An Ecological Approach to Evolving Domains Using MBSE

The Institution of Engineering and Technology Seminar on

Model Based Systems 2007

June 4-5, 2007

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Sandia National Laboratories

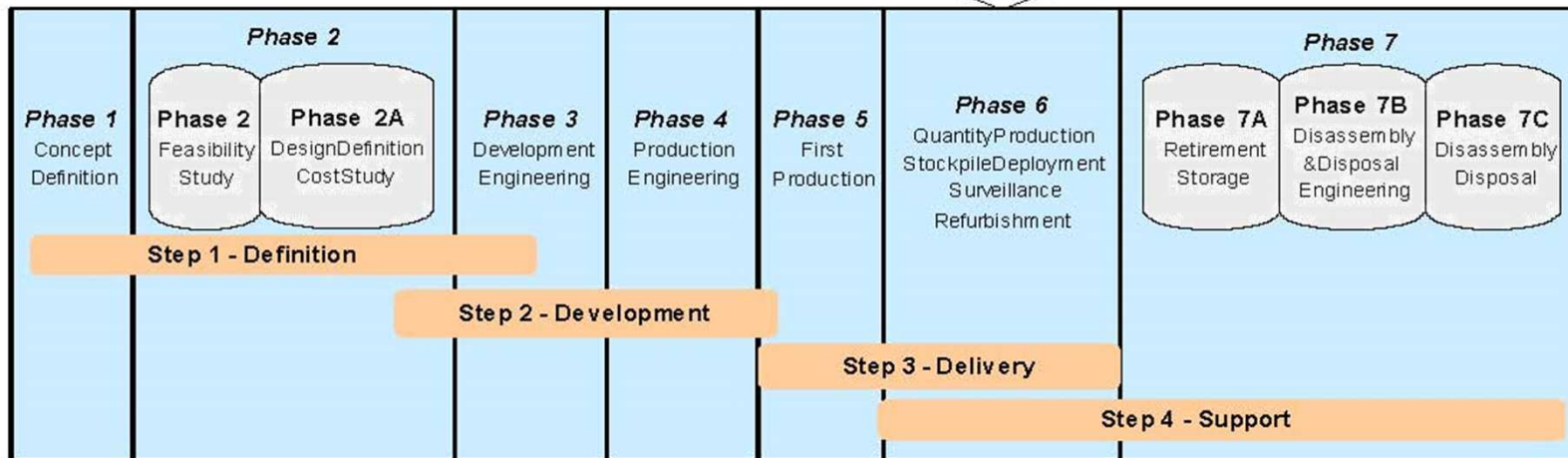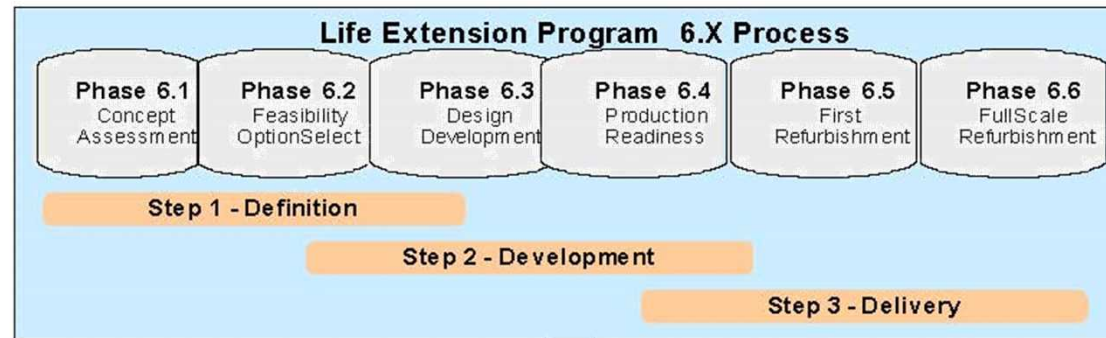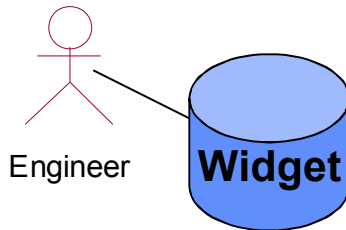**griegor@sandia.gov**

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Current State

- **System/widget/technology is the focus**
- **Life-cycles are primarily focused on getting the system deployed**
  - **Linear and not long term**
- **Support and beyond is given little detail in process models**

