INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Affordable Systems: Balancing the Capability, Schedule, Flexibility, and Technical Debt Tradespace

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Overview

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- Affordability overview
- Cost models to support affordability trades
- Tradespace examples
- Conclusions

Affordability

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- Why
  - Government mandates
  - Business value
- What
  - New systems
  - New capabilities
  - System of systems
- How
  - Analysis of options
  - Value-based decisions
  - Total ownership costs

Affordability Tradespace

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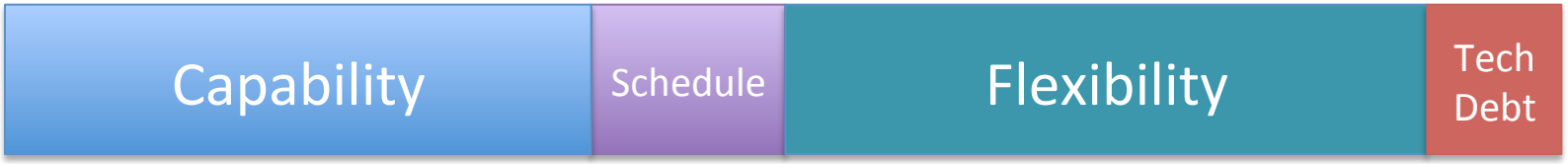
Tradespace:

Desired balance:



Typical results:

Affordability Analysis with Cost Models

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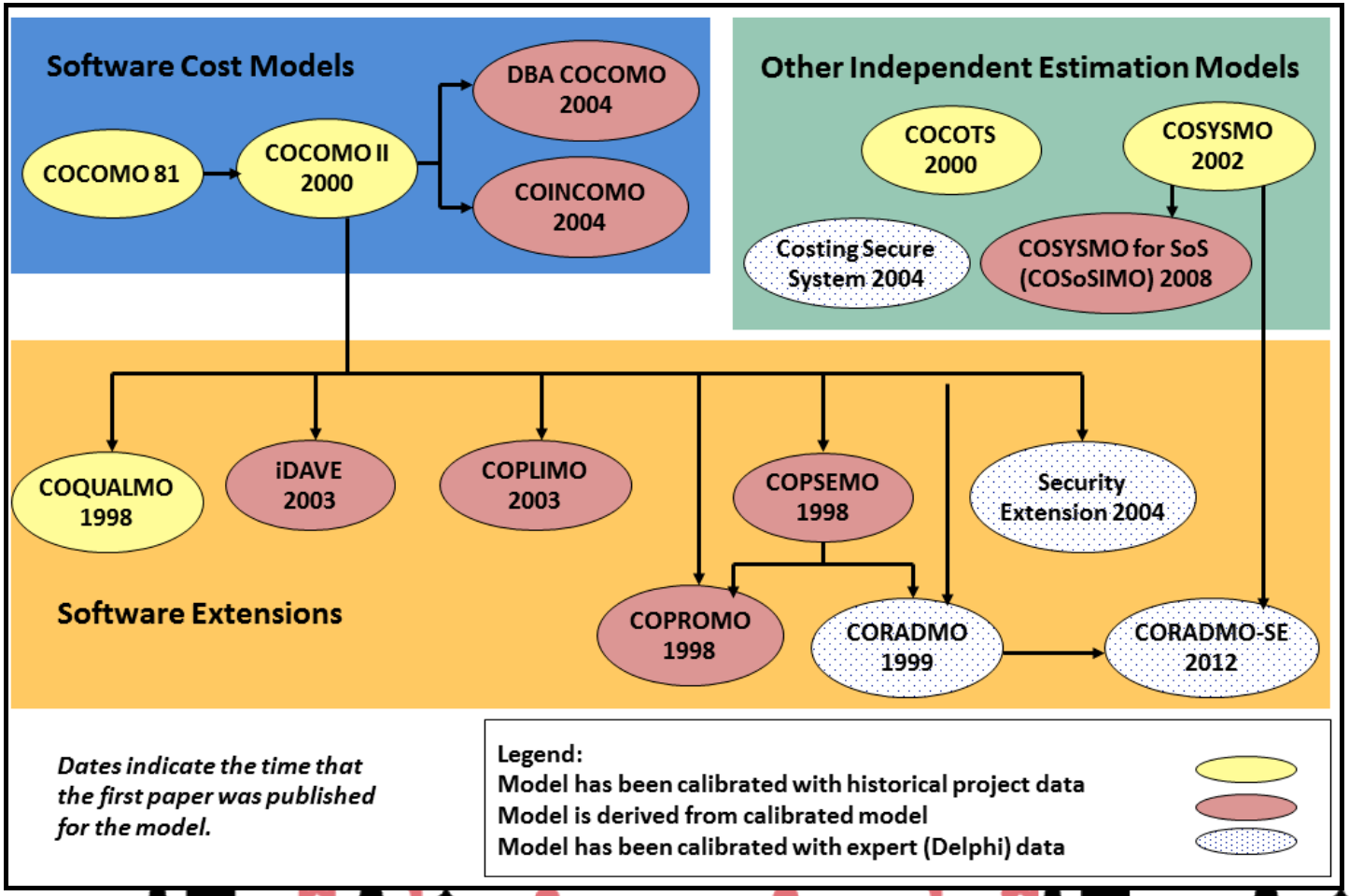

