

Models as a Foundation for Systems Engineering – Should We Expect a Breakthrough?

Brett Malone
Vitech Corporation
bmalone@vitechcorp.com

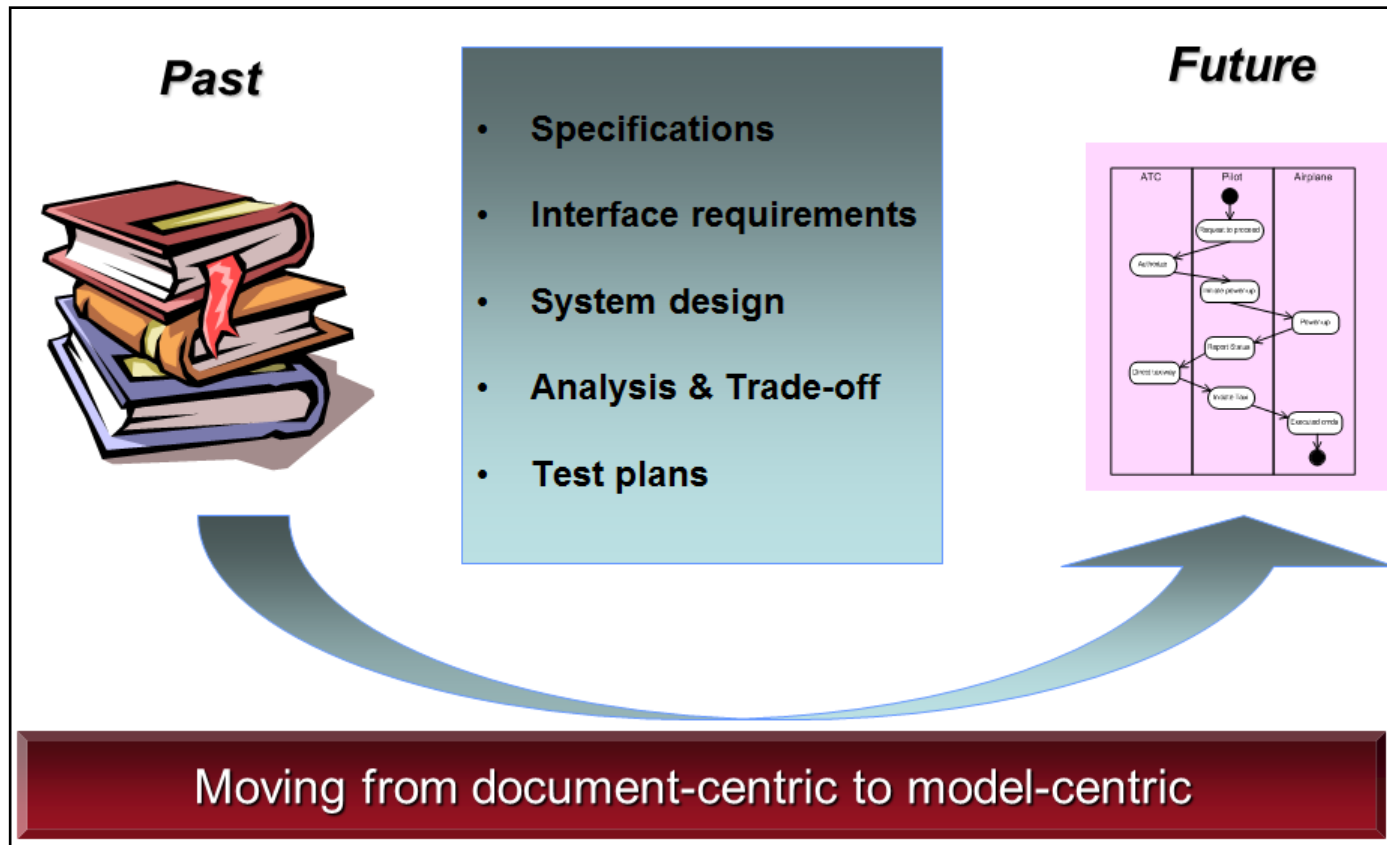
The Transition to Models?

Enablers

Inhibitors

Opportunities

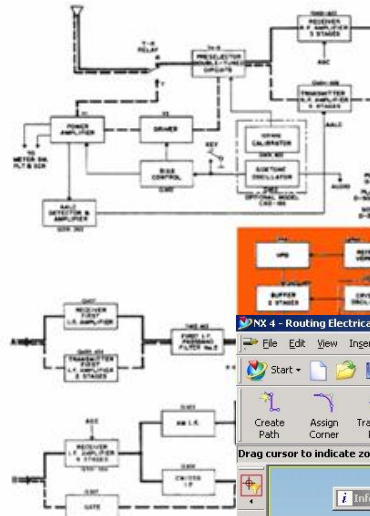
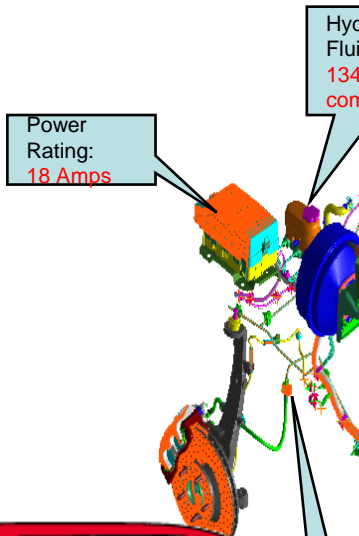
Threats