One-shot System-centric

Sandia's Product Life Cycle

Legacy M&S Approach

- **M&S community developing simulation capability know the phenomenon**
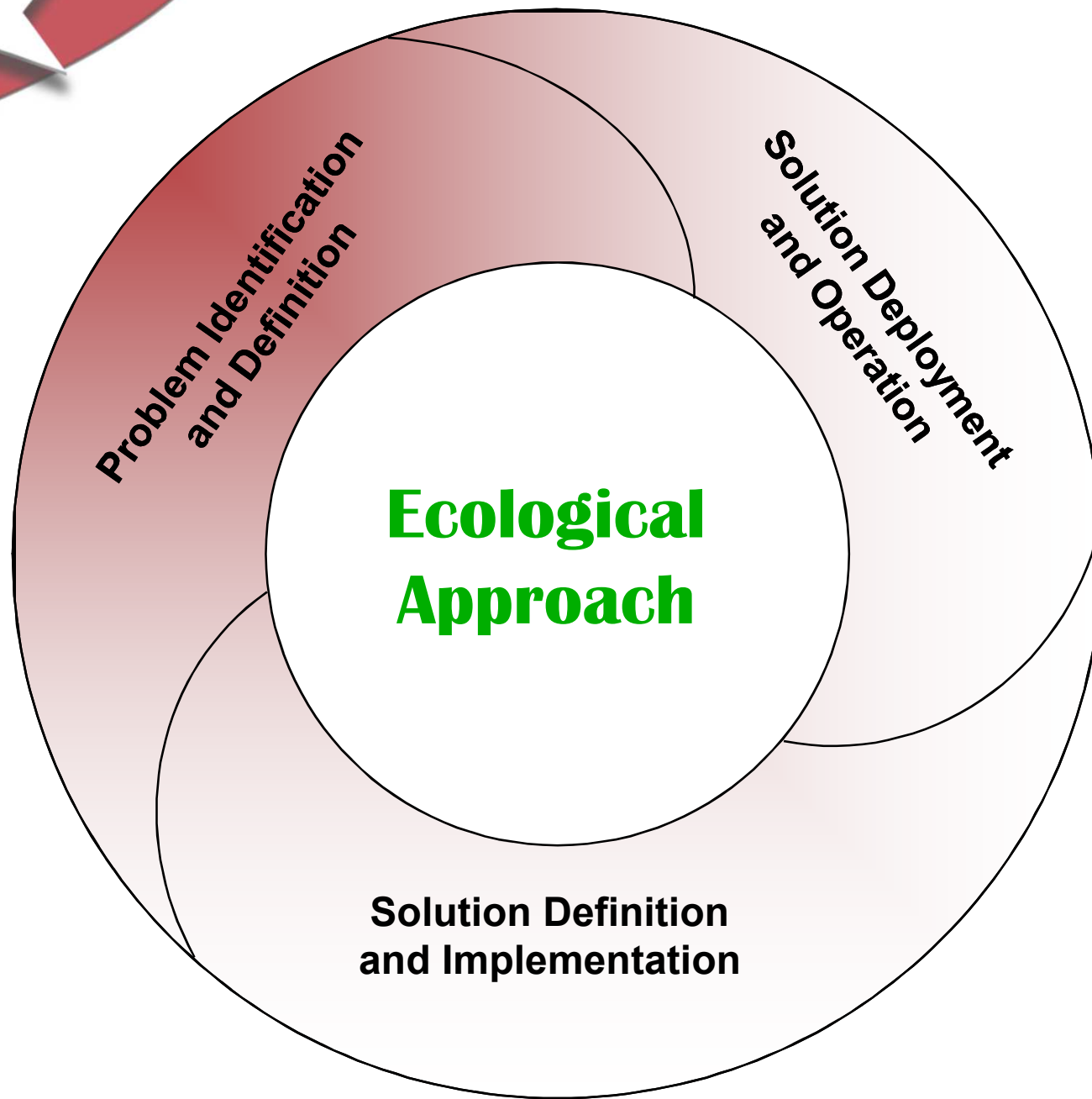 - **Rarely have expertise in modeling technology "tortured Fortran"**

> **How do we want to move forward with modeling a domain?**
> **Who do the models serve?**
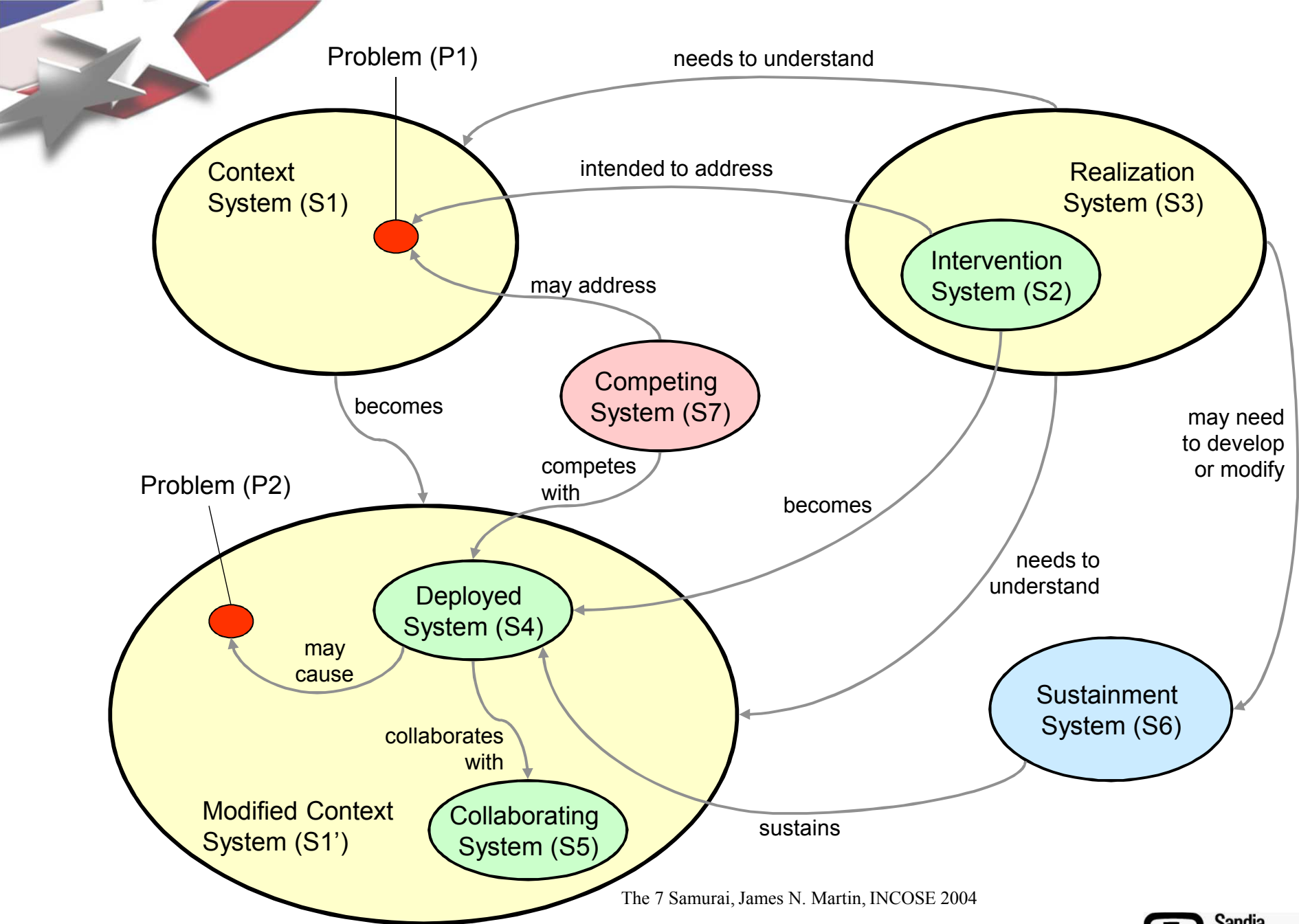
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Alternate State

