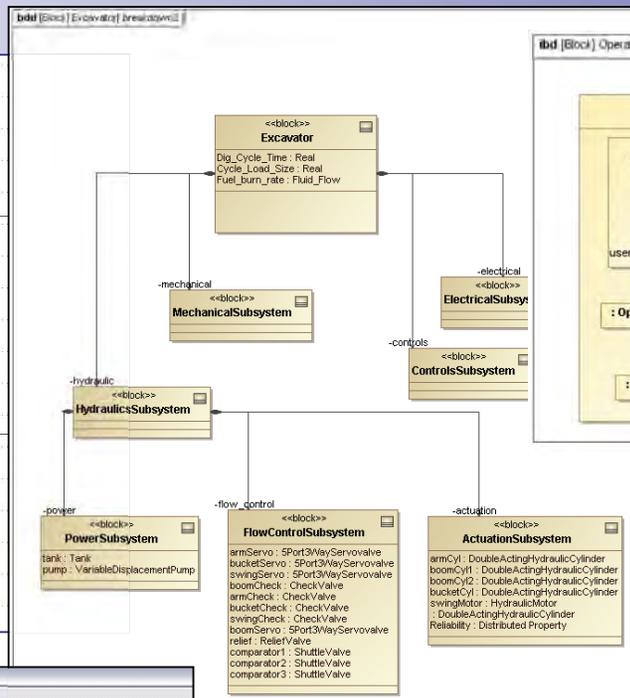
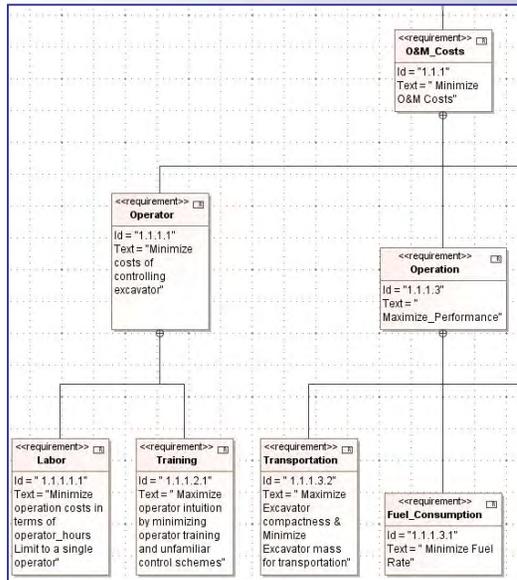
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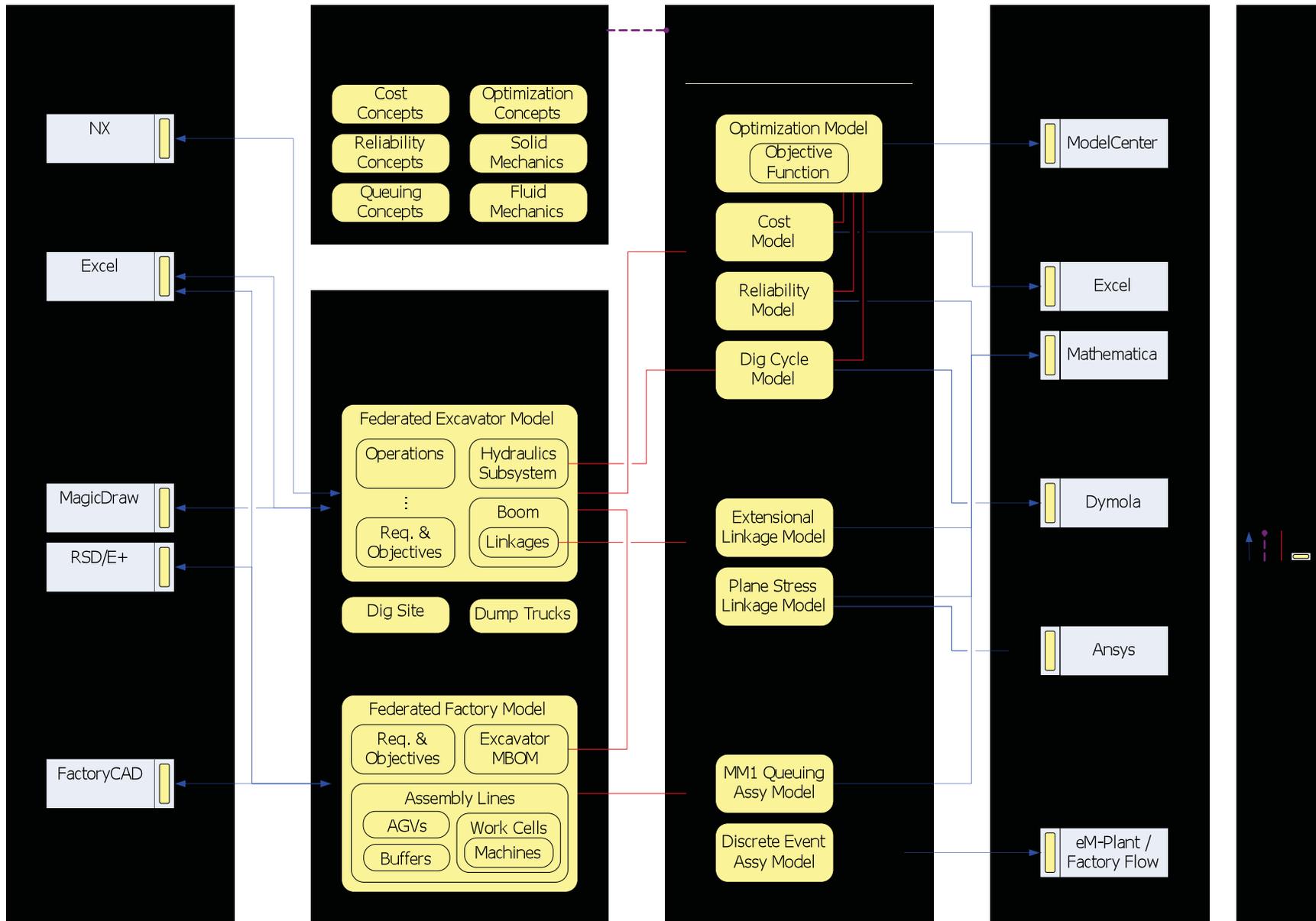
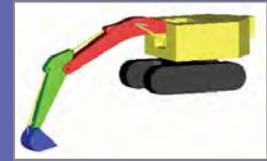
Excavator Modeling & Simulation Testbed