Building a Community

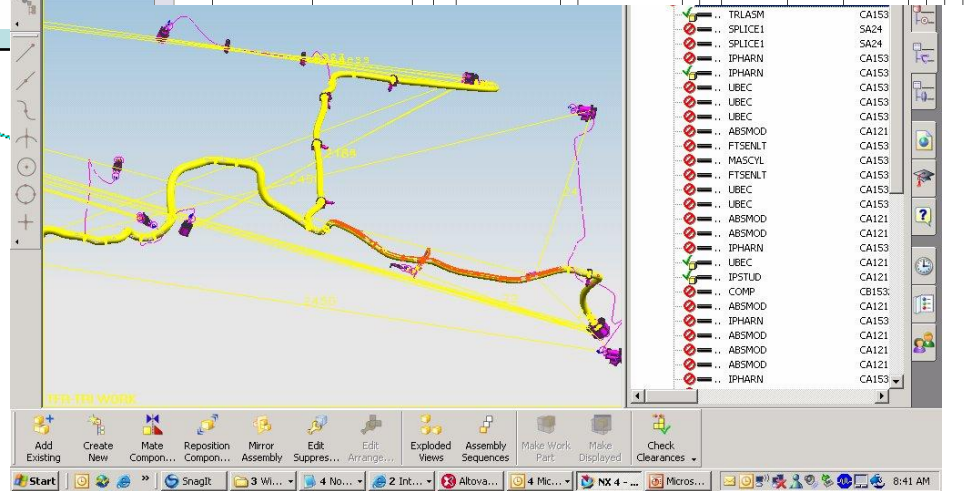


Casting an Initial Vision



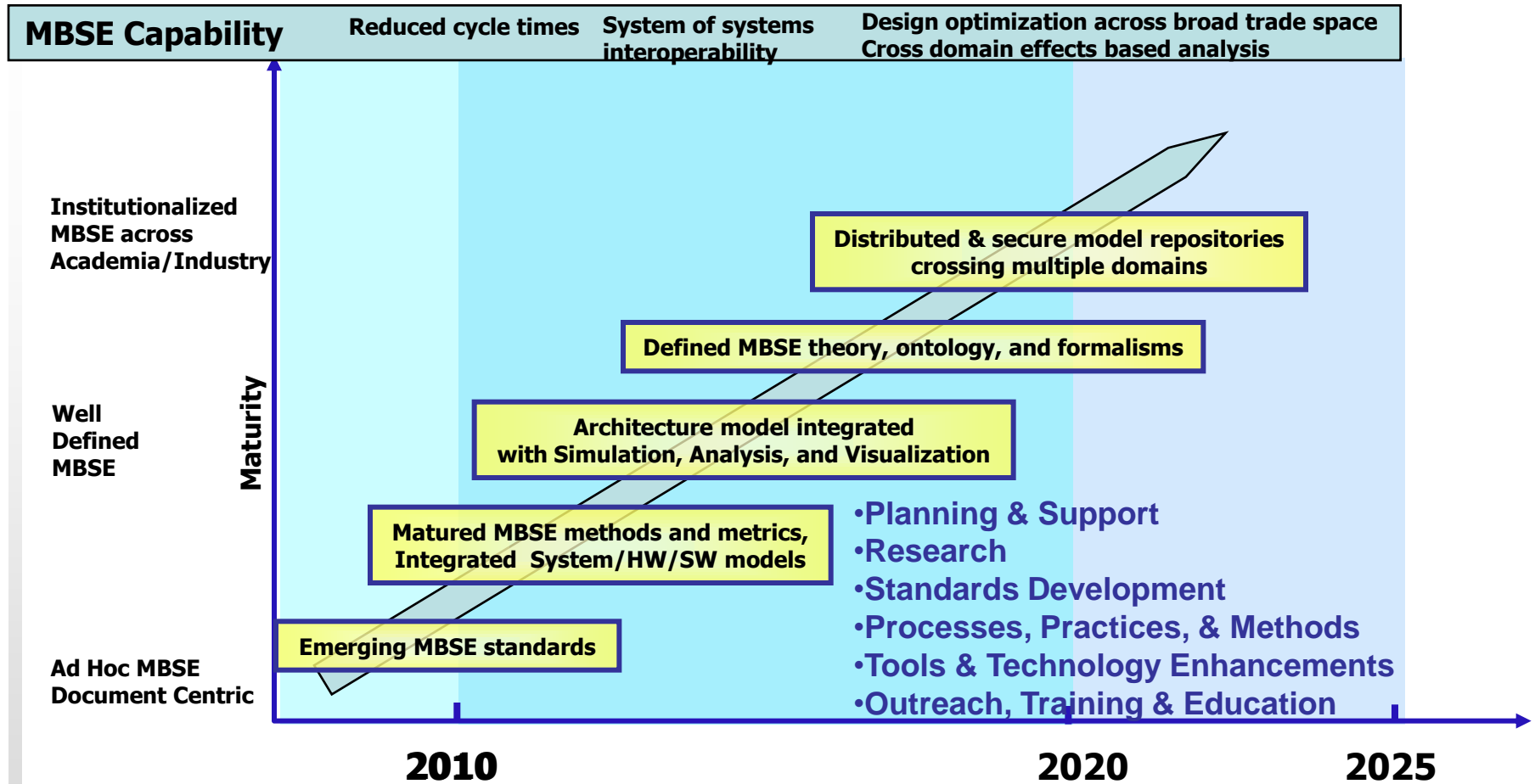
FAILURE MODE AND EFFECTS ANALYSIS (DESIGN FMEA)																	
Rev.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
2	Print #	01.03 Body															
3	System/Subsystem/Component		SubSystem														
4	Model Year(s)/Vehicle(s)																
5	Team:	T. Fender, Car Prod. Dev., Childers- Man., J. Ford-Assembly Opps															
6	Design Responsibility	Body Engineering															
7	Key Date	9/3/04															
8	Prepared by:	J. Ford-Assembly Opps															
9	Date (Orig.)	8/3/04															
10	Date (Rev.)	8/22/04															