- **Focus on domain or enterprise**
  - **No real end of life, unless something disruptive occurs**
- **Evolutionary approach to developing capability**
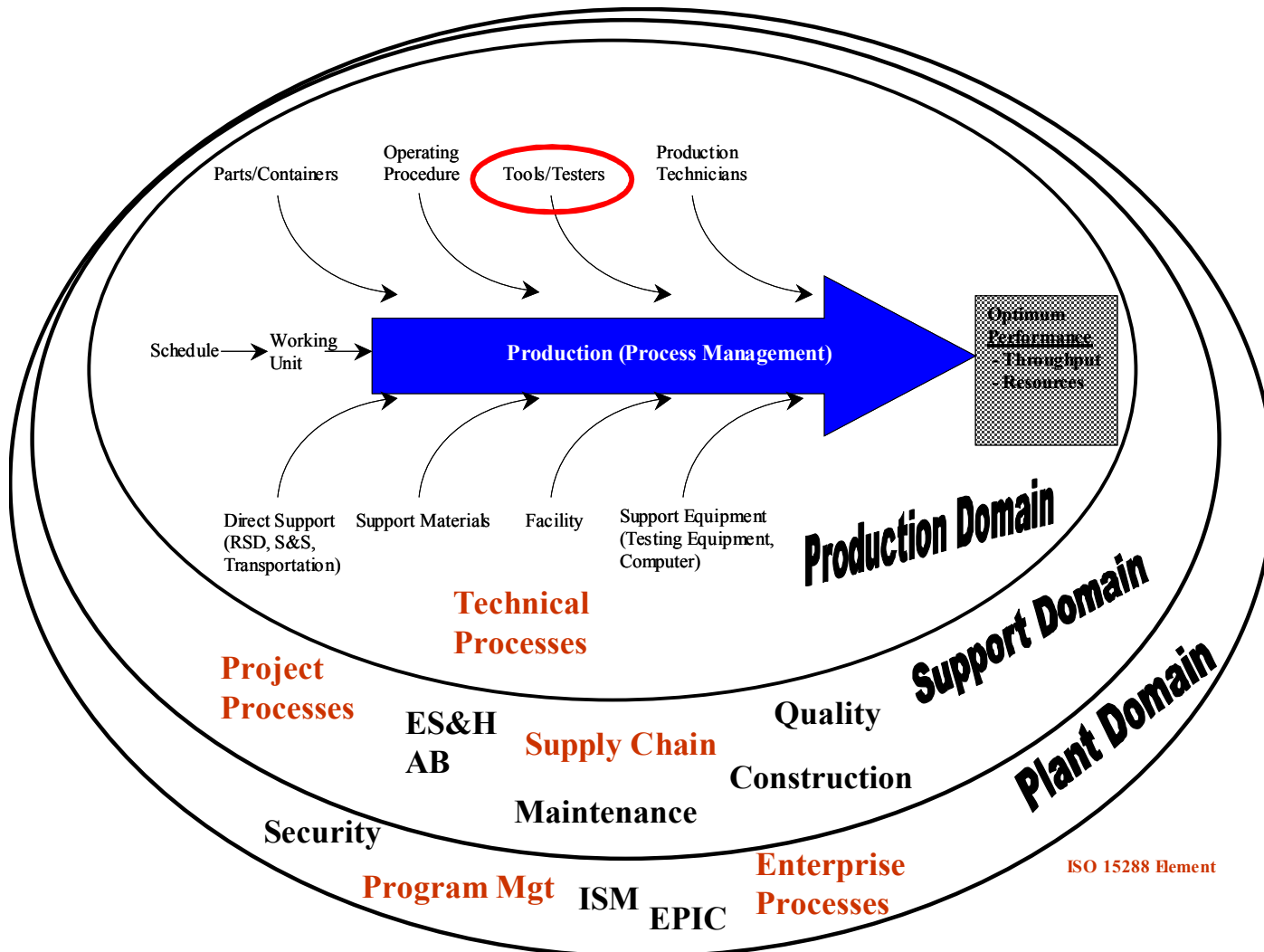- **Multiple systems – multiple models all evolving**

