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Modeling Enterprise Systems

A summary of current efforts for the SERC

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Outline

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  - Policy Maker Needs
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  - Approach Overview
- Addressing the ESoS Challenges:
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  - Acquire
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PROJECT OVERVIEW

Project Motivation

- Many of the challenges that confront the Department of Defense (DoD) today are characterized by the intersection of complex social, political, economic, and technical phenomena
  - Managing joint and international acquisition programs
  - Coordinating disaster and humanitarian responses involving governments, NGOs, and US agencies
  - Sustaining the defense supplier base in the face of declining acquisition quantities
- Each of these situations involves the interaction of independent organizations with differing objectives with direct impacts on the performance, operation, and sustainment of technical systems

Policy Maker Needs

- Explore the salient features of the enterprise system
  - Identify the key drivers of system behavior and resulting outcomes
- Perform “what if” analyses
  - Evaluate the efficacy of policy options to alter system behavior and outcomes
- “Test drive” the future
  - Allow key stakeholders experience the behavior of the “to be” system

Challenges

- Hoffman (2013) notes that the challenge of combining models for socio-technical systems results from the entanglement of the representation with the question being asked
  - i.e., a lack of independence between the referential and methodological ontologies
- A different question often necessitates a different model of the same system
- Consequently, modeling these types of systems is still largely regarded as an art
- It would be naïve to presume that one could develop an algorithmic procedure to model these types of systems

Research Objectives

- Despite the challenges, we believe it is possible to compile necessary conditions, best practices, common pitfalls, and recommended tools
- Objective 1: Identify, document, and compile modeling recommendations into a methodology for modeling enterprise socio-technical systems
  - Guidance rather than mandatory step-by-step instructions
  - Archive of useful formalisms and associated application guidance
- Objective 2: Identify approaches to visualization that allow multiple stakeholders to interact with the enterprise models

Approach Overview

- Ten step, top-down modeling methodology that allows the analyst to logically step through the model construction process
  - e.g., explore the referential ontology before you get to the methodological ontology
- Model Composition Framework
  - Preliminary approach inspired by the LCIM model (Tolk and Muguira 2003, Wang, et. al. 2009) and the simulation composition methods described by Zeigler, et. al. (2000)
- Immersion Lab
  - Provides a 7 panel interactive touch screen display
  - Test visualization approaches
- Targeted Case Studies
  - Selectively address the risks of combing models needed to represent enterprise systems relevant to DoD
  - Counterfeit parts study

ADDRESSING THE ESOS CHALLENGES

ESoS Challenge: Model

- *Model*:
  - Develop MPTs that allow quick and insightful modeling of enterprises/SoS so that the effects of changes in policies, practices, components, interfaces, and technologies can be anticipated and understood in advance of their implementation
- Approach:
  - Ten step modeling methodology, model composition framework, model archive, visualization approaches
  - We are not attempting to build a “super model” for every enterprise question
  - Rather, the methodology allows users to explore the problem space and then selectively model key trades in greater depth as needed
  - Avoid time and resource intensive multi-year simulation development efforts unless the business case is there