Sample Artifacts



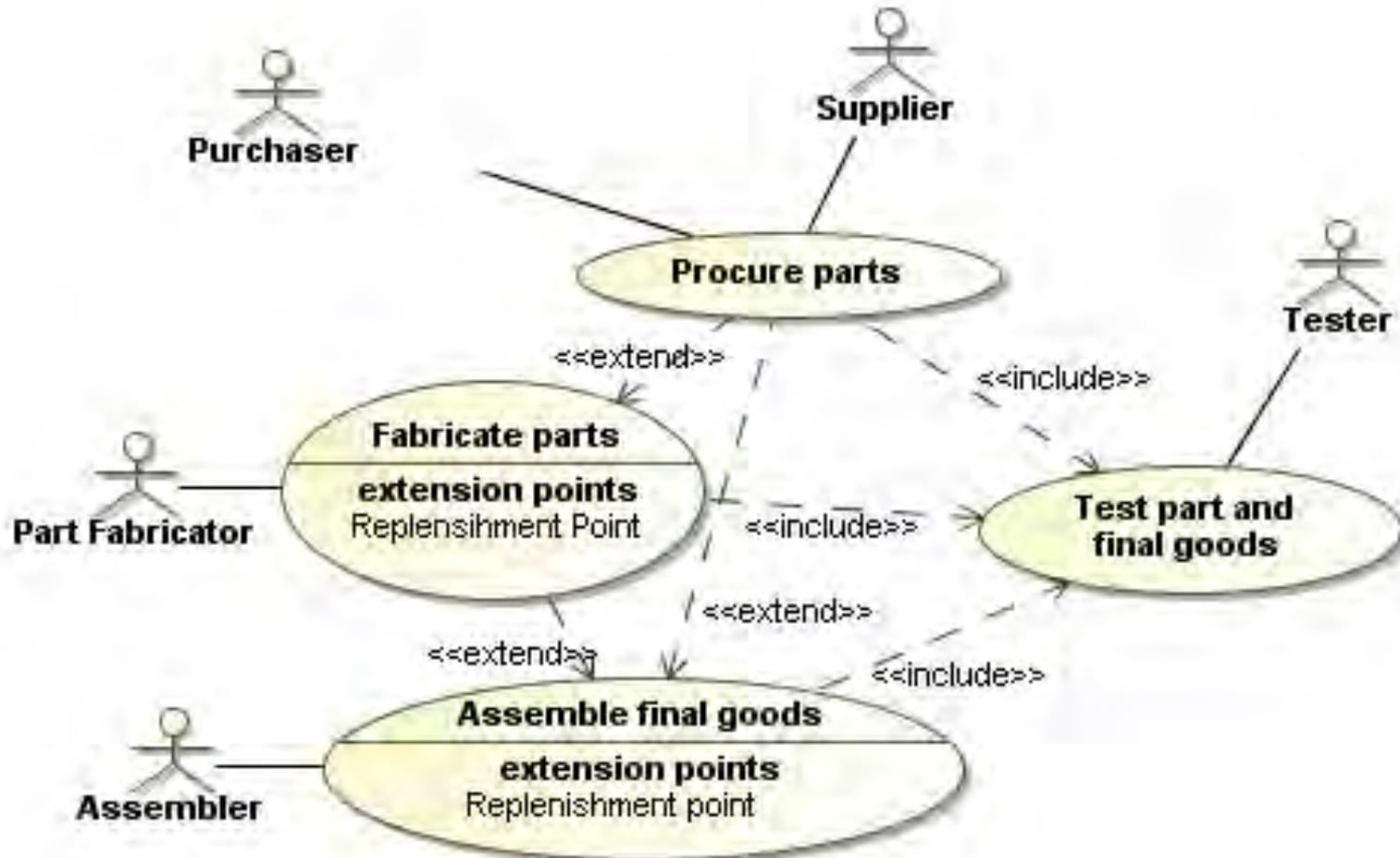
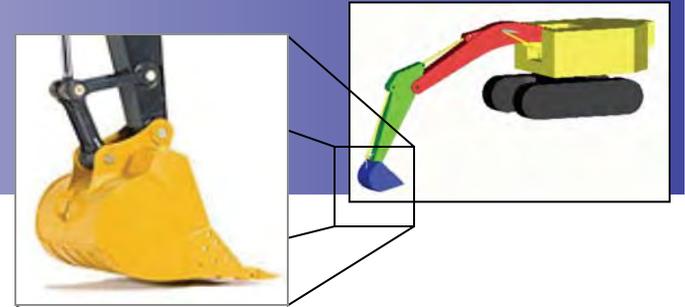
Excavator Modeling & Simulation Testbed

Interoperability Patterns View (MSI Panorama per MIM patterns)