Evolutionary Domain-centric

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Ecological Approach

Problem Identification and Definition

Solution Deployment and Operation

Solution Definition and Implementation

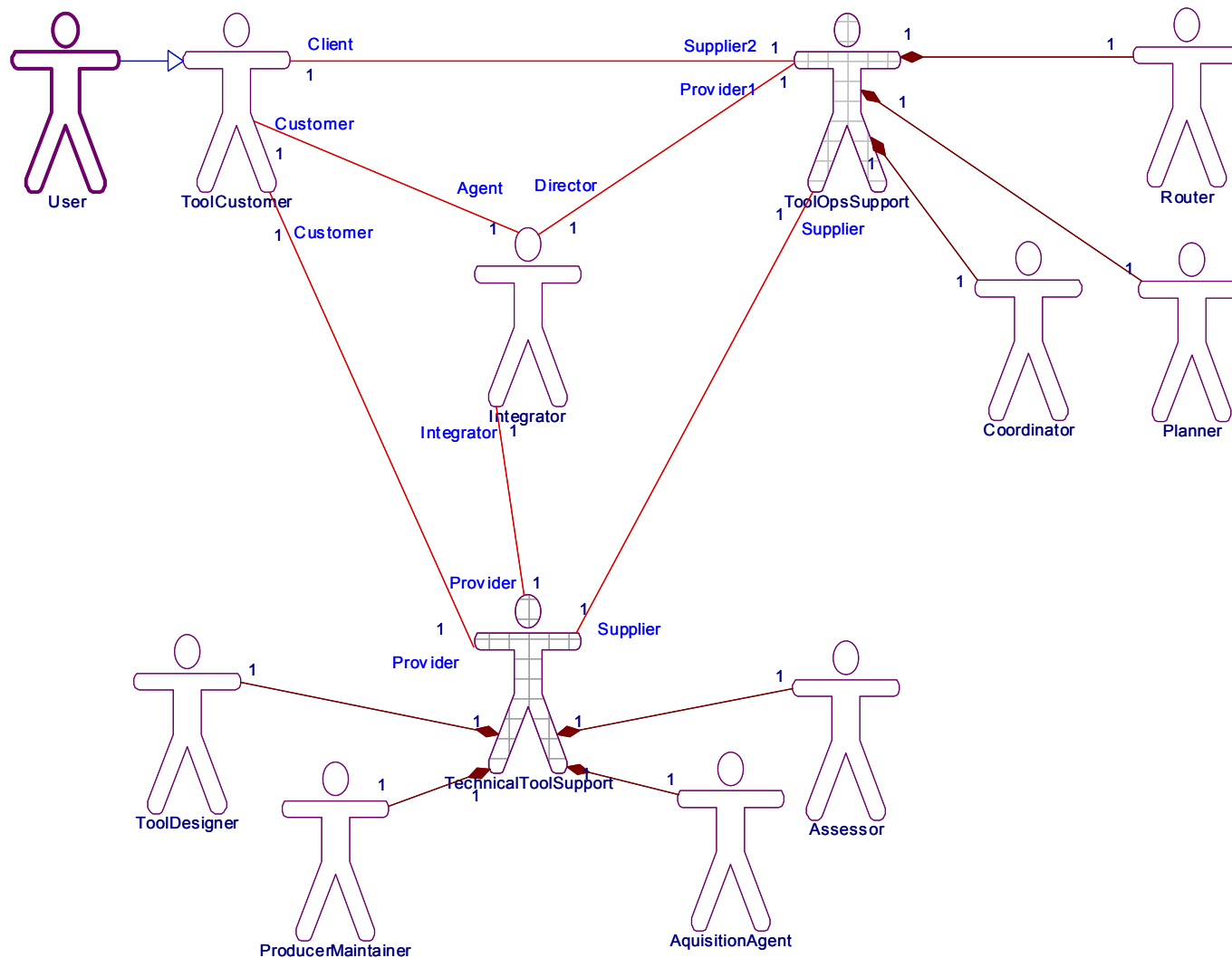Sandia National Laboratories

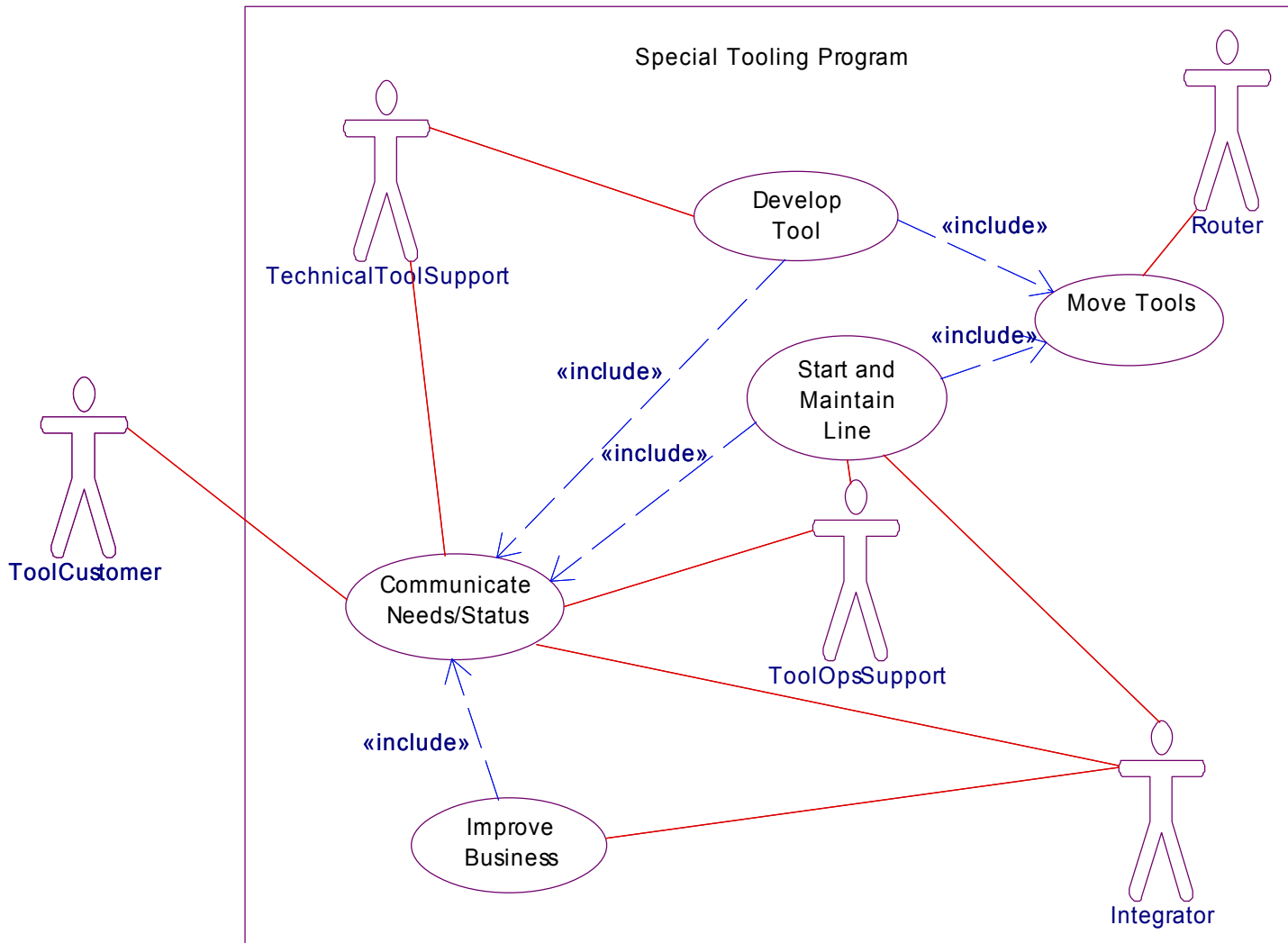The 7 Samurai, James N. Martin, INCOSE 2004
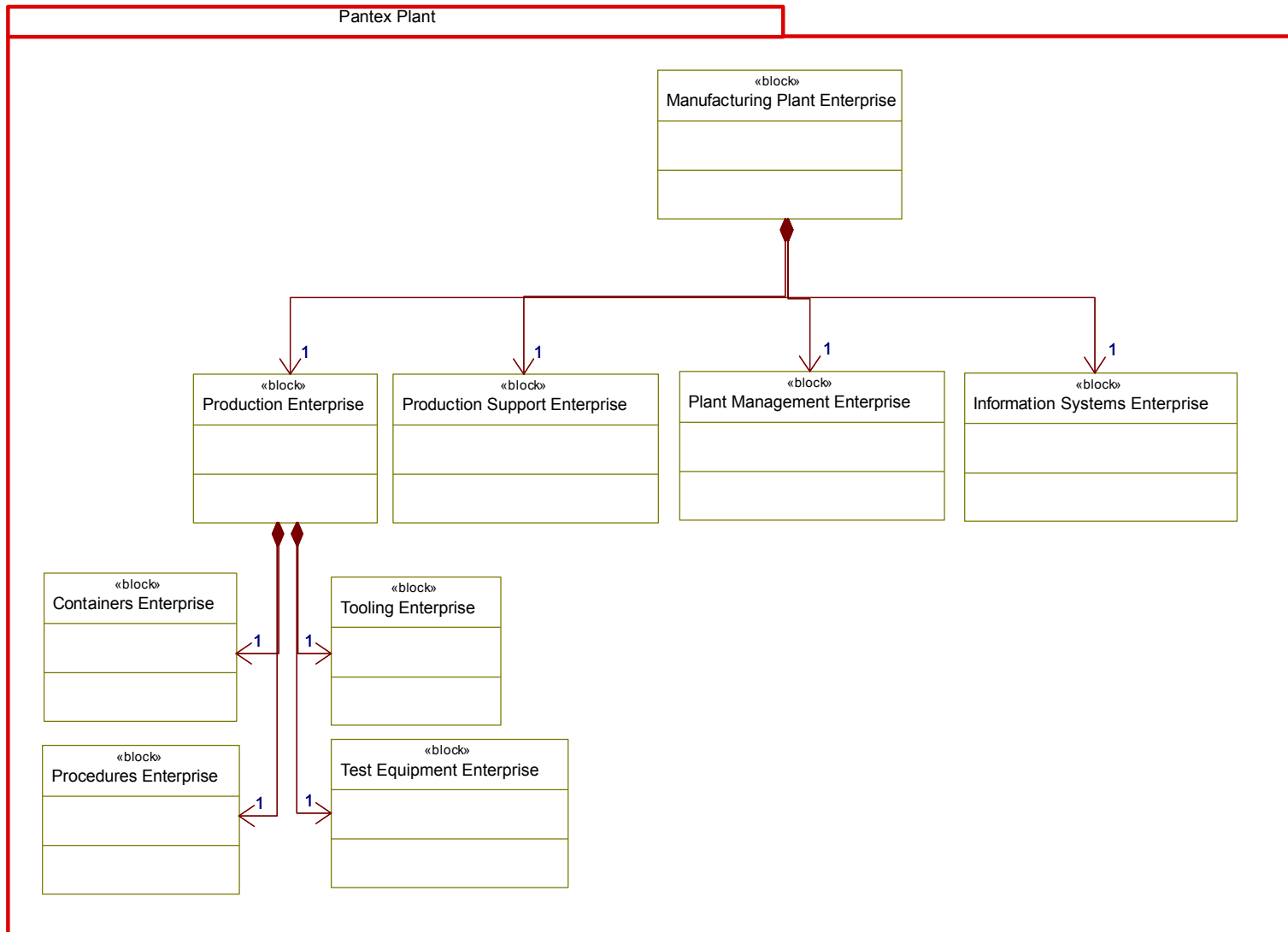
Manufacturing Enterprise Model