Cost Model Parameters Reflect Tradespace Decisions

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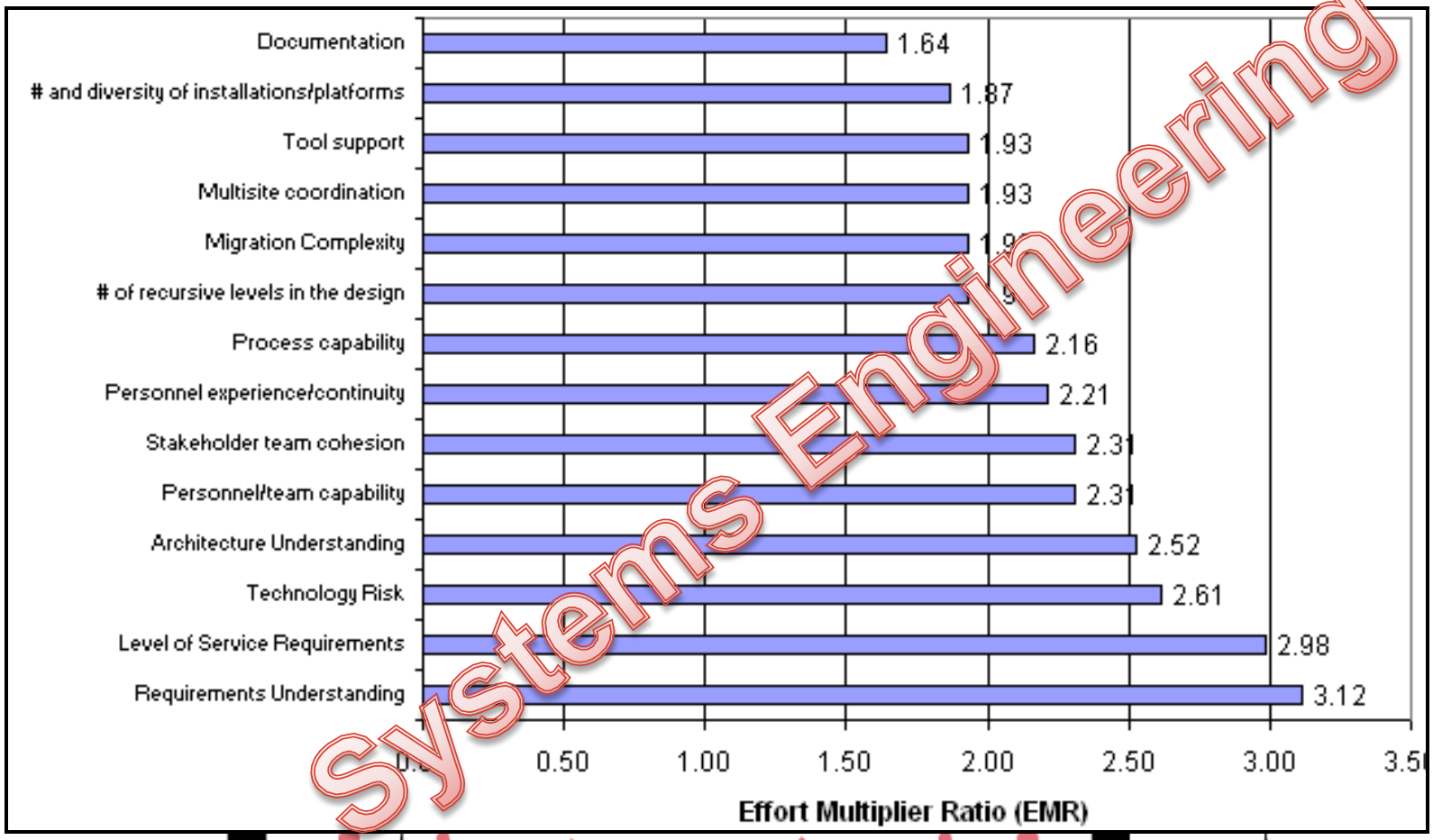