Manufacturing Use Cases

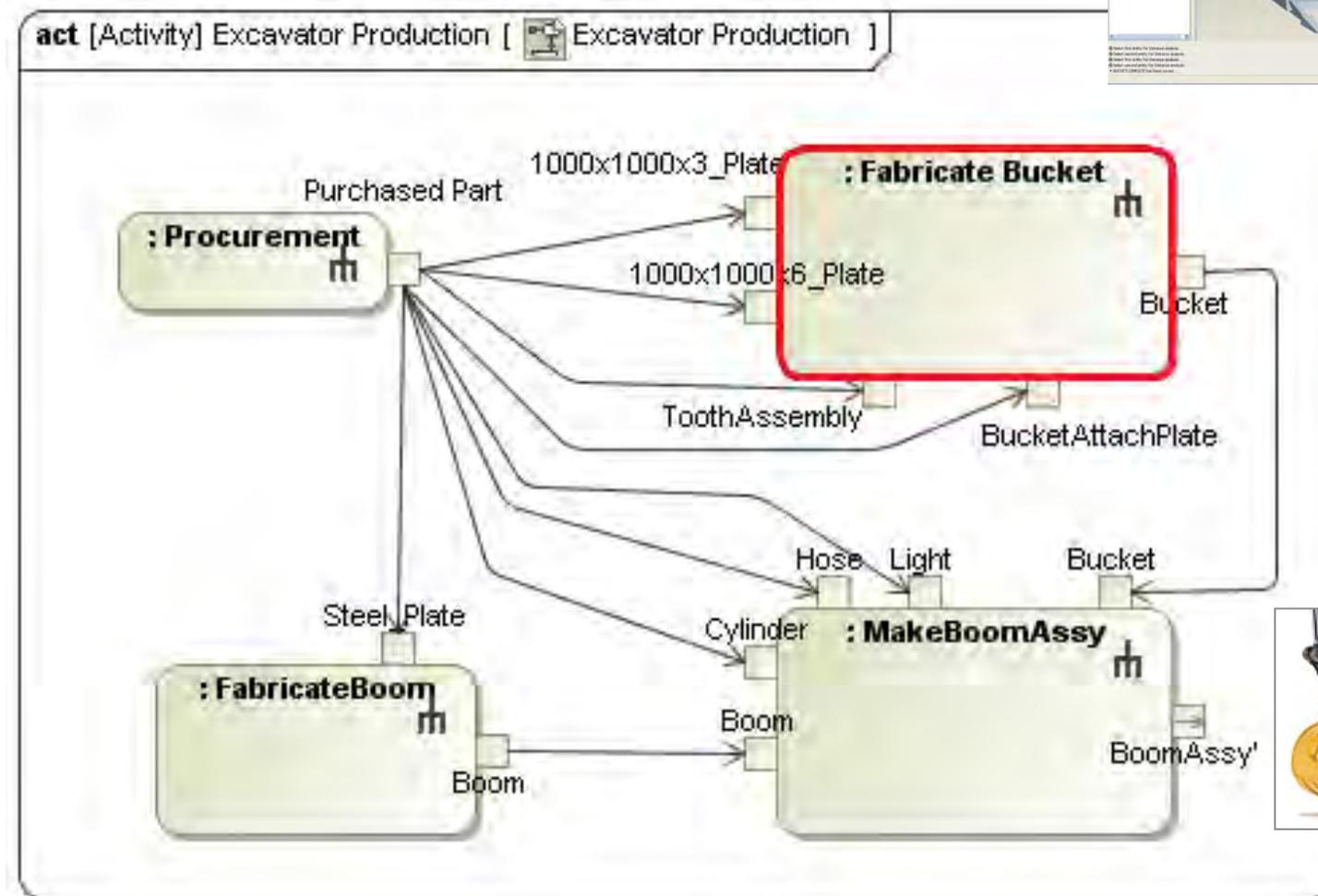
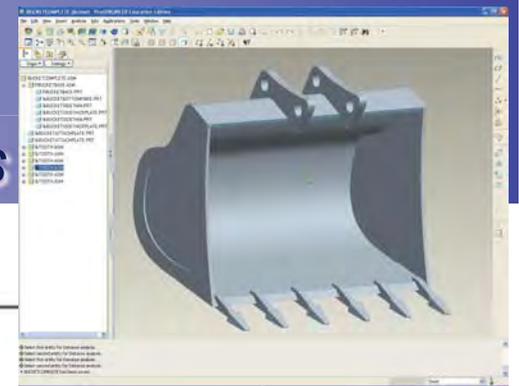
[McGinnis et al.]