Typical Modeling Scenario

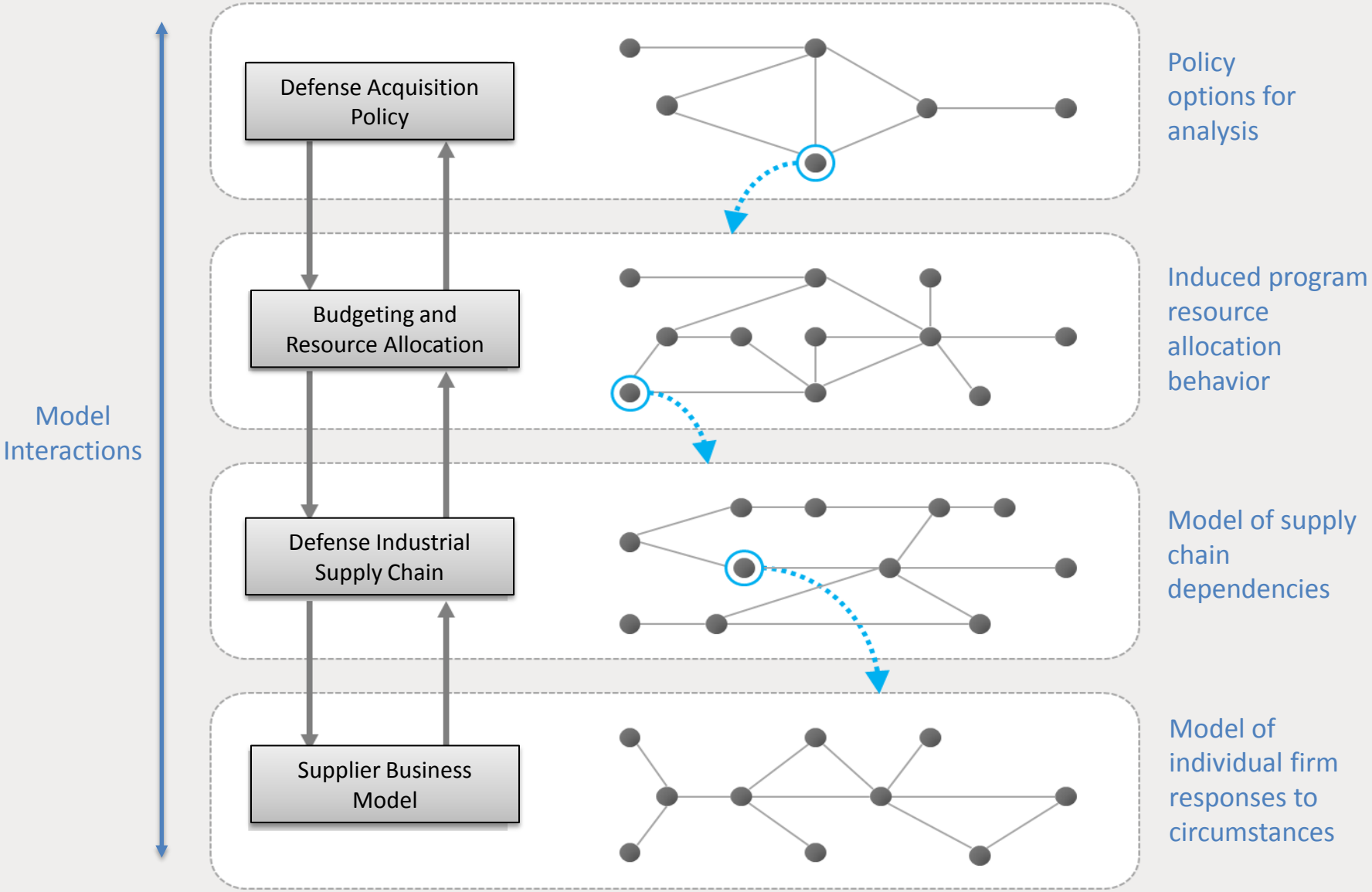
Intent	Q1	Q2	Q3	Q4	Q5	Q6	Q7		QN
Scope	■	■	■	■	■	■	■	■	■
Givens	■	■	■	■		■	■	■	
Views		■	■	■		■	■		
Models			■				■		
Dashboard			■				■		

- Process starts with N questions
- Seven of them make it through scoping
- Five of these survive the discussion of givens
- Two make it through consideration of views
- These two proceed to modeling & simulation
- Connections from N questions to two models remain

ESoS Challenge: Acquire

- *Acquire*:
  - Develop MPTs that allow insight into enterprise/SoS acquisition approaches in the face of significant uncertainty and change to minimize unintended consequences and unforeseen risks
- Approach:
  - Combining traditional process and resource allocation models with economic and behavioral models is a major thrust of our effort
  - Models can be used to explore how certain policies incentivize participants in the acquisition system
  - For example, combine microeconomic models with process models to assess the impact of a new acquisition policy on the defense supply chain

