

3rd OSD Conference on the Acquisition of Software-Intensive Systems

Acquisition Modeling: The Key to Managing Acquisition Complexity?

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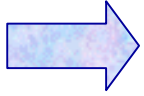
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Outline



- **Introduction**
- **Selected Modeling Technique**
- **Current Model Structure**
- **Status and Conclusion**

Personal Observation & Experience

- **Cost and schedule overruns, and performance and quality deficiencies are the norm for software-intensive space system acquisitions**
- **Problems persist despite**
 - The best efforts of “Blue Ribbon” commissions and a long list of acquisition initiatives
 - Significant advances in systems and software engineering technical processes
- **These problems are observed in every large program and program responses result in similar unsatisfactory outcomes**
 - This happens even though the Government and contractor personnel are different from program to program

Why do these problems continue to happen?

Proposition

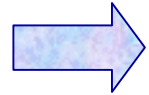
- **DoD Acquisitions have**
 - A unique set of Government and contractor organizations and personnel
 - A large diverse set of policies, strategies and processes
 - A large unique set of political, management and technical activities
 - A dynamic political, budgetary and technical environment
 - One chance to succeed
- **Acquisitions are complex, dynamic, interconnected socioeconomic systems**
- **Consequences of System Program Office (SPO) and contractor actions are not evident for months or even years**

Modeling is the most cost effective way to describe the complexity of these phenomena

Aerospace Research

- **Aerospace has a multiyear research project to study the usefulness of acquisition modeling techniques to improve acquisition success**
 - Enhance acquisition management capabilities
 - Analyze the long-term impact of policy alternatives
 - Provide a project management simulation training environment
- **This briefing provides an overview of the research to date**

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System Dynamics Modeling

- **“System Dynamics is the application of feedback control system principles and techniques to managerial, organizational and socioeconomic problems”** (Dr. E. B. Roberts)
- **“System Dynamics is a method of studying the behavior of systems to show how decisions, policies, structures and delays are interrelated to influence growth and stability.”** (Dr. J. Forrester)

Characteristic	System Dynamics	Agent-Based
Building block	Feedback loop connecting behavioral variables	Individual agents connected by feedback loop
Object of interest	Structure of the System	Agents' Rules
Research approach	Deductive: Infer from structure to behavior	Inductive: Infer from individual agent's behavior to system behavior
Handling of Time	Continuous simulation	Discrete or continuous
Character of object of interest over time	Structure is fixed	Agents' rules can be fixed or adaptive

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* Adapted from “Integrating System Dynamics and Agent-Based Modeling”

How Could Modeling Help?

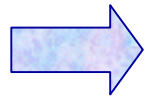
System Technical Performance Analysis

- How is coverage affected by a change in constellation altitude?
- What is the impact on throughput of this system architecture?