Process Planning Model

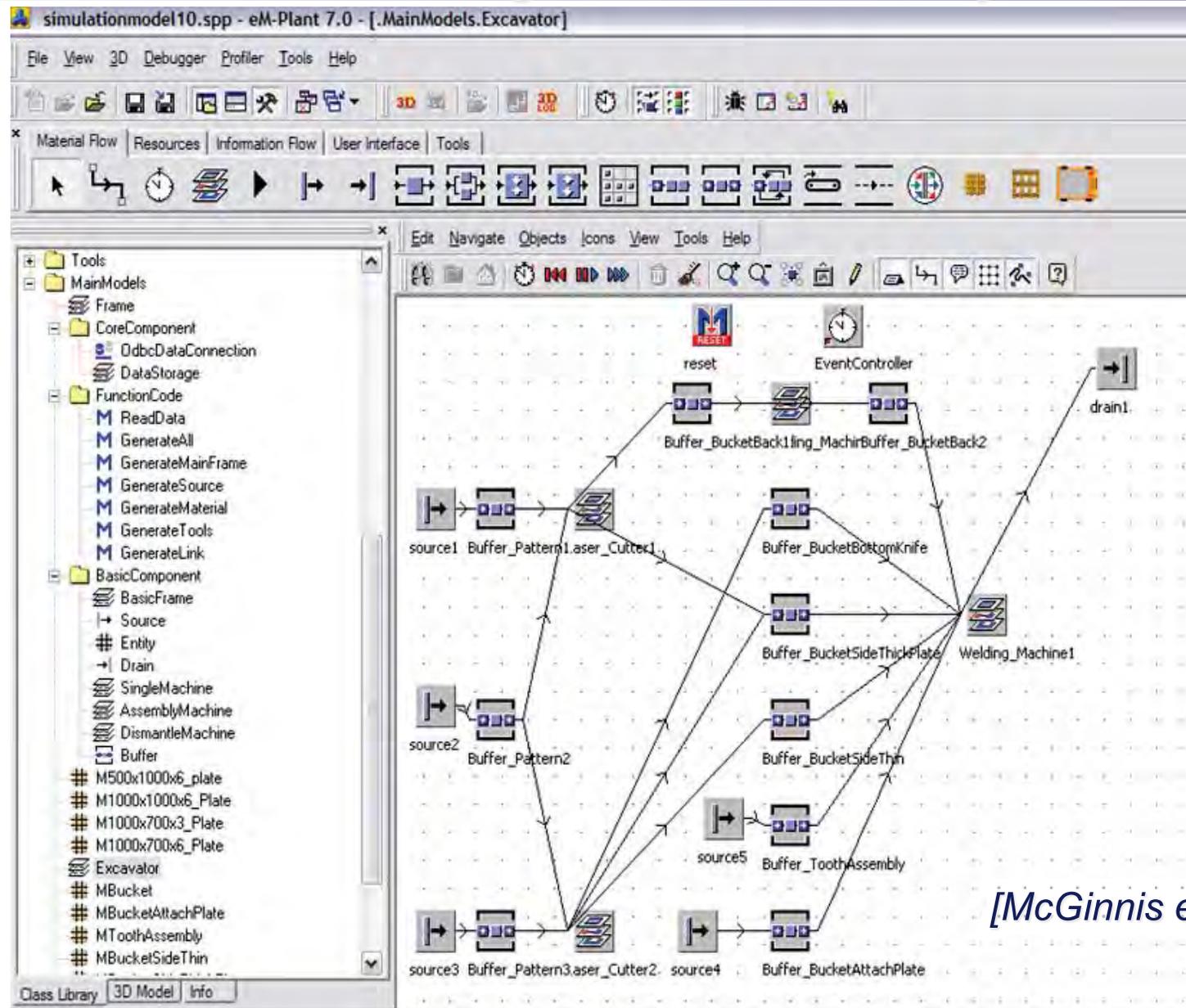
Functional modeling style using SysML activities

[McGinnis et al.]



eM-Plant Simulation

Discrete event model auto-generated from SysML



[McGinnis et al.]

Exploration of System Architectures

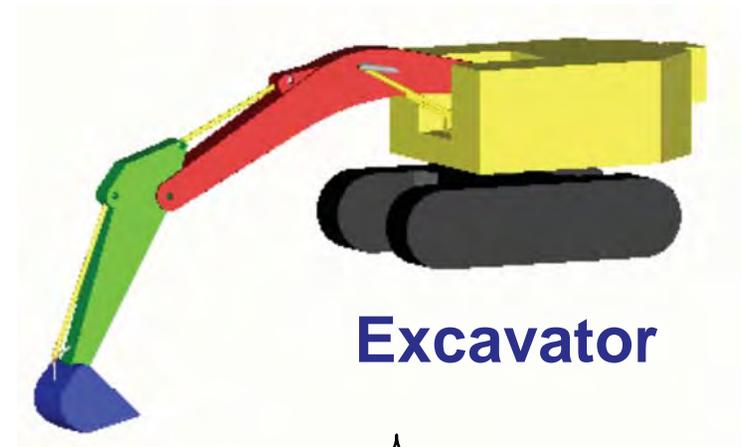
Problem Statement

Given:

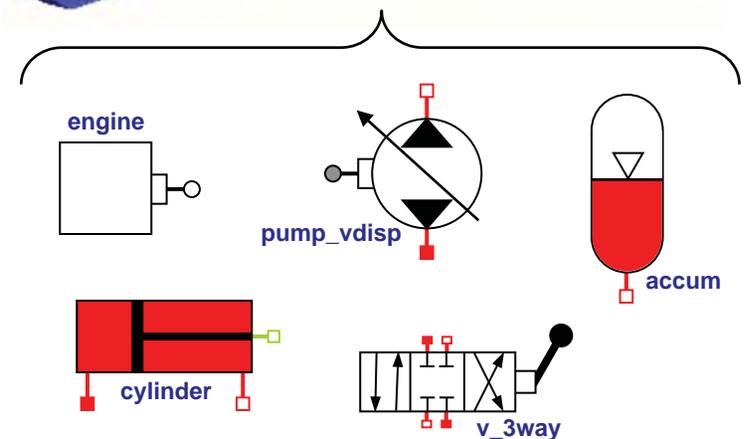
- Component models
- Objectives / preferences

Find:

- Best system architecture
- Best component parameters
- Best controller



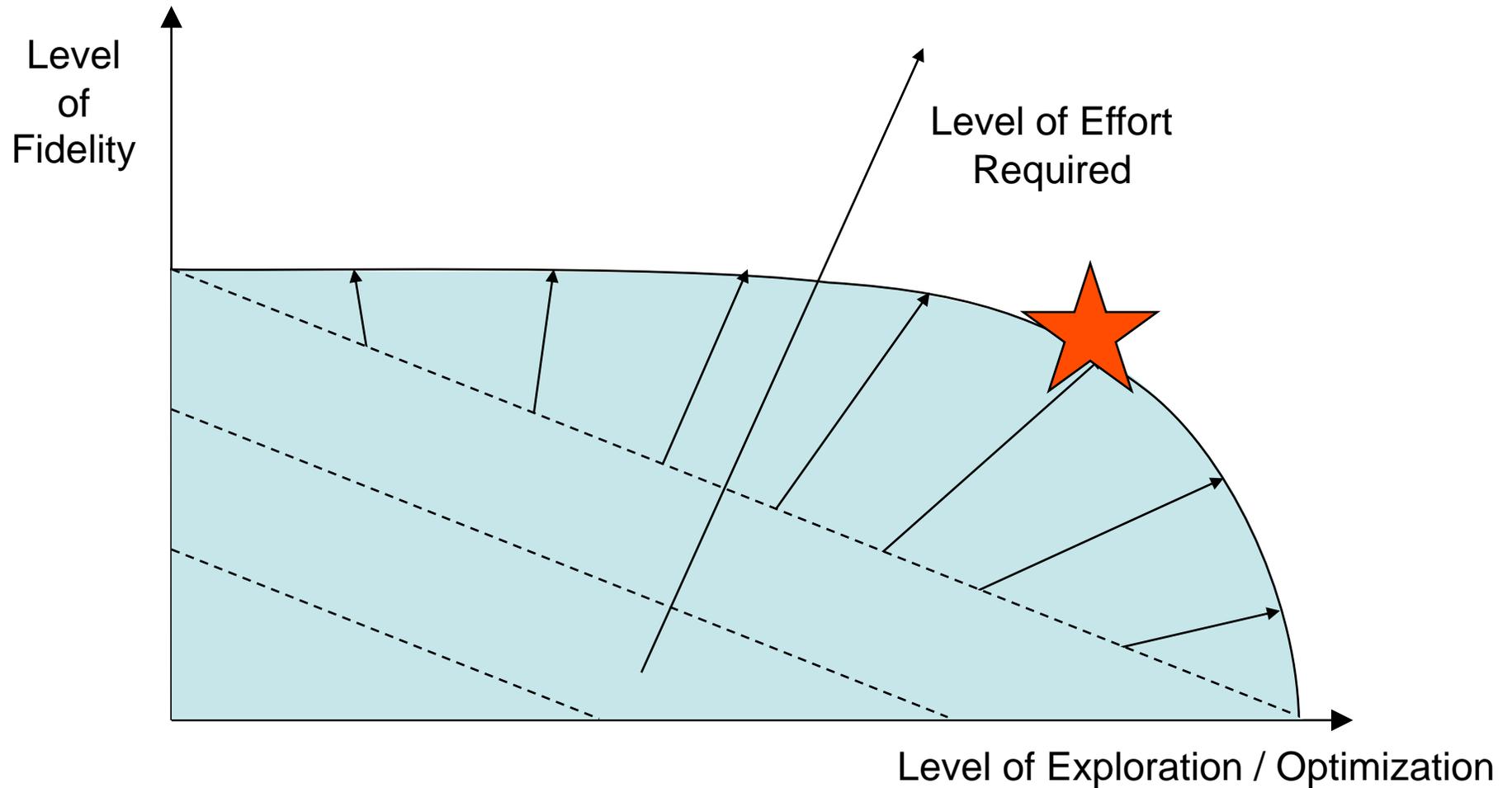
Excavator



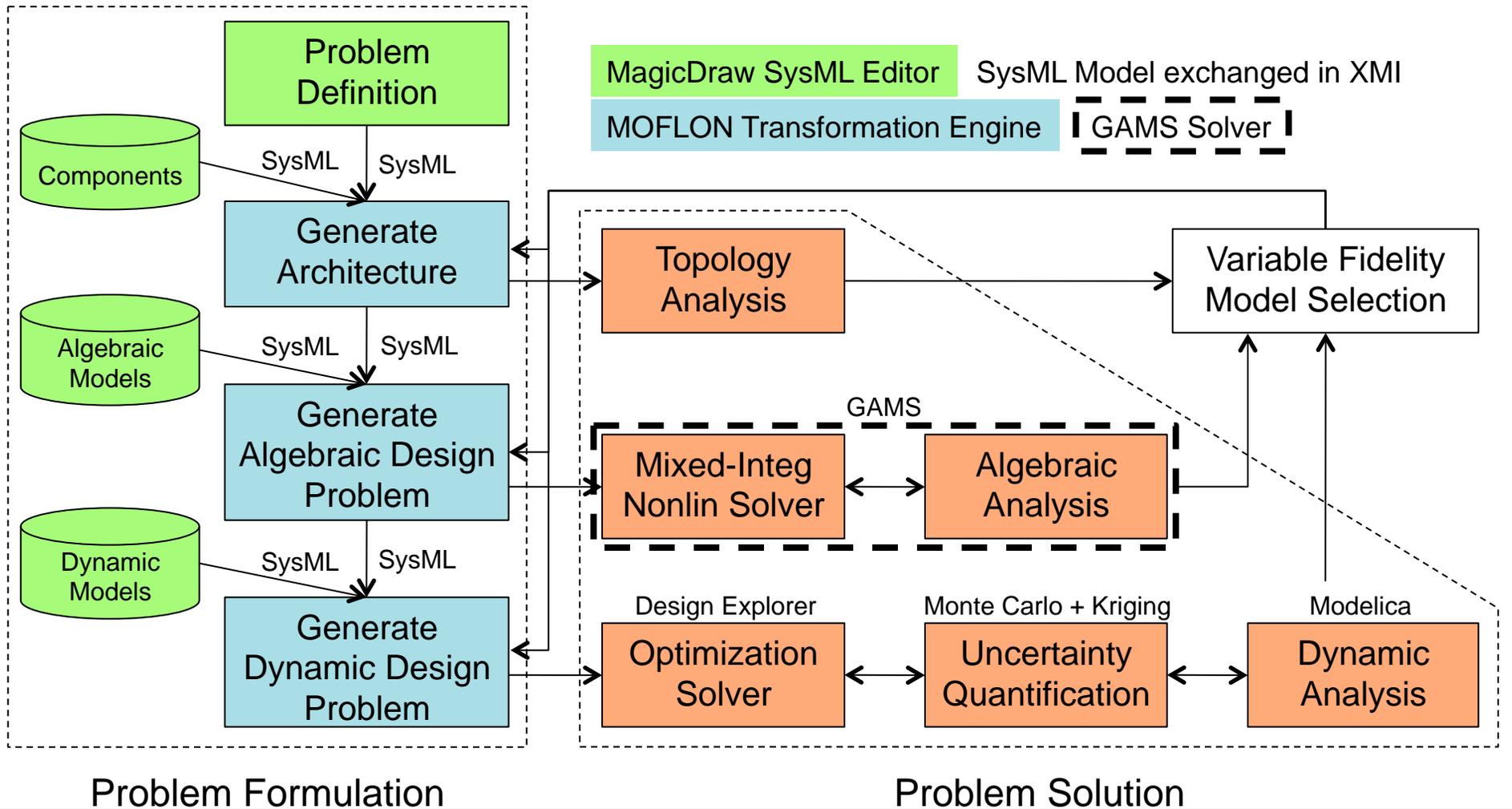
How to connect and size these?