Rev	Item/Function	Potential Failure Mode	Potential Effect(s) of Failure	S	I	C	O	D	R	Recommended Actions	Responsibility	Action Results
11	17	Front Door LH	Corroded interior lower door panels	Undesirable appearance due to rust	5	None	2	6	80	Add laboratory accelerated	A. Take-Body Eng 8/9/04	Based on test results upper
12	18						4	8	160	Add laboratory	Combine w/test for	Test results (Test No. 1481)
13	19						2	2	20	None		3
14	20						5	8	200	Add team evaluation using	Body Eng. & Assembly	7
15	21						3	1	15	None		7
16	22						5	100		Body Eng. & Assembly	Evaluation showed	7
17	23	Front Door RH	Corroded interior lower door panels	Undesirable appearance due to rust	4	None	5	8	160	Add laboratory accelerated	A. Take-Body Eng 8/9/04	Based on test results upper
18	24						4	3	45	Add laboratory	Combine w/test for	Test results (Test No. 1481)
19	25						2	2	15	None		7
20	26						5	100		Body Eng. & Assembly	Evaluation showed	7
21	27						3	1	12	None		7
22	28						6	4	96	Add team evaluation using	Body Eng. & Assembly	Based on test, 3 additional vert Evaluation showed



Minimum Turn Radius: 24 ft.
 Dry Pavement Braking Distance at 60 MPH: ~~110~~ ft. 90 ft