Policy, Strategy and Process Performance Analysis

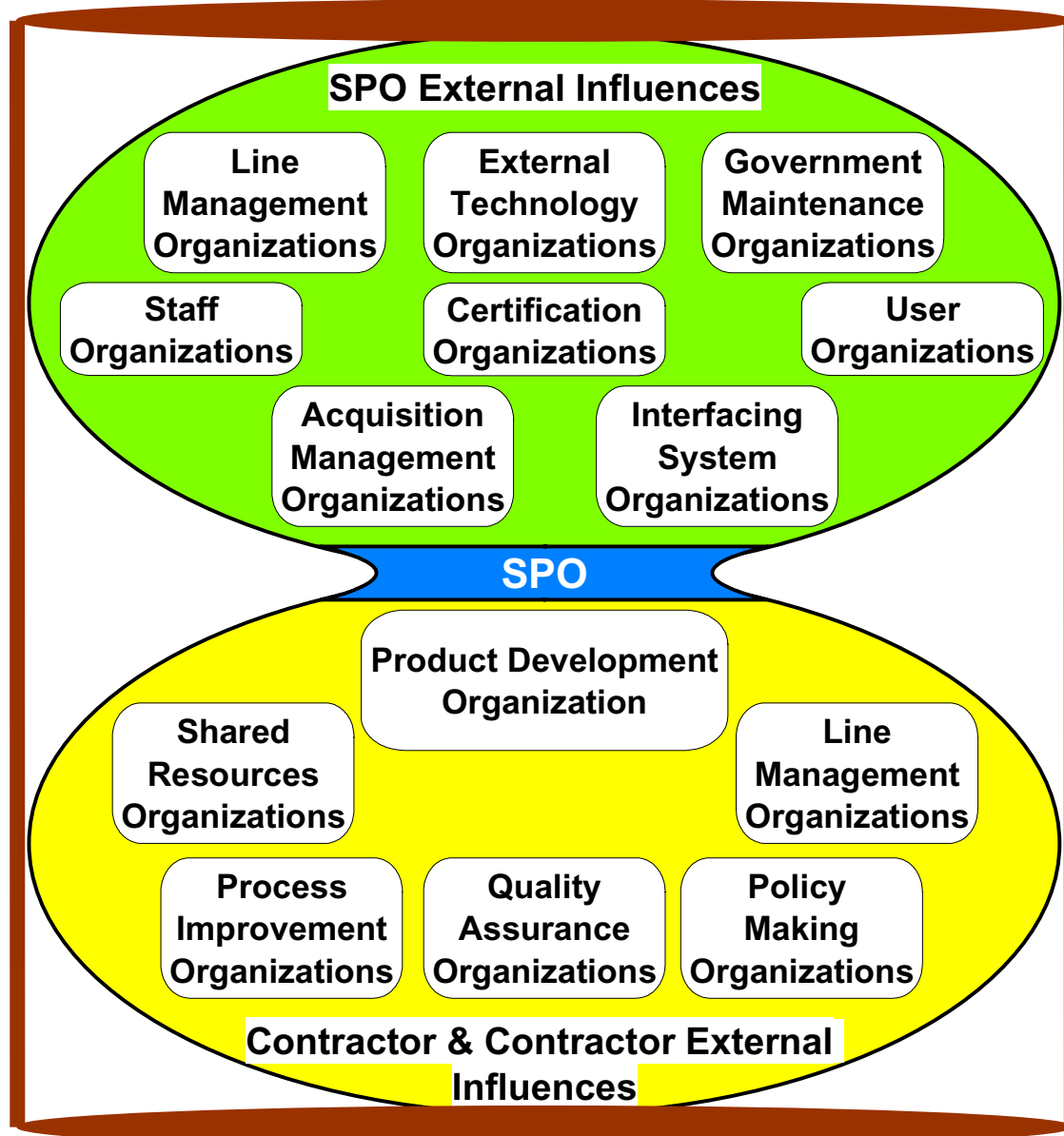
- Is this program executable using the proposed policies, strategies, processes, budget and schedule?
- Where should the SPO focus its effort to make the greatest impact?
- What is the impact of performing these unplanned tasks?
- What is the impact of delays in these decisions?
- What is the impact of product quality on acquisition success?
- What is the impact of rework caused by these requirements changes?
- How does SPO size and experience impact acquisition success?
- Etc.