Designer's Dilemma

M&S Risk/Benefit vs. Cost



Architecture Exploration Framework



Problem Formulation

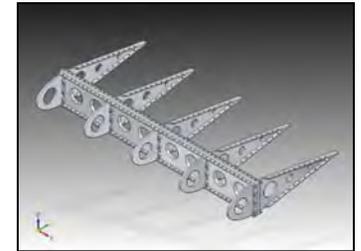
Problem Solution

Both Problem Formulation and Problem Solution phases are implemented in ModelCenter

SysML Parametrics

Peak et al.

- ◆ Road scanning system using unmanned aerial vehicle (UAVs)
- ◆ UAV-based missile interceptor system trade study
- ◆ Space systems (tutorials): orbit planning; mass/cost roll-ups
- ◆ Space systems (studies/pilots): FireSat (INCOSE SSWG), ...
- ◆ Space systems (actuals): science merit function, ...
- ◆ Environmentally-conscious energy systems / smart grid
- ◆ Manufacturing “green-ness” / sustainability assessments
- ◆ Regional water management systems (e.g. South Florida)
- ...
- ◆ Mechanical part design and analysis (FEA)
- ...
- ➔ ◆ Wind turbine supply chain management
- ◆ Insurance claims processing and website capacity model
- ◆ Financial model for small businesses
- ◆ Banking service levels model
- ...

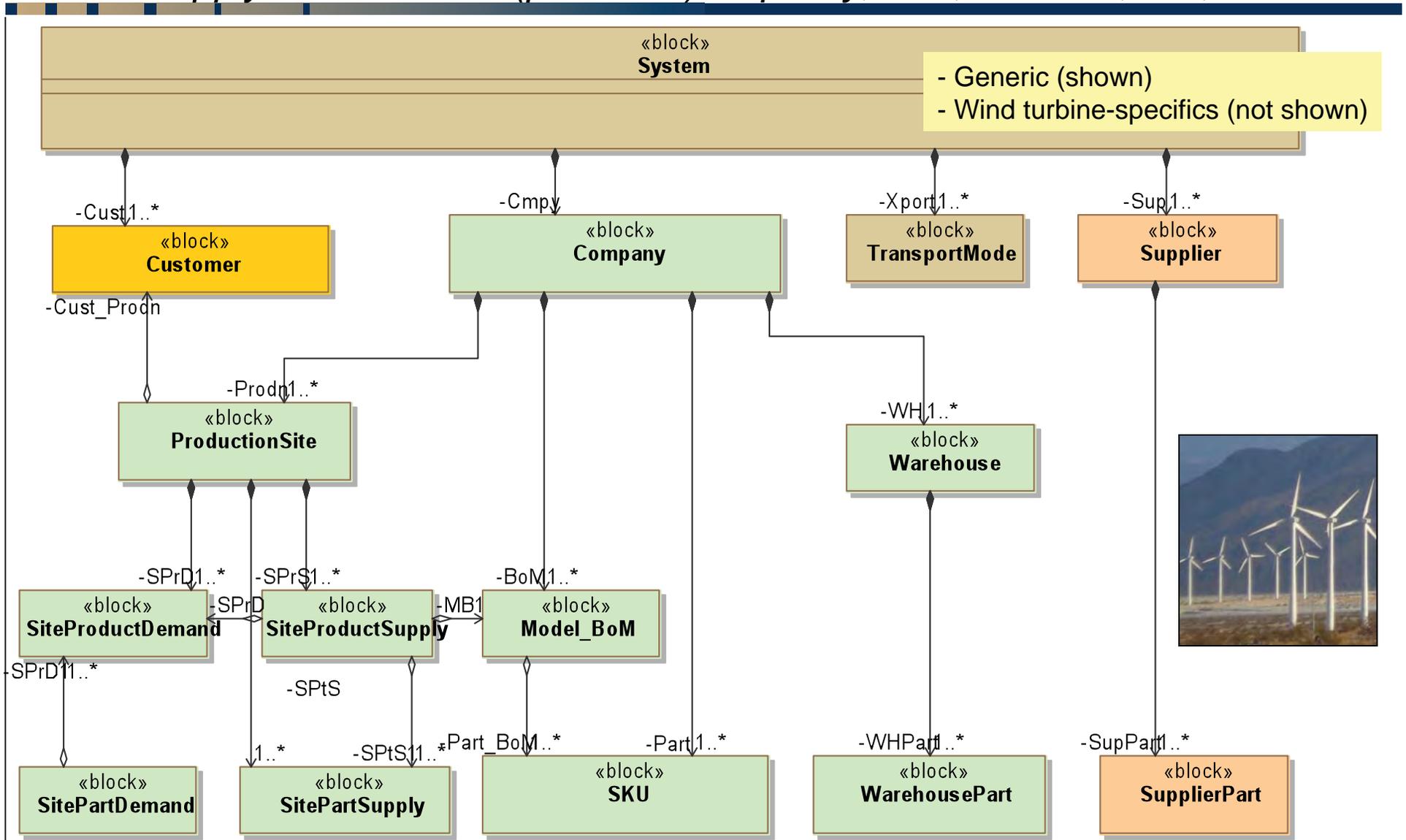


*Next-Generation
Spreadsheet Technology++
(object-oriented, multi-dimensional, ...)*