Cost Model Parameters Reflect Tradespace Decisions *(continued)*

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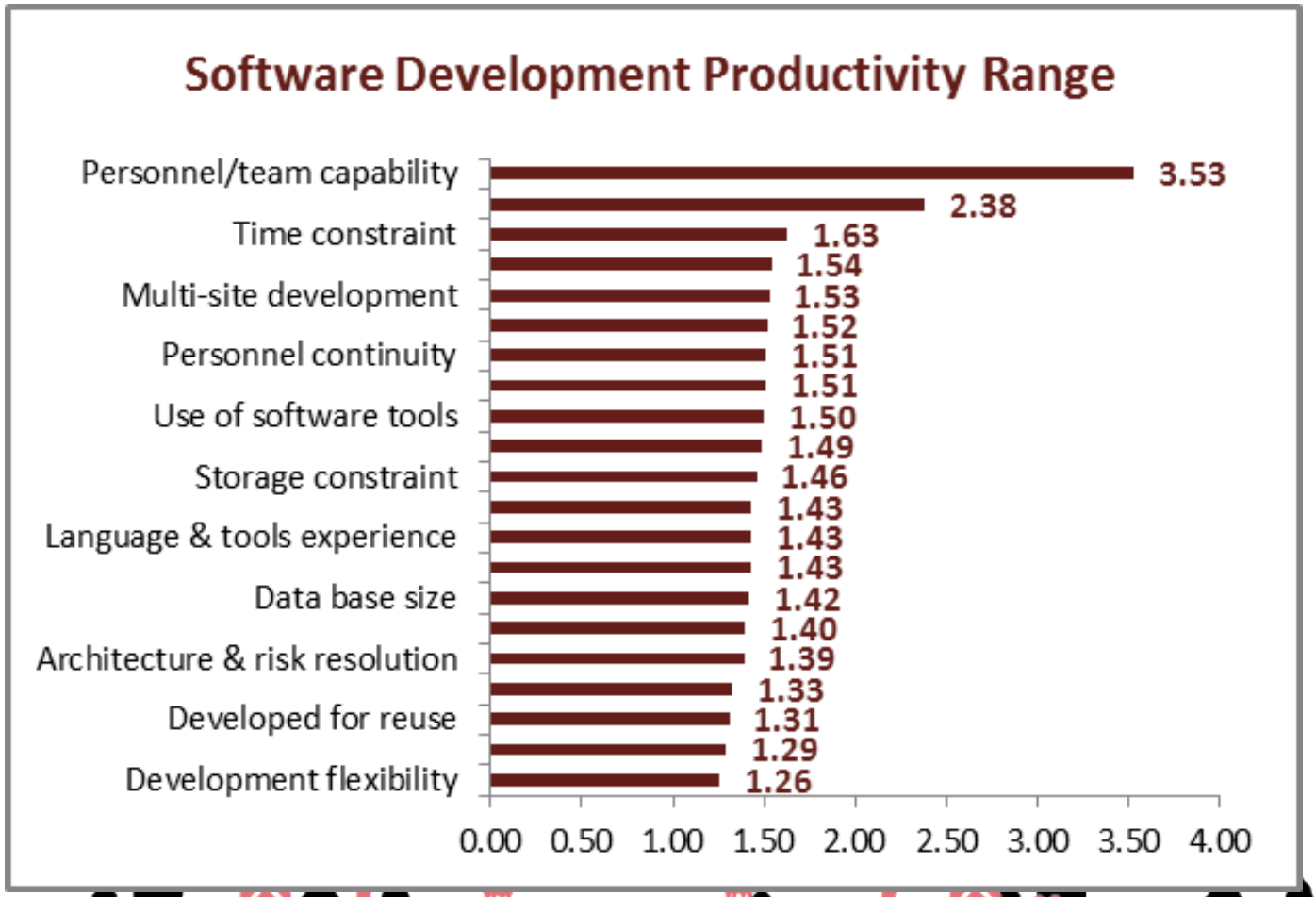