Outline



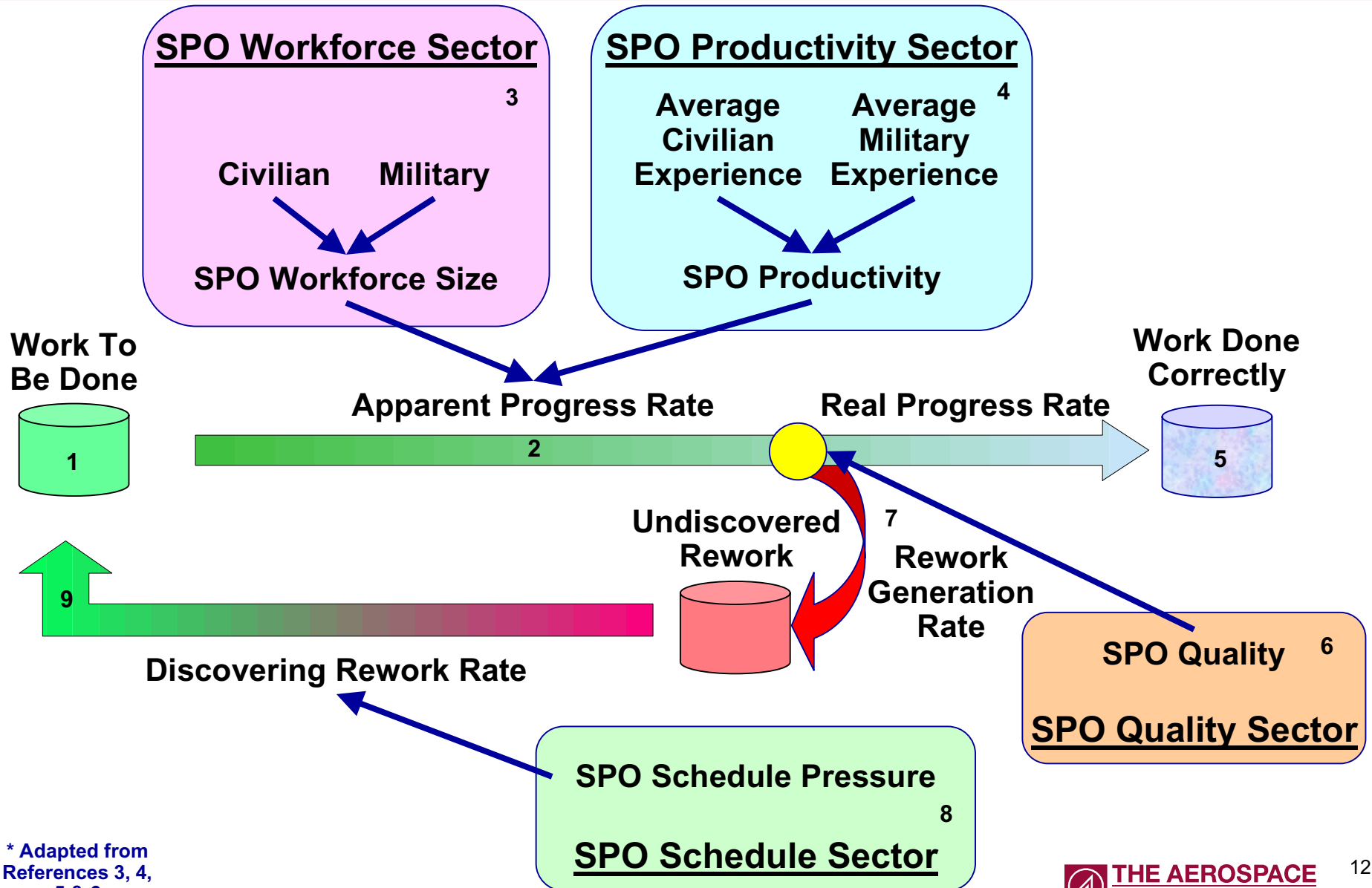
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The SPO's Essential Role in Acquisition Success