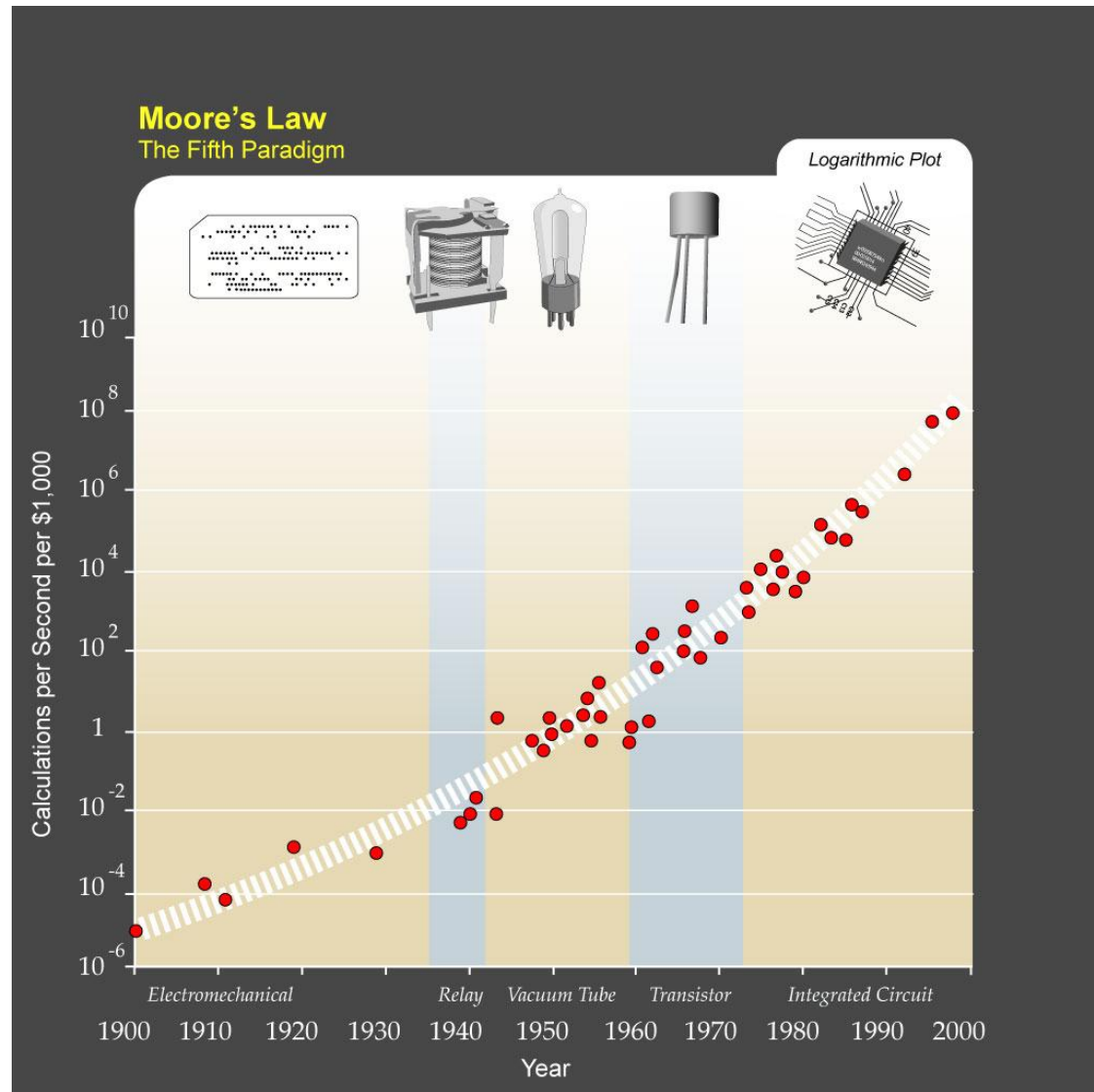
INCOSE MBSE Roadmap



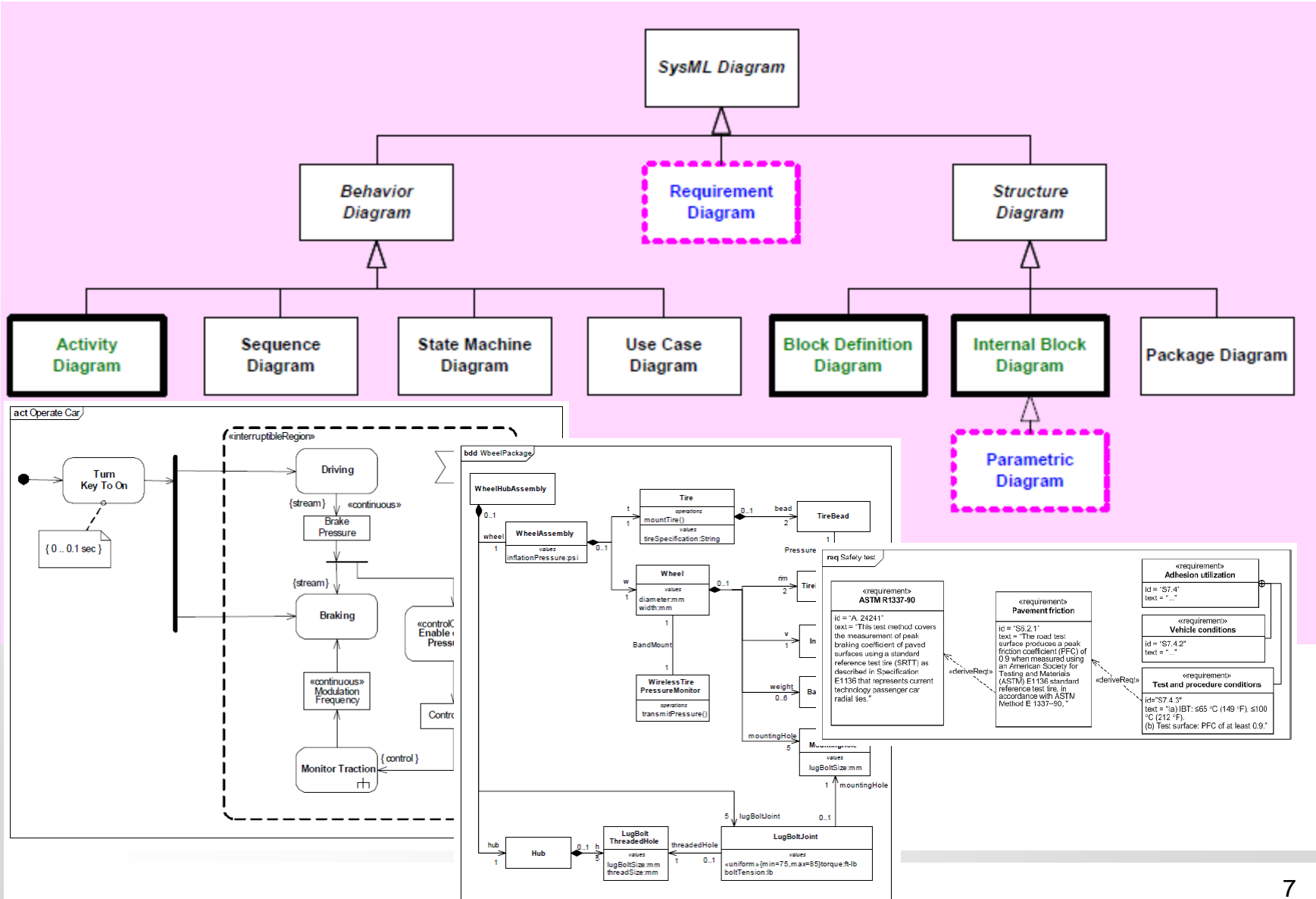
Reprinted from INCOSE MBSE Workshop, February 2010

Advancing Technology

- Computing power
- Cloud computing
- Database technologies
- Reasoning engines
- ...