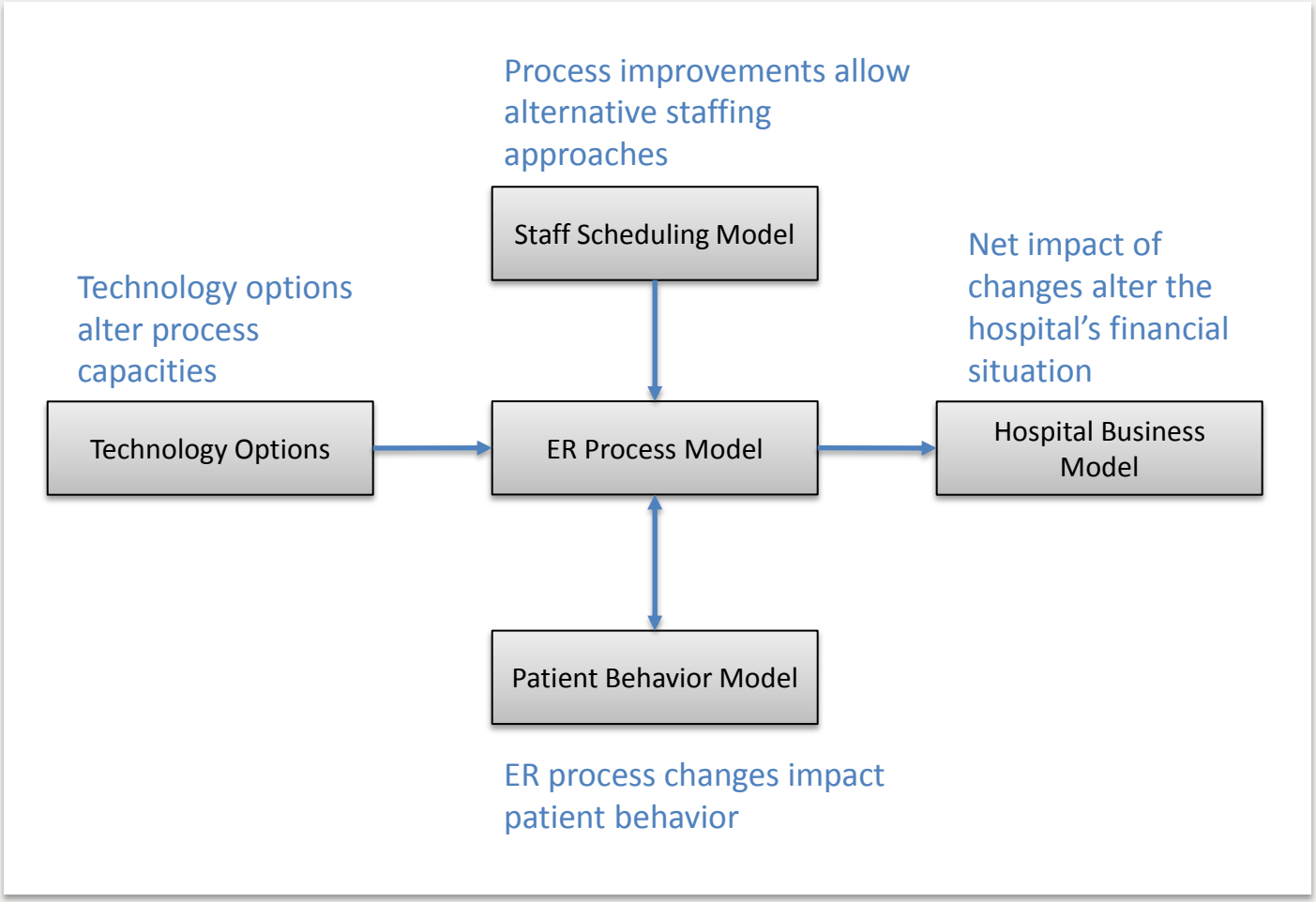
Example: Supplier Response to Acquisition Policy



ESoS Challenge: Evolve

- *Evolve*:
  - Develop MPTs that facilitate evolving and growing an enterprise/SoS, including insight into different architectural and integration approaches that facilitate evolution in the face of uncertainty and change in how an enterprise/SoS is employed, the technologies available to realize it, and the environment in which it exists
- Approach:
  - Use the modeling methodology to explore the impact of technological, process, and policy changes on organizational outcomes
  - For example, a technology change may have the effect of altering resource utilization within a process, which allows the enterprise to experiment with alternative resource allocation schemes

Notional Example: Technology Insertion for Improving ER resource utilization



ESoS Challenge: Verify

- *Verify*:
  - Develop MPTs that allow the properties of an enterprise/SoS to be anticipated, monitored and confirmed during development and evolution, including an enterprise/SoS which includes legacy systems that are in operation while development and evolution are underway
- Approach:
  - Visualization methods will allow key stakeholders to “test drive” the “to be” system prior to implementation
  - Analysis can be used to identify drivers of enterprise behavior that should be monitored during development/implementation
  - Interactive exercises can be used to “game” human and organizational behavior

Immersion Lab

Immersion Lab

References

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QUESTIONS?

BACKUP?

Overall Methodology

1. Decide on the Central Questions of Interest
2. Define Key Phenomena Underlying These Questions
3. Develop One or More Visualizations of Relationships Among Phenomena
4. Determine Key Tradeoffs That Appear to Warrant Deeper Exploration
5. Identify Alternative Representations of These Phenomena
6. Assess the Ability to Connect Alternative Representations
7. Determine a Consistent Set of Assumptions
8. Identify Data Sets to Support Parameterization
9. Program and Verify Computational Instantiations
10. Validate Model Predictions, at Least Against Baseline Data