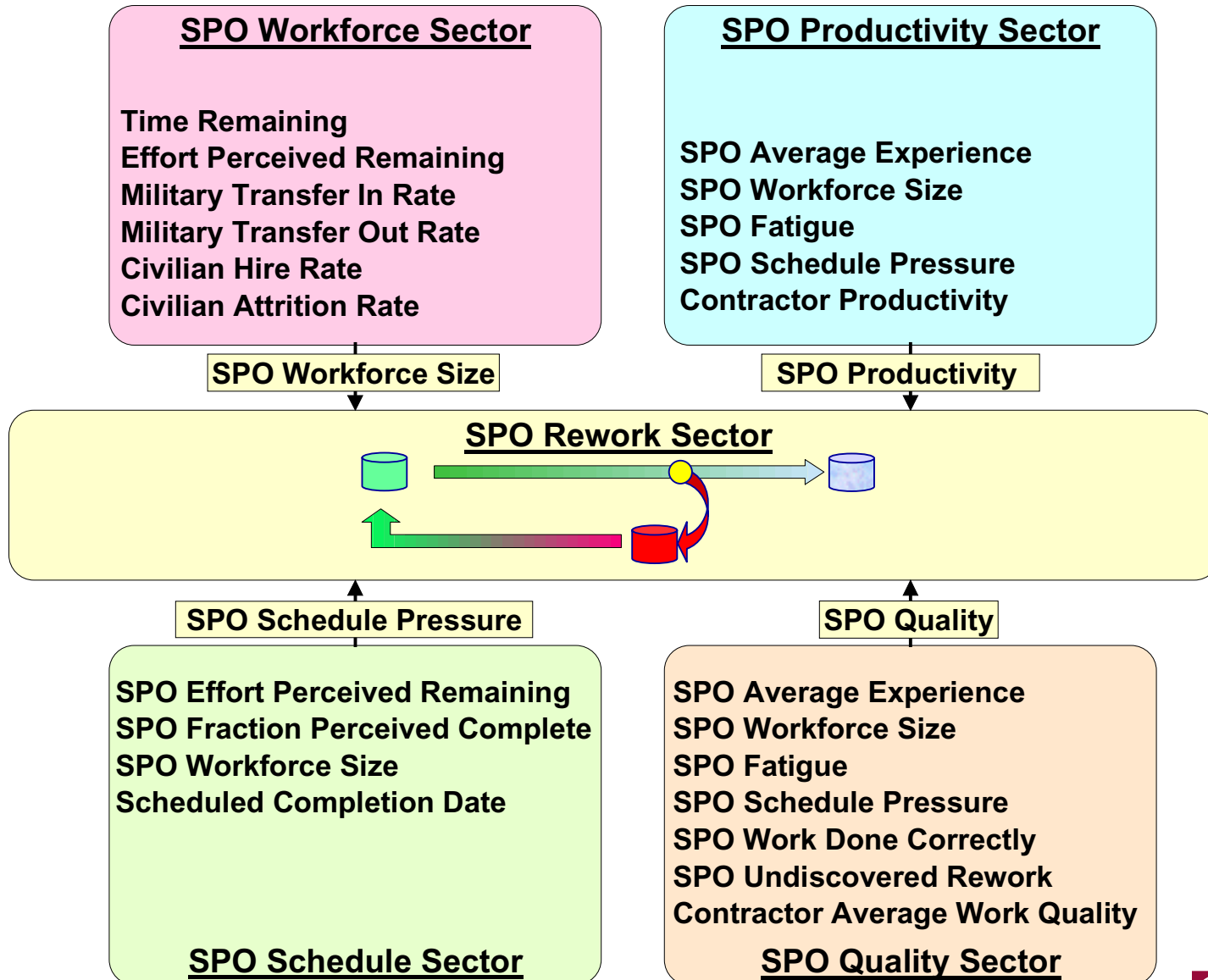
The SPO is the Center of the Acquisition Hour Glass