The Development of SysML



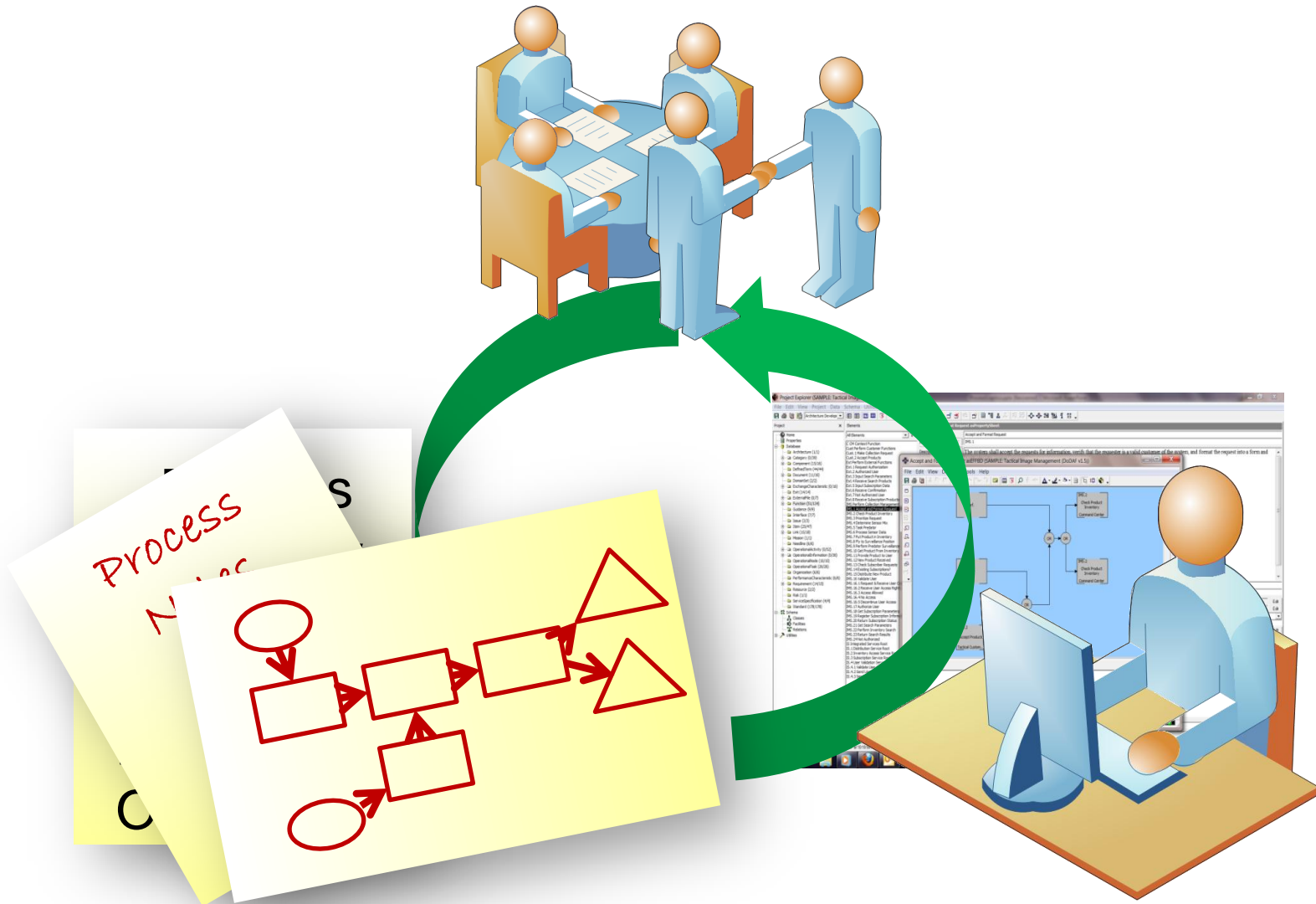
SysML as an Enabler

- A visual modeling language with semantics and standard notation
- Communication alignment with software domain

