Collaboration Infrastructure for Agile Model-Based Design

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Parallel process innovations promote agility

Emergent General Principles

• Emphasize Learning Velocity
  • “Fail early – Fail often”
  • Frequent Experimentation and Testing
  • Address the most important uncertainties early

• Short duty cycles
  • Frequent opportunities to test & pivot
  • “Bite size” development steps
  • Minimal initial versions incrementally improved

• Cross functional teams
  • Engage community of interest throughout development

Across Multiple Domains

• Agile Software Development
  • “Scrum – The Art of Doing Twice the Work in Half the Time” – Jeff Sutherland

• Discovery-Driven Planning
  • “Discovery-Driven Growth” – Rita Gunther-McGrath & Ian MacMillan

• Lean Manufacturing
  • “The Toyota Way” – Jeffrey Liker

• Lean Startups
  • “The Lean Startup” – Eric Ries

Process innovation in engineering complex systems requires infrastructure enabling broad interaction.
Collaboration needed among domains & tools

577 engineering tools & products in use at BAE Systems for Combat Vehicle System development (circa 2012).

Need infrastructure for Agile Design Evaluation combining multiple tools/models
RSIDE: Resilient System Integrated Design Environment

Flexible workflow enabled by:
Lightweight, task-specific modeling framework which supports extensible professional tools, proprietary data and capturing expert knowledge to tame the complexity

ECTo: concept exploration
Manufacturability analysis
Plug-in tools & models (general & proprietary)
Trade study analysis of design geometry, system optimization
Engineering analysis, integration with CAD tools
Operational environment & Deep Red Team
Integrated Metrics

Provides Infrastructure to Connect Diverse Models & Tools
- Seamless Evolution from Conceptual Exploration to Detailed Design
- Support for proprietary models
- Commercial tools incorporated as needed
- Co-reasoning captures cascading effects
- Distributed collaboration successfully demonstrated on Amazon cloud

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Tool & model relationships must be maintained
Infrastructure for engagement across locations & organizations

- Provide Agile Interaction Between Distributed Models/Expertise
- Organizations Retain Control of What Is Exposed vs. Protected
- Virtual Prototype Evaluated Unconstrained By Location of Models/Tools
Firewalling of proprietary content enabled by RSIDE Cloud Infrastructure

- Dynamic Nodes Published Globally, Evaluated Locally
Sharing component model libraries via same infrastructure

Product Structure helps define Ontology

- Vendor supplied parts are already established
- Ontology based on Product structure to provide basis for establishing needs of product
- Need to find balance between top down design and component selection
- Iterative product inclusion in CML as products are analyzed and fielded

Domain Archetypes

- Experts use experience to build models with tools
- Domain experts use different views of the same data requiring filters
- Once models are applied to a specific product, they can be stored as a view of that product.

Meta Data
- Software
- Part Data
- Models
- Archetypes
- Knowledge
- Configurations

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Metrics framework provides extensible & composable metrics

Metrics Framework designed to support:

- **Distributed development** and use of metrics;
- **Agile creation** of new (derived) metrics from composition of models, metrics, and search, sampling, aggregation methods
  - Supports robustness, resiliency, and adaptability metric definition and evaluation
- **Customization** of metrics and dashboards to support individual user focus.
- Integrated into global environment as a Web Service
- Allows for easy access to all models being used to build and test design.
Summary

• Current uses of Model Based Engineering are limited by multiple issues
  • Significant labor required to establish data flows among tools and models
  • And to maintain/recreate these connections for each design change
  • Agile design exploration limited by communications barriers between individual contractors and government experts
  • Barriers to collaboration results in problems being discovered late with resulting cost and time penalties
• Prototype enabling infrastructure provides proof of principle demonstration and initial capabilities for agile collaborative design
  • Facilitate interaction among diverse and extensible collections of models and tools
  • Provide for collaboration between organization while allowing customized protection of IP and sensitive information
  • Create foundation for innovation in evaluation of advanced metrics for scoring alternatives in terms of robustness, resilience, and adaptability
Thank you