Simplified SPO Rework Sector*



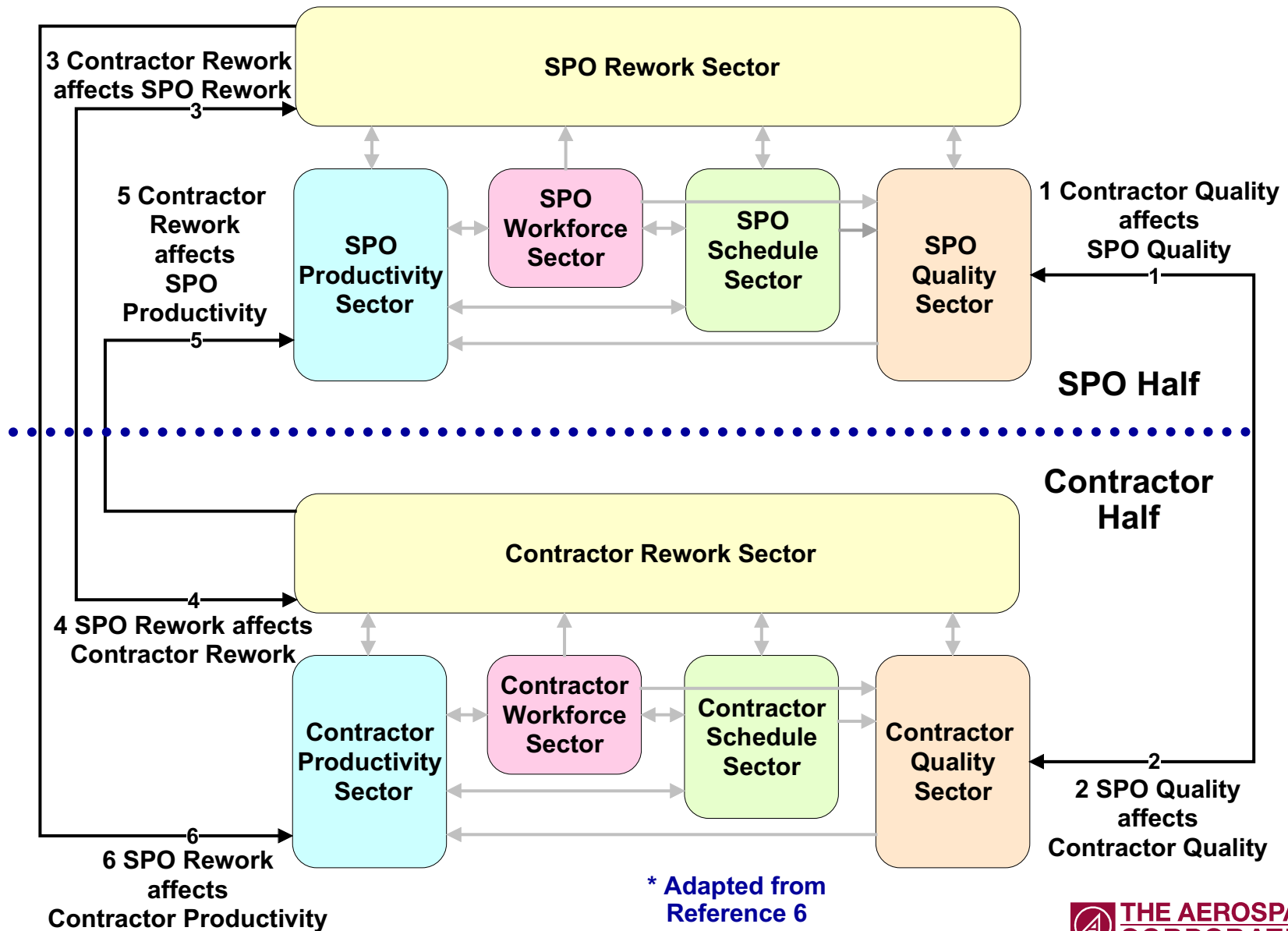
* Adapted from References 3, 4, 5 & 6

SPO Rework Influences*



* Adapted from Reference 6

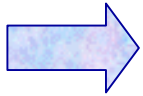
SPO-Contractor Model Sector Relationships*



* Adapted from Reference 6

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Model Status

- **Completed the first iteration**
- **Currently gathering data needed to begin model validation**
 - Initial focus is on a retrospective analysis of an existing program
- **Potential model enhancements**
 - Decompose the model into multiple space system acquisition phases
 - Decompose communication/decision delays by type
 - Explicitly incorporate the impact of concurrent engineering task parallelism
 - Explicitly incorporate SPO personnel task overload

