SYSTEMS ENGINEERING Research Center

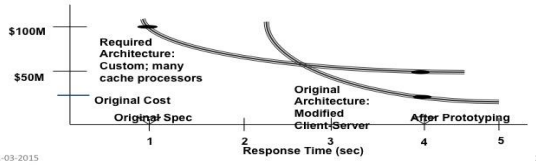
RT-137
Systems Qualities Tradespace and Affordability
Barry Boehm, USC-PI

AFIT, Georgia Tech, MIT, NPS, Penn State, USC, U. Virginia, Wayne State

Criticality of SQ Tradeoffs

Major source of DoD, other system overruns

- SQs have systemwide impact
  - System elements generally just have local impact
- SQs often exhibit asymptotic behavior
  - Watch out for the knee of the curve
- Best architecture is a discontinuous function of SQ level
  - "Build it quickly, tune or fix it later" highly risky
  - Large system response time example: 1-character change in 2000-page spec
    - 4 seconds: cost $30 million; 1 second: cost $100 million



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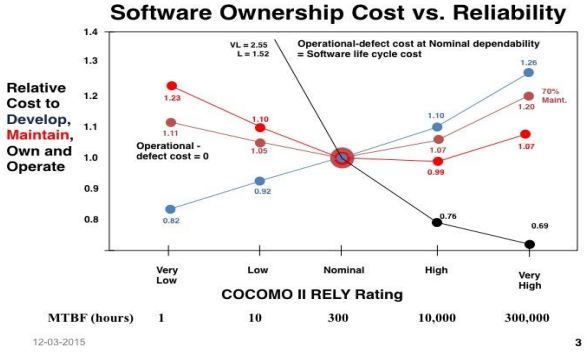
Software Ownership Cost vs. Reliability



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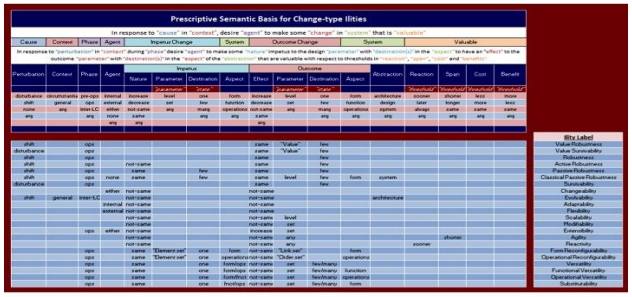
MIT SQs Ontology: 14-D Semantic Basis



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SysML Building Blocks for Cost Modeling

Russell Peak, GaTech- Jo Ann Lane, USC

- Implemented reusable SysML building blocks [Peak]
  - Based on SoS/COSYSMO SE cost (effort) modeling work by Lane, Valerdi, Boehm, et al.
- Successfully applied building blocks to healthcare SoS case study from [Lane 2009]
- Provides key step towards affordability trade studies combining architecture and cost driver tradeoffs

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Piloting MMPTs with TARDEC, NAVSEA

Penn State — College of Engineering

- Extended Set-Based Design
  - Infrastructure reserve capacity keeps options open & costs down for future upgrades & defers limiting decisions
  - Potential future configurations and capabilities are enabled or excluded by design decisions
  - Focus on the **achievable region of capability space** given design decisions rather than regions of "configuration space"
- Adversarial Risk Analysis
  - Adversaries adapt by choosing battlefields, tactics and equipment that avoid our systems' strengths and exploit their limitations
  - Adversaries can be more nimble than the MDAP process
  - Adversaries learn from each other, potential adversaries learn from past adversaries
- Technology Maturation Risks and Opportunities
  - Robust solutions can exploit opportunities, but are effective without them
  - Near-optimal over a range of maturity, cost & capability scenarios

UAV-ISR Architecture Trades Analysis: AFIT, NPS

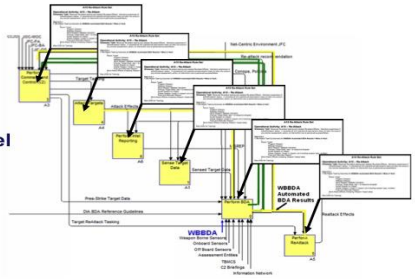
OV-6a Rules Model: AFIT

At ESD Level…

Major Combat Operations

…and System Level

Perform BDA



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Supporting Better Buying Power Objectives

- *Affordability: Strengthen and expand "should cost"*
  - Developing next-generation life-cycle cost models
- *Use of incentive-type contracts. "formulaic incentives"*
  - Strengthening formulas; linking them to SysML models
- *Increase the use of performance-based logistics (PBL)*
  - Extending RT-18 Total Ownership Cost models
  - Strengthening software performance-based logistics
- *Use Modular Open Systems Architecture for innovation.*
  - Working with TARDEC and NAVSEA on set-based design
- *Provide clear "best value of performance" definitions for industry*
  - Working with industry on cost-performance trades via INCOSE, NDIA
- *Improve our leaders' ability to understand and mitigate risk*
  - Fully integrated via RT-107 Quantitative Risk PI Gary Witus

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