Tooling Stakeholders

Behavioral Context

External Block Diagram at the Plant Level

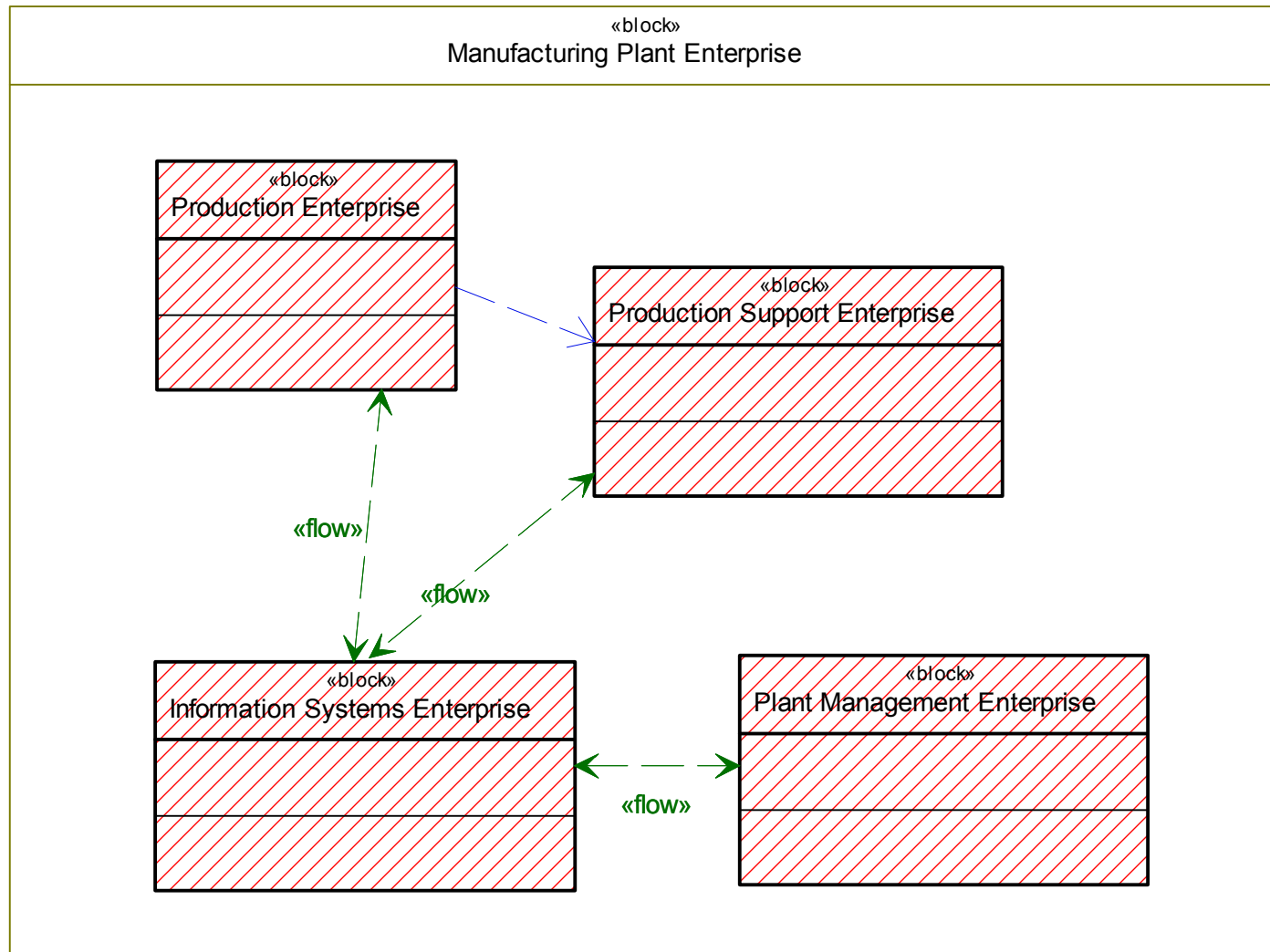# Internal Block Diagram of the Plant

Diagram of the Relationship of Shops

Goals of Modeling

- **Develop models (static and dynamic) of the Pantex Special Tooling Enterprise as a strategic tool for identifying improvement.**

- **Use the static model as a capstone view of the Special Tooling Enterprise that all stakeholders can relate to**

- **Identify Opportunities for Improvement**
  - **Operational**
  - **Workflow**
  - **Measurement**
  - **Information Systems**

Model is an Organizational Asset

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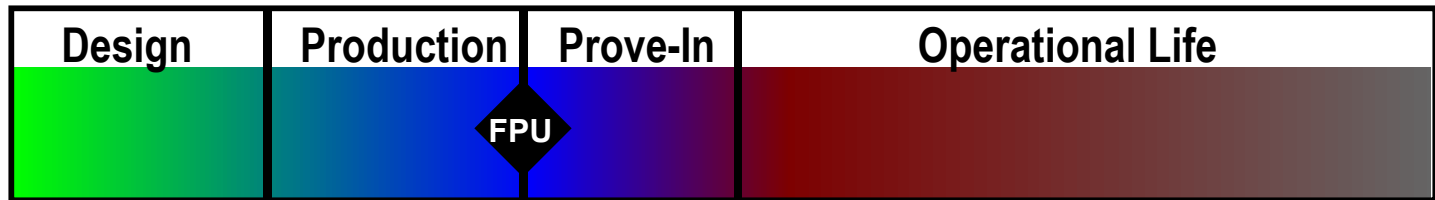# Information Changes

- **Information System Changes**
    - **Incremental development of integrated information system for tooling enterprise**
    - **Define architecture that aligns IT system to business needs using the enterprise model as guide**

**Model Guides
Infrastructure Development**

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Operational Changes

- **Use Model to Guide Operational Changes**
  - **Standardization of workflow across all shops**
  - **Formalization of tool production and prove-in processes (transition from design to operational life)**