Example Framework: Affordability Opportunity Tree

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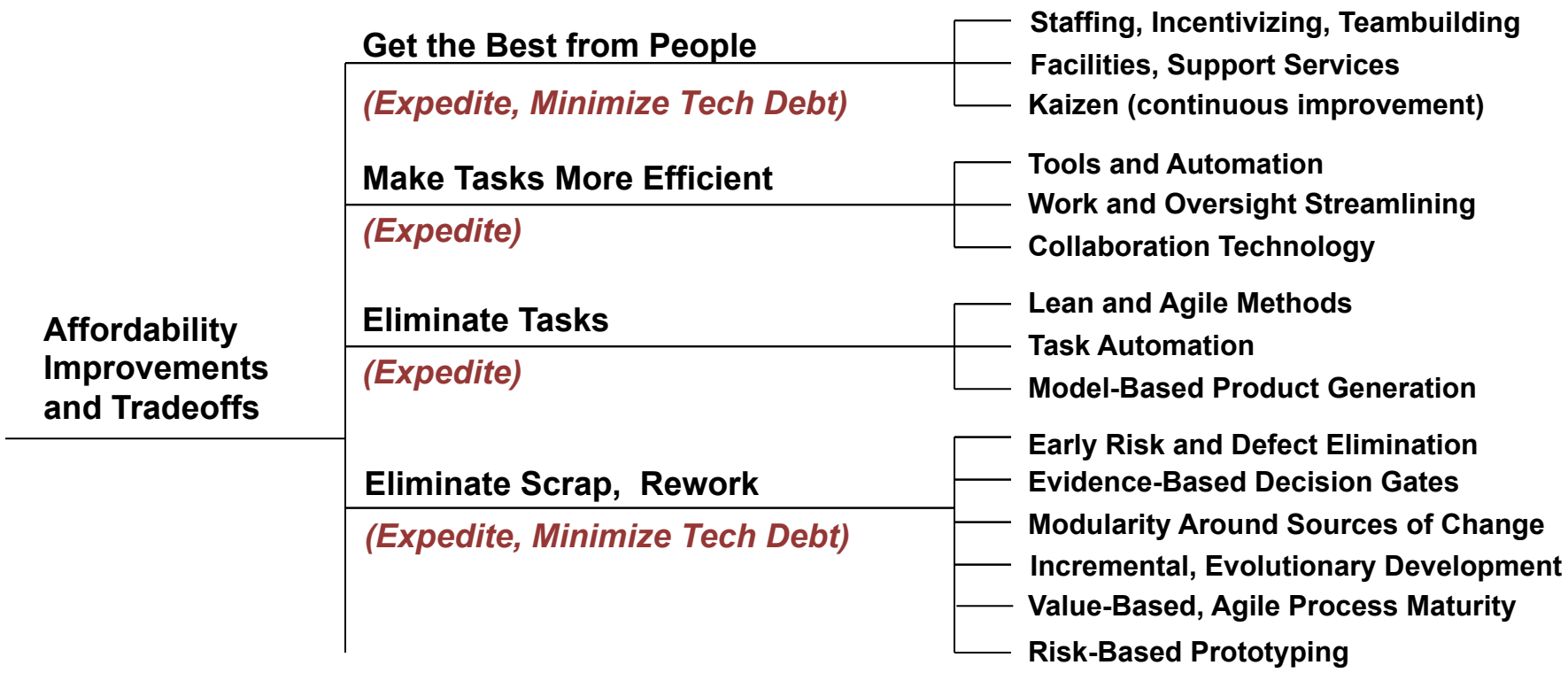