Conclusion

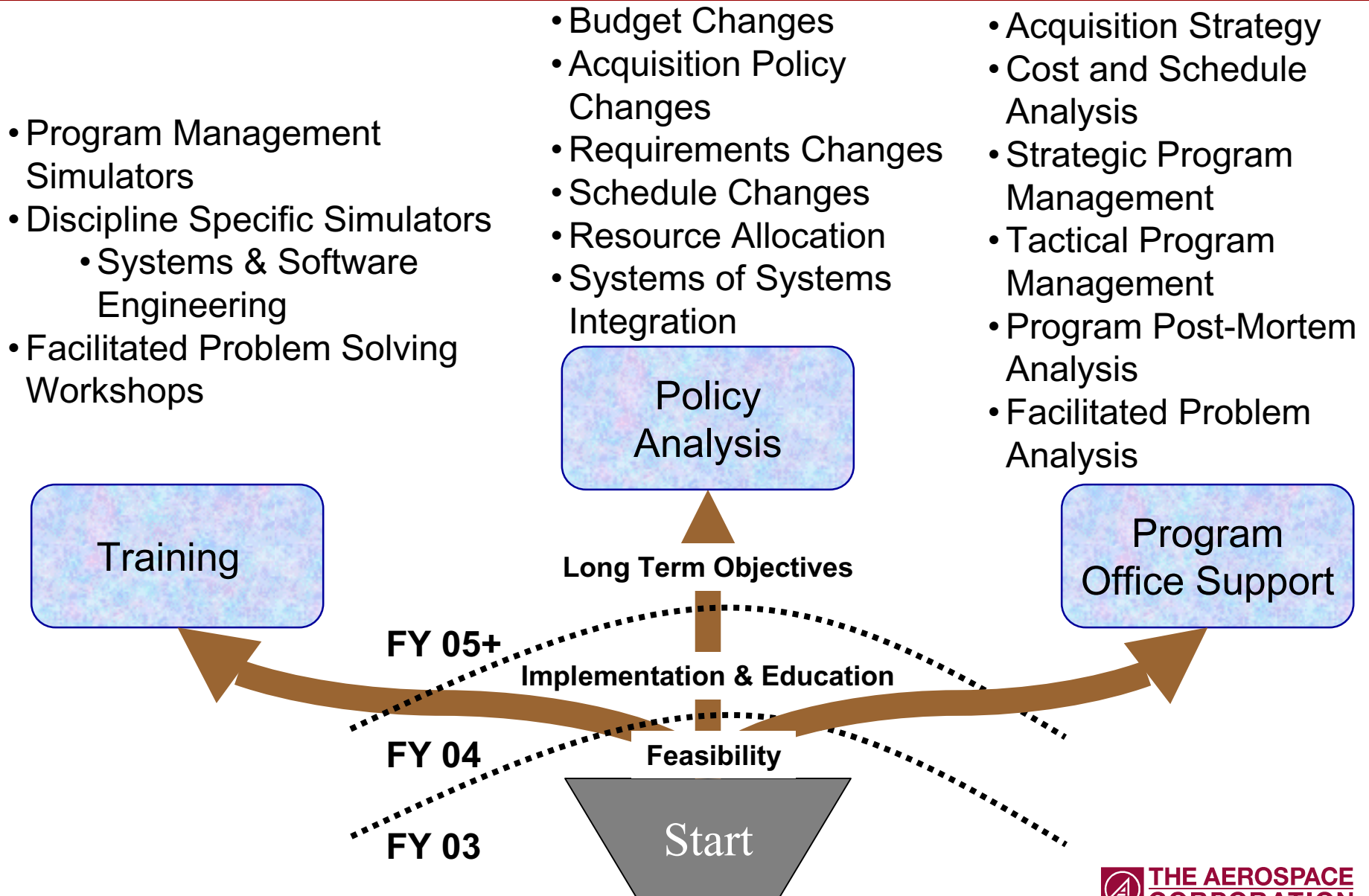
- **System dynamics modeling is a way to describe SPO and contractor alternative courses of action and answer questions about their long term consequences**
 - Has already been used in many industries for the contractor half
- **Acquisition modeling success depends on model validation and the willingness of decision makers to act on the results**
 - Has already been done in many industries for the contractor half
- **Successful use of SPO-contractor system dynamics models in the software-intensive space system acquisition domain depends on**
 - Demonstrating that the models provide useful insight into questions important to acquisition decision makers and
 - Acquisition decision makers trusting the models sufficiently to act based on the models' results