Design	Production	Prove-In	Operational Life
		FPU	

  - **Improve accuracy and quality of work orders**

Model Guides Enterprise Operational Changes

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Workflow Changes

- **Requirements management**
  - **Tooling enterprise regulatory requirements**
  - **Move investment in assurance activities to early in development of a tool**
  - **Tool design requirements**
- **Explicitly define states and transitions of work products**
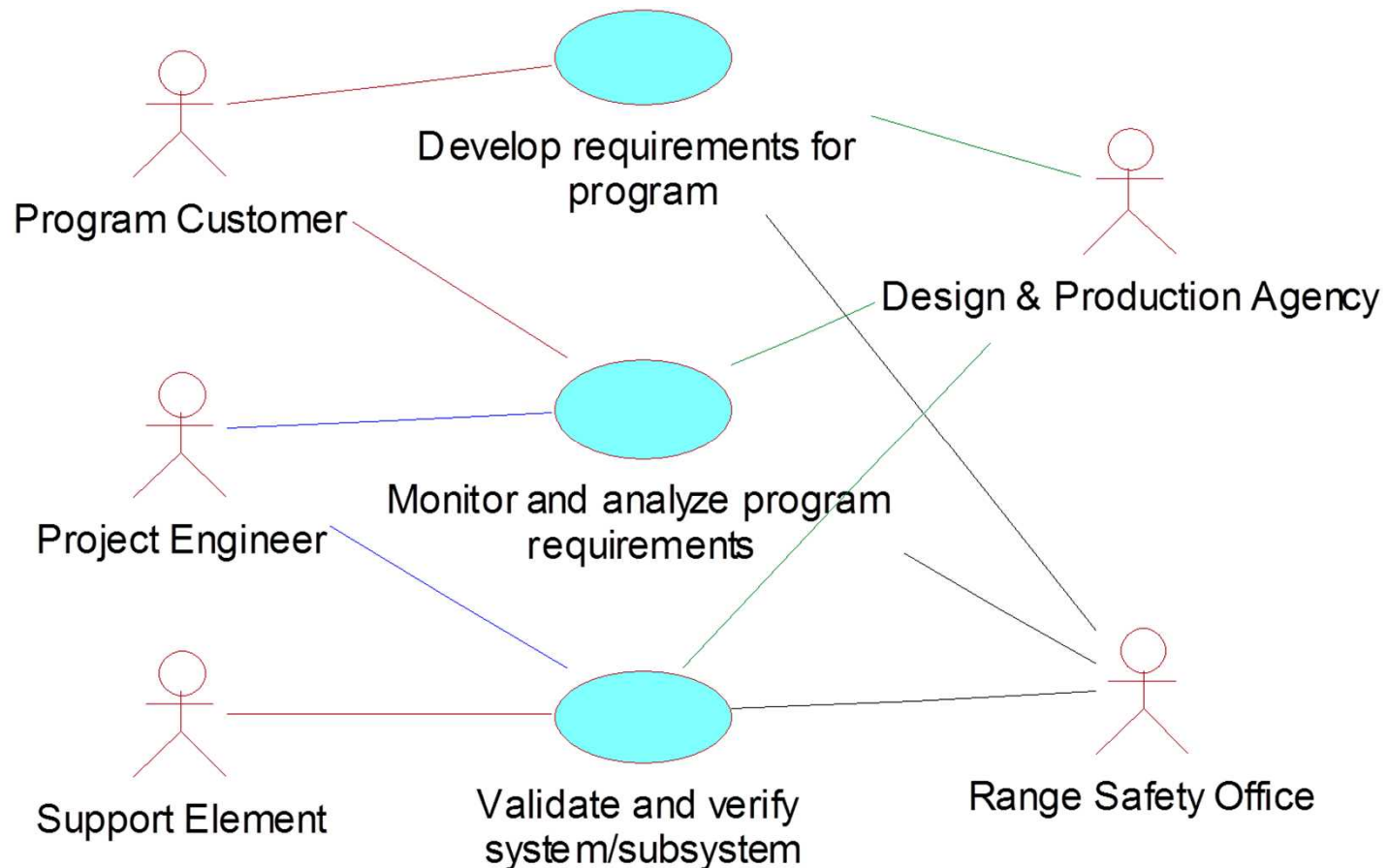

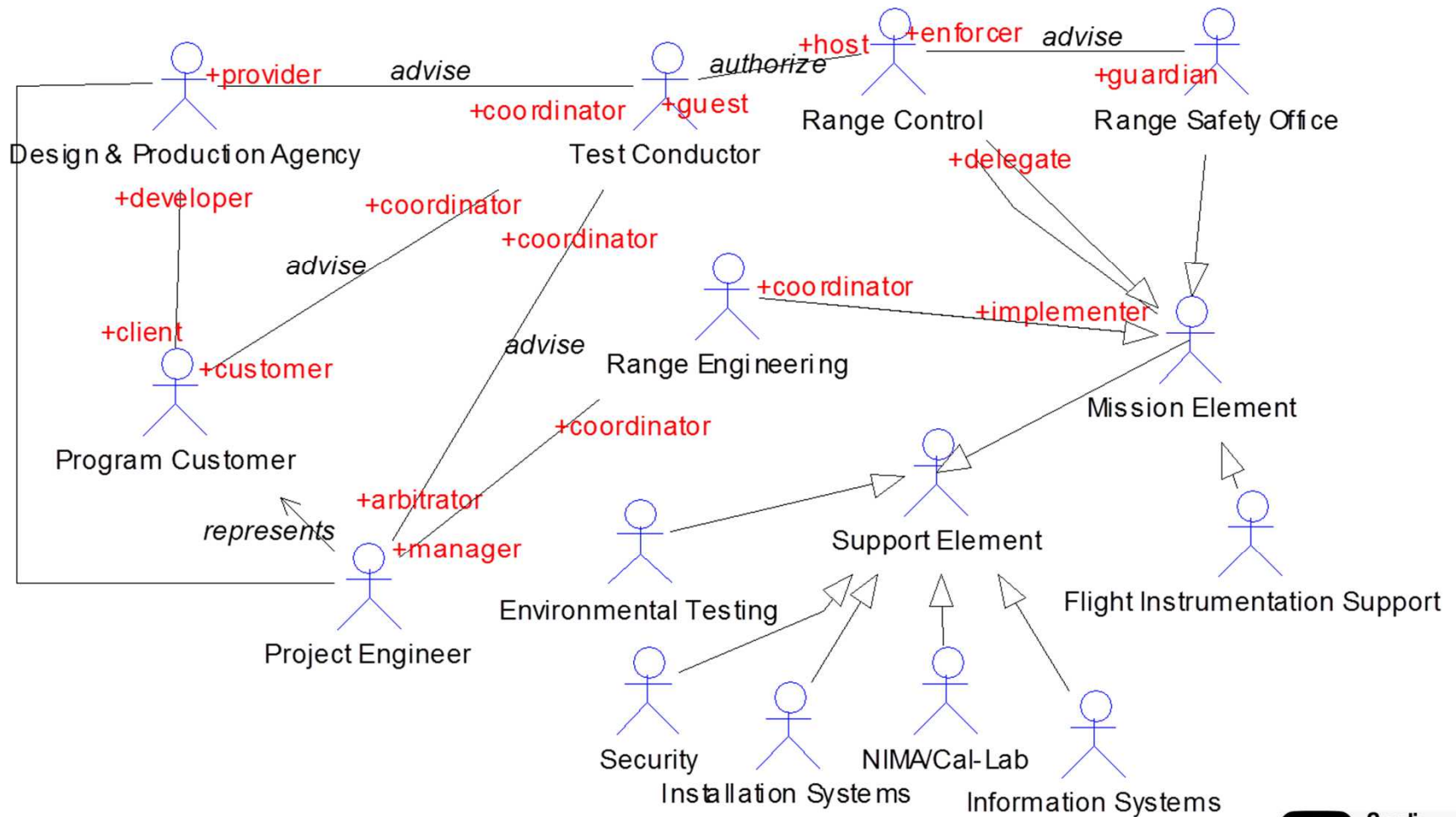**Modeling Spawns Process Improvement Initiatives**