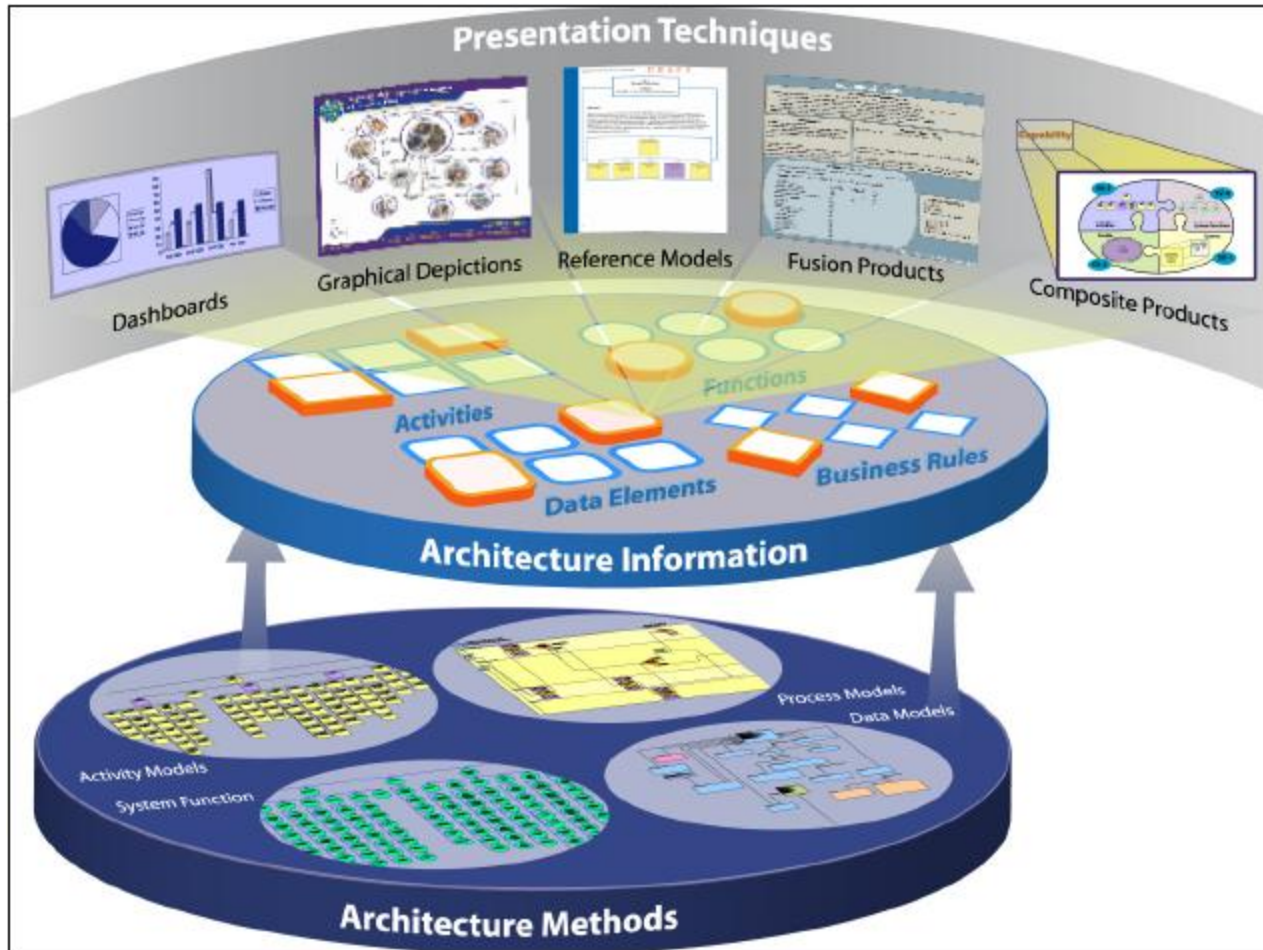
SysML as a Threat

- MBSE \neq SysML
- Complexity of representation
- Rate of incorrect implementation (SysML treated as a series of diagrams)
- “SysML as a universal and complete representation”