Backup Material

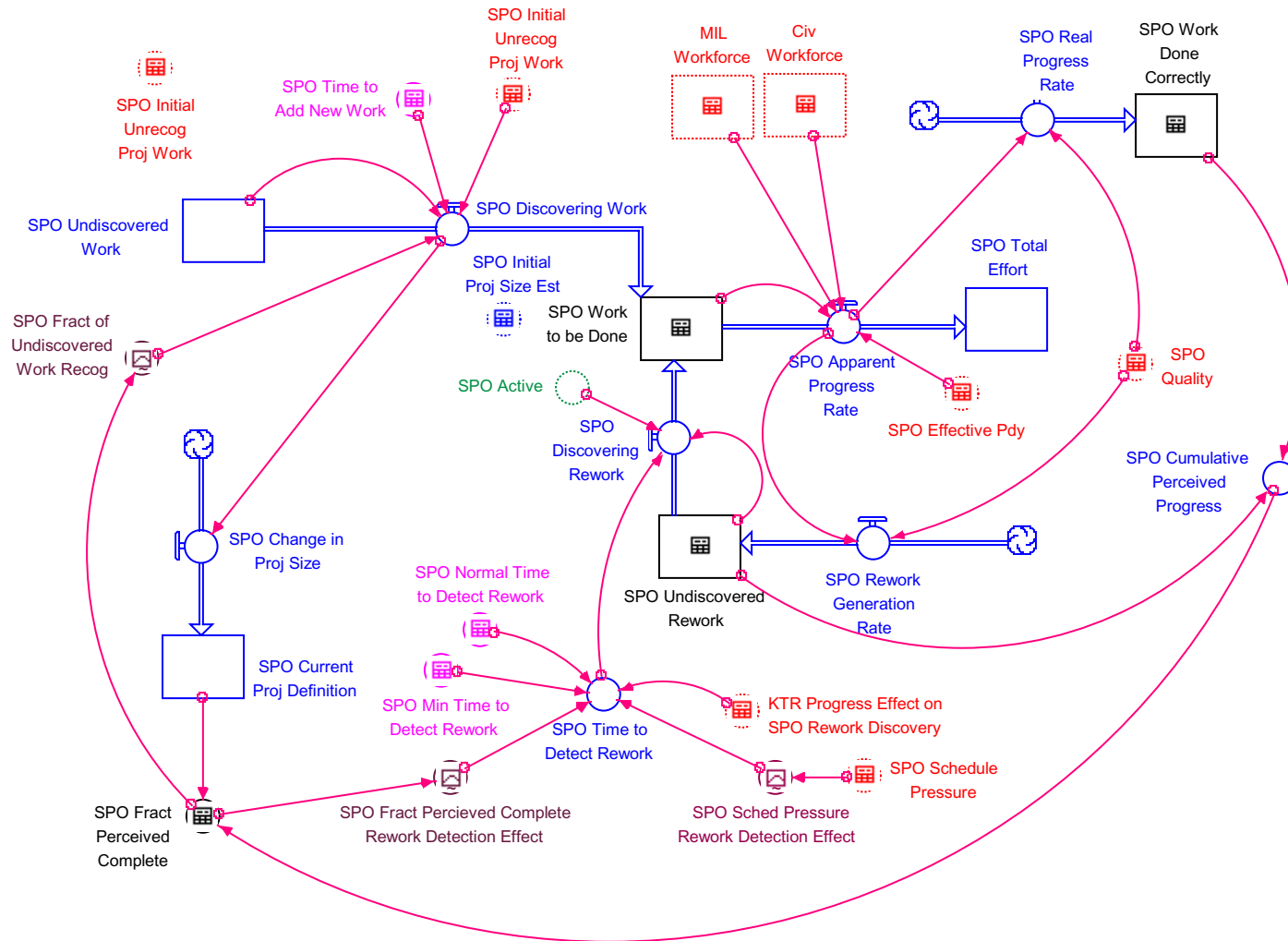
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Acquisition Modeling Research Goals: Support Increased Acquisition and Program Execution Success