Measurement Changes

- Change culture to rely on metrics as improvement tools
- Align metrics to provide information on tool operational effectiveness
- Develop predictive modeling capabilities

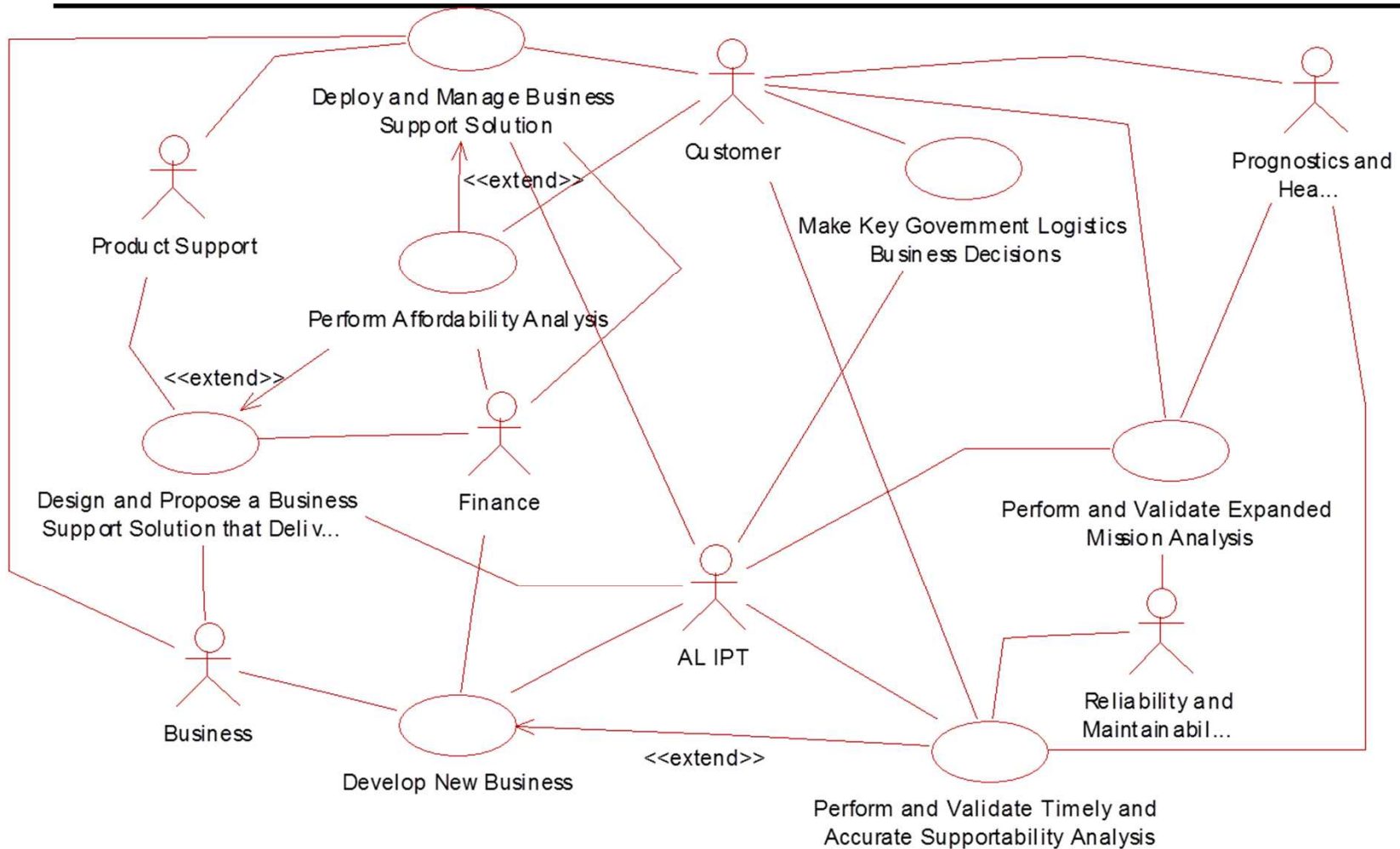**Model Drives Explicit Definition and Flow Down of Parametrics**

Flight Test Range Use Cases

Flight Test Range Stakeholders

JSF Logistics Use Cases

JSF Logistics Stakeholders

MBSE Requirements/Challenges (1)

- **Impacts external environment**
  - **Enter dialogue with Customers, Partners, Suppliers, and Policy Makers**
  - **Entire domain needs to evolve**
  - **Requires standards**
- **Cultural Change**
  - **Organizational perspective and investment**
    - **Move away from reactionary, one-shot perspective**
    - **Organizational investment in MBSE infrastructure, can't be tenuous**
  - **Systems Engineers**
    - **Serious tools and accountability**
    - **Move away from Power Point engineering**

MBSE Requirements/Challenges (2)

- **Resource availability**
  - **IT professionals with systems analysis background**
  - **Systems Analysts & Modelers required**
  - **Architects are hard to come by**
    - **Need to grow and mentor**
- **Long-term investment**
  - **Models need to be engineered**
  - **Models are tangible assets**
  - **Models require maintenance**
- **Tool Integration**
  - **Simulation tools operating in silo**

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