Communication Mismatch: Manager, Architect, and Domain Experts

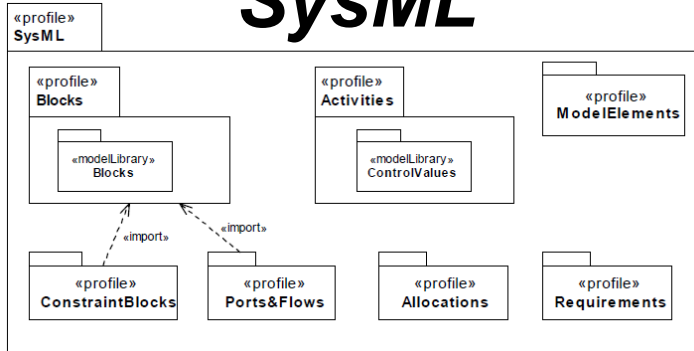


Communication Mismatch: Enabling Communication in the SME's Language

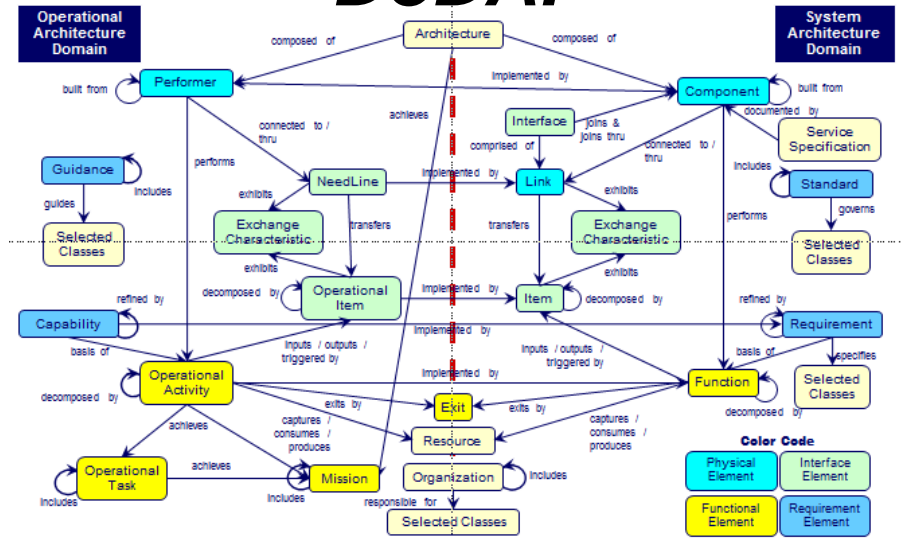


Models and Languages

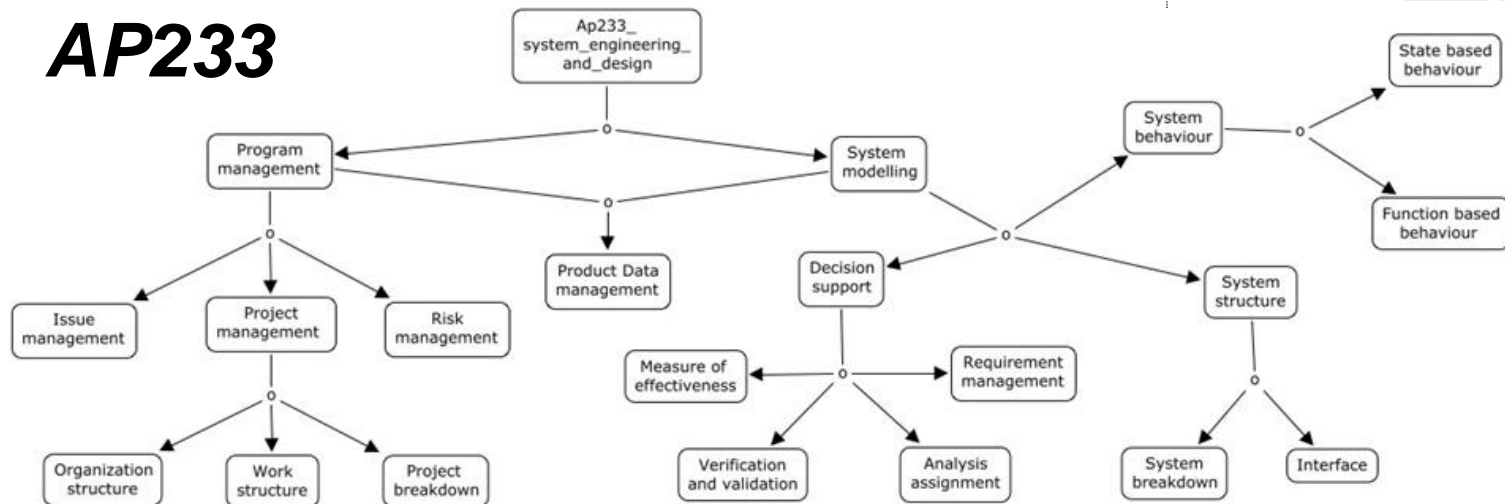
SysML



DoDAF



AP233



Evolution of Frameworks and Standards

Process Standards

Representations and Interchange

AP233

GEIA STANDARD
 Processes for Engineering and Information Technology
 EIA-632 (Upgrade and Revision of EIA-649)
 JANUARY 1999
 GOVERNMENT ELECTRONICS INFORMATION TECHNOLOGY

INTERNATIONAL STANDARD ISO/IEC 26702
 IEEE Std 1220-2005
 Carnegie Mellon Software Engineering Institute
CMMI[®] for Development, Version 1.2
 CMMI-DEV, V1.2
 CMU/SEI-2006-TR-008 ESC-TR-2006-008
 Improving processes for better products
 CMMI Product Team
 August 2006

INTERNATIONAL STANDARD ISO/IEC 15288
 Systems and software engineering — System life cycle processes
 Ingénierie des systèmes et du logiciel — Processus du cycle de vie du système

OMG Systems Modeling Language (SysML)
 Unified Profile for the Department of Defense Architecture Framework (DoDAF) Ministry of Defence Architecture Framework (MoDAF)
 FTF Data
 Standard Document Number: formal/2007-12-01
 Standard document URL: <http://www.omg.org/spec/XMI/2.1/PDF>
 Associated Schema file: <http://www.omg.org/spec/XMI/20071001.html>
 Original file: psc07-10-06



Frameworks

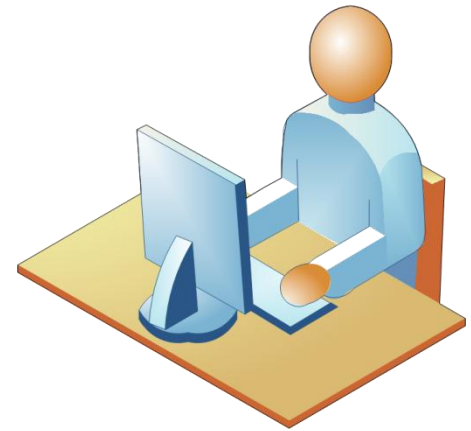
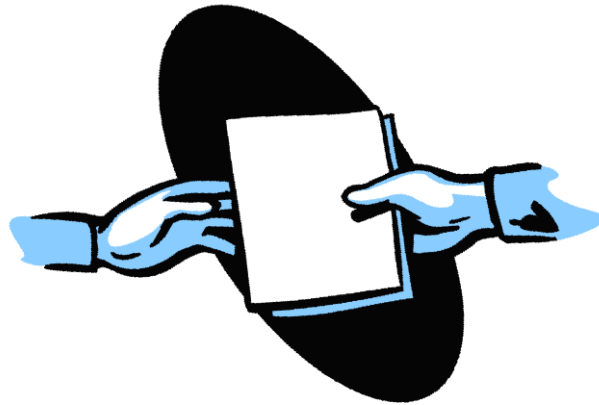
FEA Consolidated Reference Model Document Version 2.3