Example Framework: Affordability Opportunity Tree *(continued)*

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Affordability Improvements and Tradeoffs

- **Simplify Products (KISS)**
  - *(Expedite)*
  - Risk-Based Prototyping
  - Value-Based Capability Prioritization
  - Satisficing vs. Optimizing Performance
- **Reuse Components**
  - *(Expedite)*
  - Domain Engineering and Architecture
  - Composable Components,Services, COTS
  - Legacy System Repurposing
- **Reduce Operations, Support Costs**
  - *(Minimize Tech Debt)*
  - Automate Operations Elements
  - Design for Maintainability, Evolvability
  - Streamline Supply Chain
  - Anticipate, Prepare for Change
- ***Value- and Architecture-Based Tradeoffs and Balancing***
  - *(Longer-term investment with min Tech Debt)*

Example: Architecture Strategy Options

- High module cohesion/low module coupling
- Service-oriented architecture
- Autonomous adaptive systems
- Modularization around sources of change
- Multi-layered architecture
- Many built-in options, entry points
- User configurability/programmability
- Spare/expandable capacity
- Product line architecture/reusable components
- …

Each has synergies and conflicts with respect to flexibility and affordability

Affordability Tradespace Revisited

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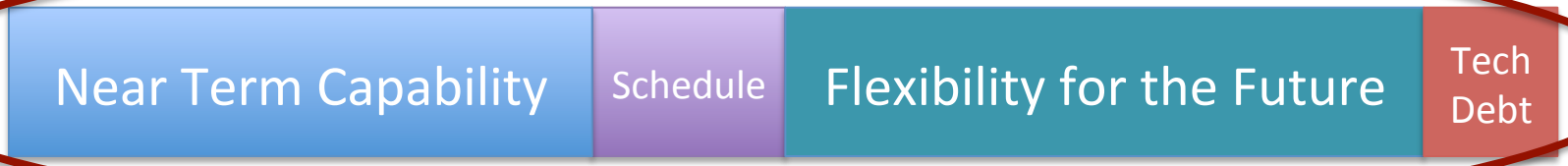
Tradespace:

Desired balance:



Typical results:

Summary of Affordability Research to Date

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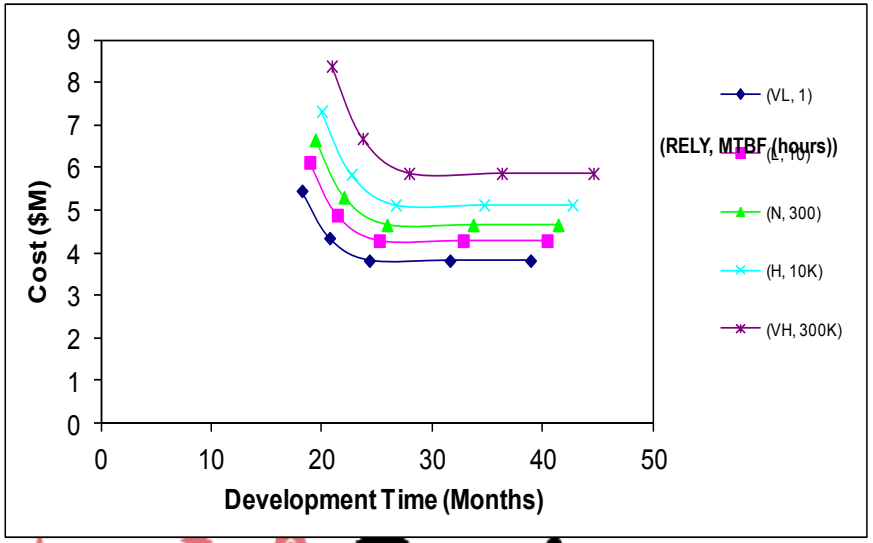
- Affordability considerations
  - Include development of
    - New systems
    - Existing systems
    - Systems of systems
  - Start with balancing capabilities and their performance characteristics
  - Continue with investments in foundations and architecture
    - Manufacturability
    - Maintainability
    - Future options and opportunities
    - Total cost of ownership considerations
  - Plan for the retirement of aging, fragile systems that are difficult to maintain