SysML Model: Global Supply Chain Mgt. & Optimization

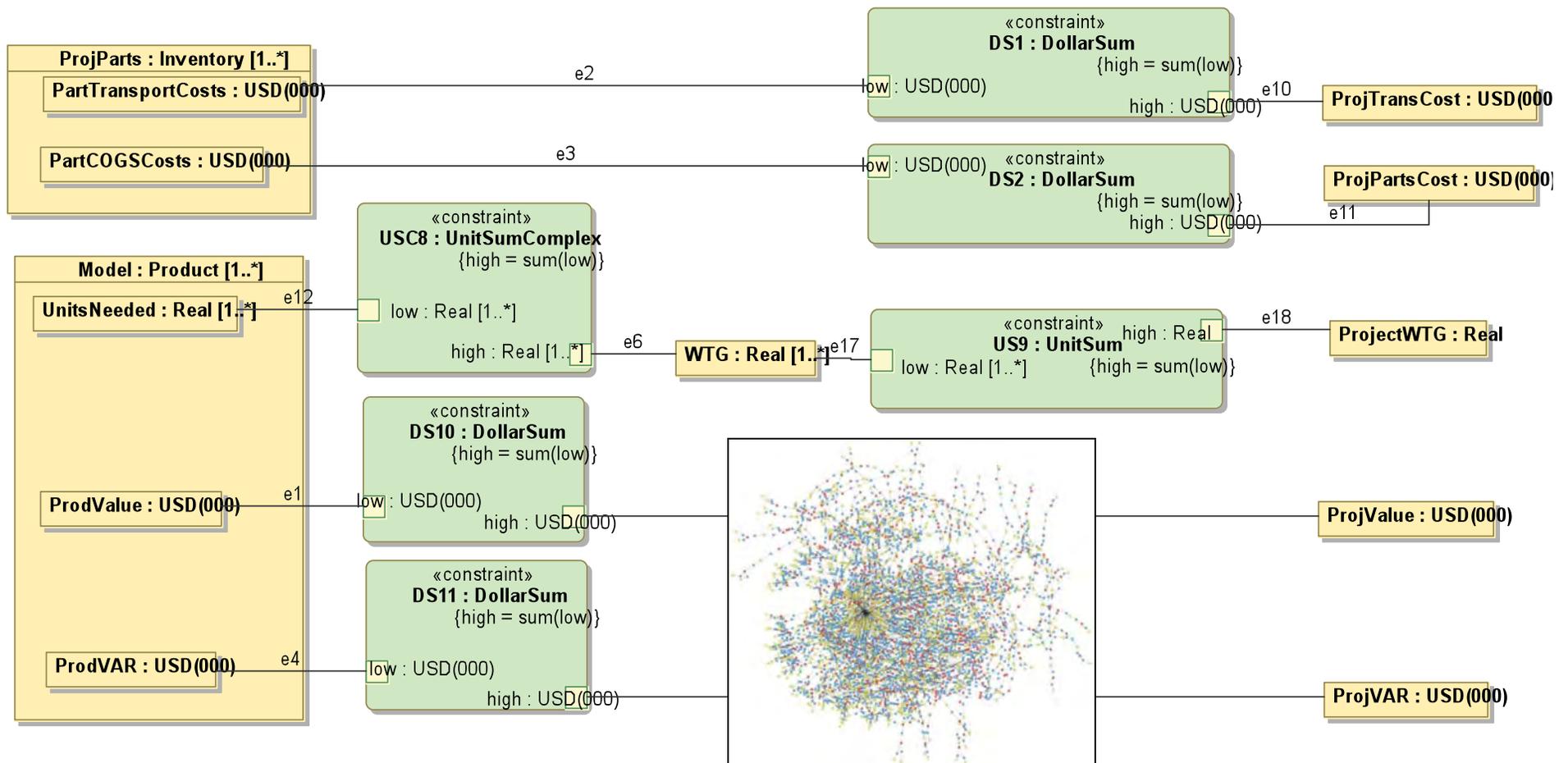
supply chain metrics (per-week): capacity, cost, lateness, risk, ...



Supply Chain Model – SysML Parametrics

Connect to Optimization Models, Compute Value-at-Risk

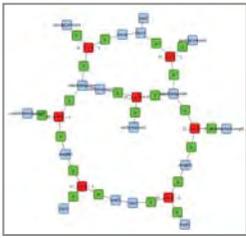
Ex. Given 100's of product orders and sourcing plans for the next 12 months, what percent of my business is at-risk if Supplier X does not deliver, or if Part Y becomes obsolete?