October 2007

Treasury Enterprise Architecture Framework
 July 2000 - Version 1.0
 Department of the Treasury
 Chief Information Officer Council
 www.treas.gov/cio



Contractual Boundaries



Research and innovation vehicles

- Organic MBSE Community / Working Groups
- Masters and Doctoral students (growth in SE programs)
- Systems Engineering Research Center (SERC)
- DARPA META program

For the practitioner

- Wizards, aids, and process guides
- Intelligent agents
- SE design automation
- Heuristics
- Patterns and pattern recognition
- Assisted engineering
- ...

For our customer

- Sensitivity analysis (requirements and requirement changes)
- Trade space capability and portfolio analysis
- Automated assurance of system integrity
- ...

Changes in the Systems Domain

- The SE domain
 - COTS, GOTS, and reuse – increased emphasis on integration and reconfiguration for new capabilities
 - Intelligent, adaptive (self-evolving), and chaotic systems
 - Widely divergent system lifetimes (cell phones and submarines)
 - Compressed cycle time / accelerated time to market
 - Dominance of commercial systems
- An era of evolution
 - Influences of new technologies (biotech, ...)
 - Rise of cost-effectiveness (limited government budgets, market economics in commercial domain)
 - Rise of national specialization
- The noteworthy challenges of this generation are systems problems

Begin with the End in Mind



The Path to the Future

Community

Communication

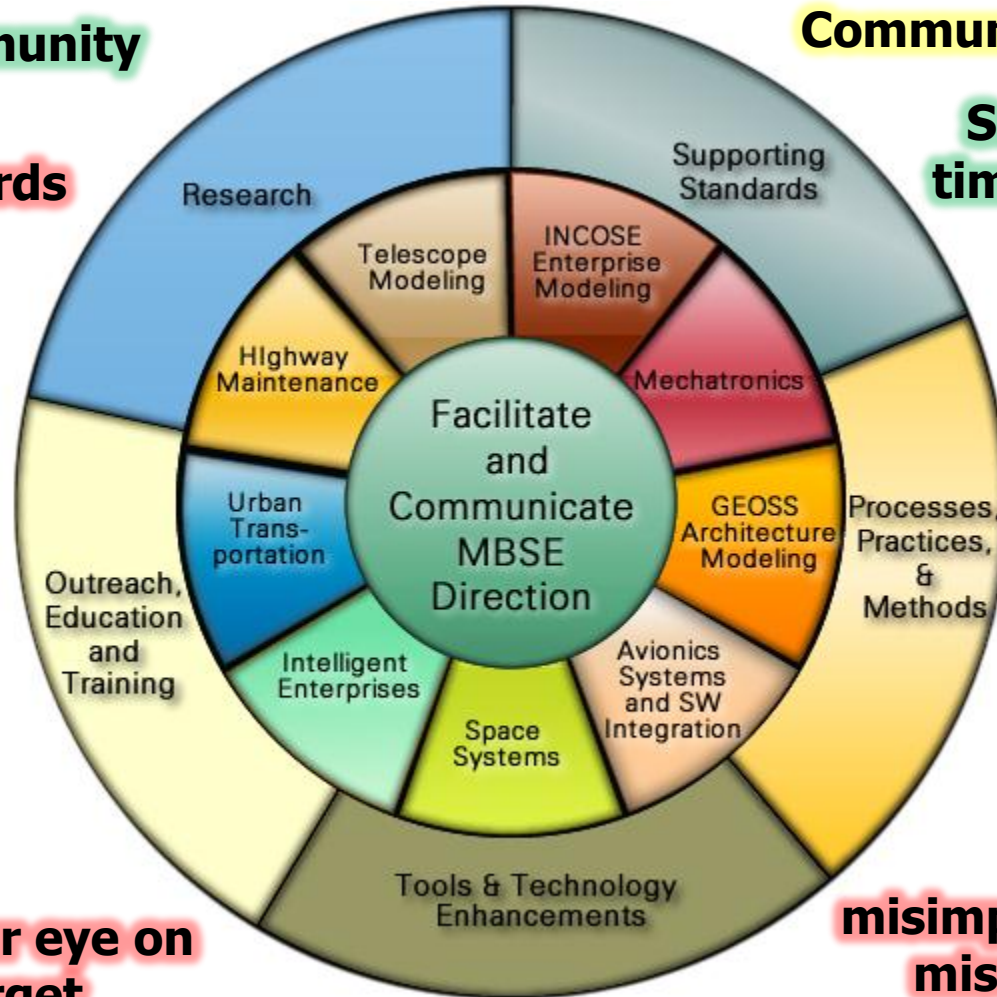
Sufficient and timely standards

Premature standards or standards proliferation

SysML as intended

Expanded vehicles for research and innovation

Keeping our eye on the target



Models and Languages

Contractual Boundaries

Vision

SysML misimplemented and misunderstood

Changes in the Systems Domain

Advancing Technology