- Candidate models and tools to support affordability trades
  - "How much is enough"



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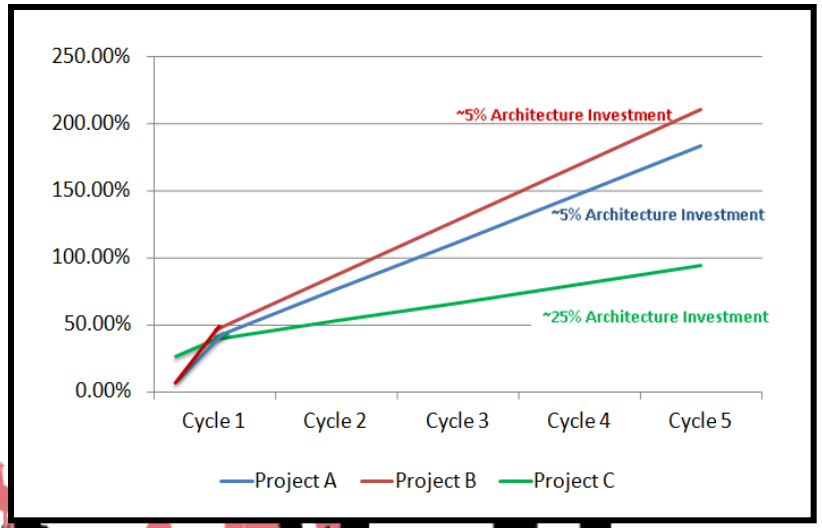

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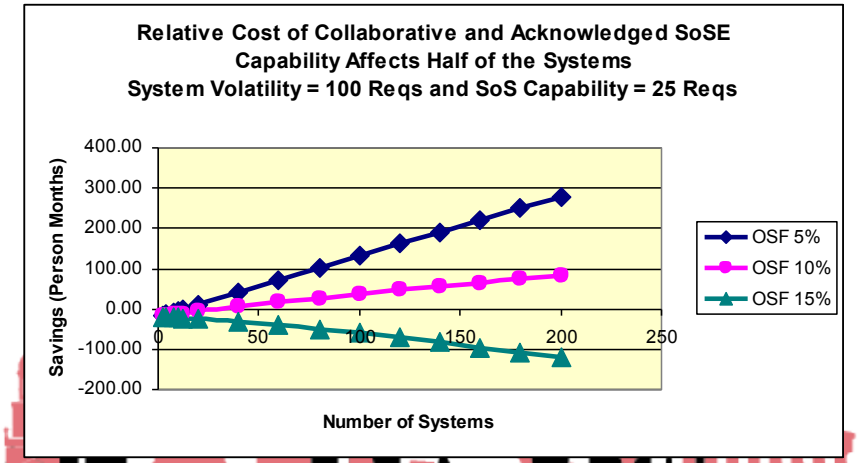
- Candidate models and tools to support affordability trades
  - "How much is enough"
  - Total cost of ownership
  - System of systems engineering investments



Conclusions

- Affordability tradespace focus
  - Value-based capability assessments
  - Incorporation of flexibility
  - Minimization of technical debt
- Parametric cost models critical to analysis of options
  - Alternative solutions
  - Future options
- Early investments in flexible architectures enhance
  - Expedited engineering
  - Flexibility for future options
  - Affordability over the life of the system and associated systems of systems

Acknowledgement

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This material is based upon work supported, in whole or in part, by the U.S. Department of Defense through the Systems Engineering Research Center (SERC) under Contract H98230-08-D-0171. SERC is a federally funded University Affiliated Research Center managed by Stevens Institute of Technology.

Survey

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