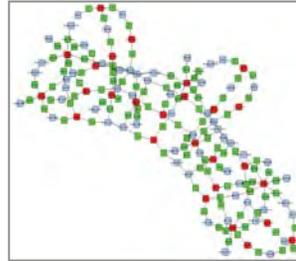
Model “DNA Signatures” Using SysML Parametrics

Panorama Tool by Andy Scott (Undergrad Research Asst.) and Russell Peak (Director, Modeling & Simulation Lab)
Examples as of ~9/2009 — Low/Medium Complexity

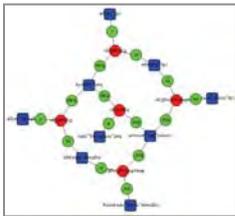
a. Snowman



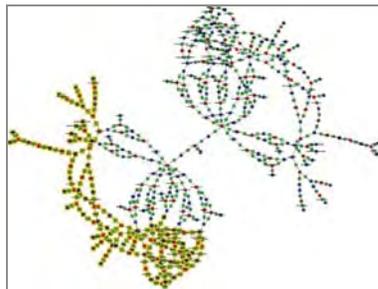
e. Cactus



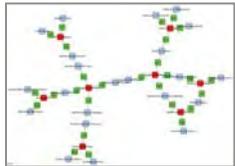
b. Mini Snowman



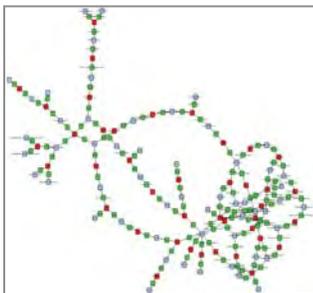
f. ?



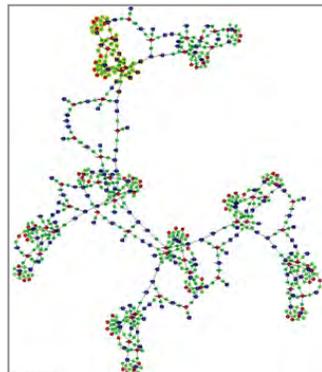
c. Snowflake



d. Mouse



g. Robot



Test: Match the actual model titles (below) to their “DNA signatures” with imagined titles (left).

___ **g** ___ 1. South Florida water mgt. (hydrology) model

___ **a** ___ 2. 2-spring physics model

___ **e** ___ 3. 3-year company financial model

___ **c** ___ 4. UAV road scanning system model

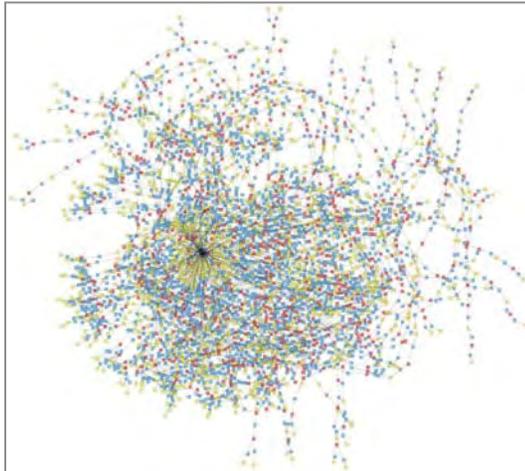
___ **b** ___ 5. Car gas mileage model

___ **d** ___ 6. Airframe mechanical part model

___ **f** ___ 7. Design verification model
(automated test for two Item 6. designs)

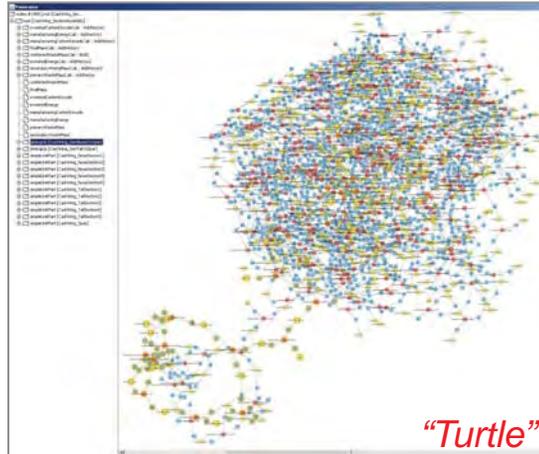
Recent Models: ~Medium Complexity

supply chain metrics



"Galaxy with Black Hole"

mfg. sustainability: airframe wing



"Turtle"

electronics recycling network



"Tumbleweed"

mfg. sustainability: automotive transmissions



"Turtle Bird"



"Angler Fish"

SysML/MBSE Curriculum & Formats

Statistics as of Sept 2010 — www.pslm.gatech.edu/courses

- ◆ Full-semester Georgia Tech academic courses
 - ISYE / ME 8813 & 4803: Since Fall 2007 (~95 students total)
- ◆ Industry short courses
 - Collaborative development & delivery with InterCAX LLC
 - Multiple [offerings,~students] and formats since Aug 2008
 - » SysML 101 [14,~260]; SysML 102 (hands-on) [12,~205]
 - Modes:
 - » Onsite at industry/government locations
 - » Open enrollment via Georgia Tech (Atlanta, DC, Orlando, Vegas, ...)
 - » Web-based “live” since Apr 2010
 - Coming soon: 201/202, 301/302 (int/adv concepts, OCSMP prep, ...)
- ◆ Georgia Tech Professional Masters academic courses
 - Professional Masters in Applied Systems Engineering
www.pmase.gatech.edu
 - ASE 6005 SysML-based MBSE course - Summer 2010
 - ASE 6006 SE Lab (SysML-based system design project) - Fall 2010

Contents

- Introduction
- Selected SE-related efforts
 - Professional Masters in SE (PMASE)
Bishop, et al.
 - Tennenbaum Institute (TI)
Bodner, Rouse, et al.
 - GTRI SE Initiative
Ender, et al.
 - Aerospace Systems Design Lab (ASDL)
Mavris, et al.
 - Model-Based SE Center (MBSEC)
McGinnis, Paredis, Peak, et al.

*See also our work
in RT16 and RT25*

*See also our work
in RT21 and RT24*

- ➔ • Summary

Georgia Tech as part of SERC



- Pleased with collaboration in SERC to date
- Looking forward to new opportunities in SERC together