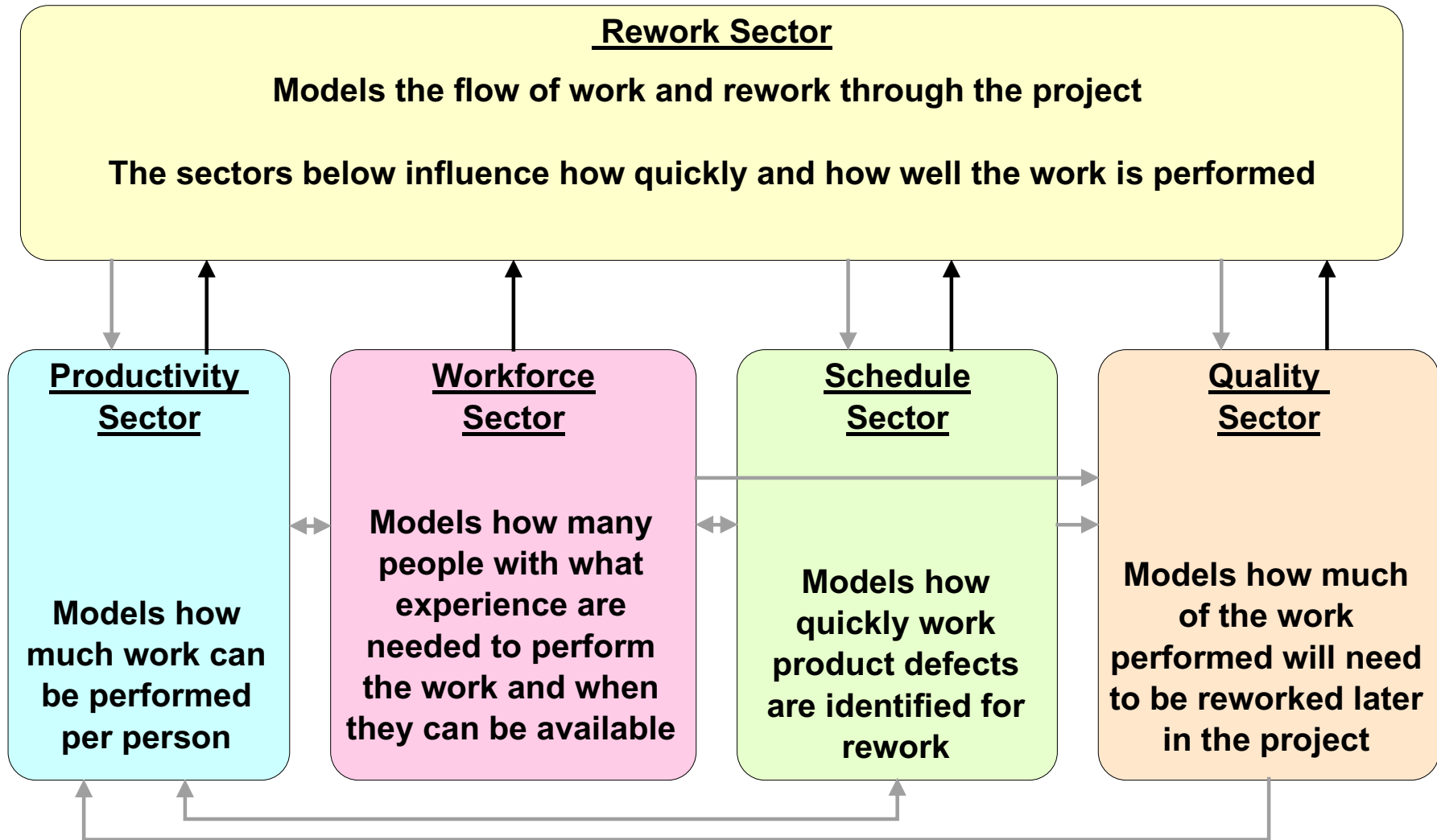


SPO Rework Sector – Stella® Version*



*High Performance Systems

General Project Model Sectors*



* Adapted from Reference 6

References - 1

Introductory

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 - John D. Sterman
- **“A Skeptics Guide to Computer Models”**
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 - References 1 & 2 are useful, short introductions to system dynamics and computer models
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 - American Programmer, May 1993
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 - Project Management Journal, Volume XXV, March 1994
 - Kenneth G. Cooper
 - References 3, 4 & 5 are important early papers

Program Related Analysis

- **“The Cost and Cycle Time Implications of Selected Contractor and Air Force System Program Office Management Policies During the Development Phase of Major Aircraft Acquisition Programs”**
 - MIT Masters Thesis, 1999
 - Sean Morgan
 - The paper that instigated the current research and the inspiration for the current model

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 - The Journal of Product Innovation Management 18, (2001) 258-300
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 - International Journal of Risk Assessment and Management, Vol. 1, Nos. 1 and 2, 149-159, 2000
 - Terry M. Williams
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 - Kenneth G. Cooper
 - References 11 & 12 are related papers for the Peace Shield Program