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An Ecological Approach to Evolving Domains Using MBSE

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Current State

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- 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

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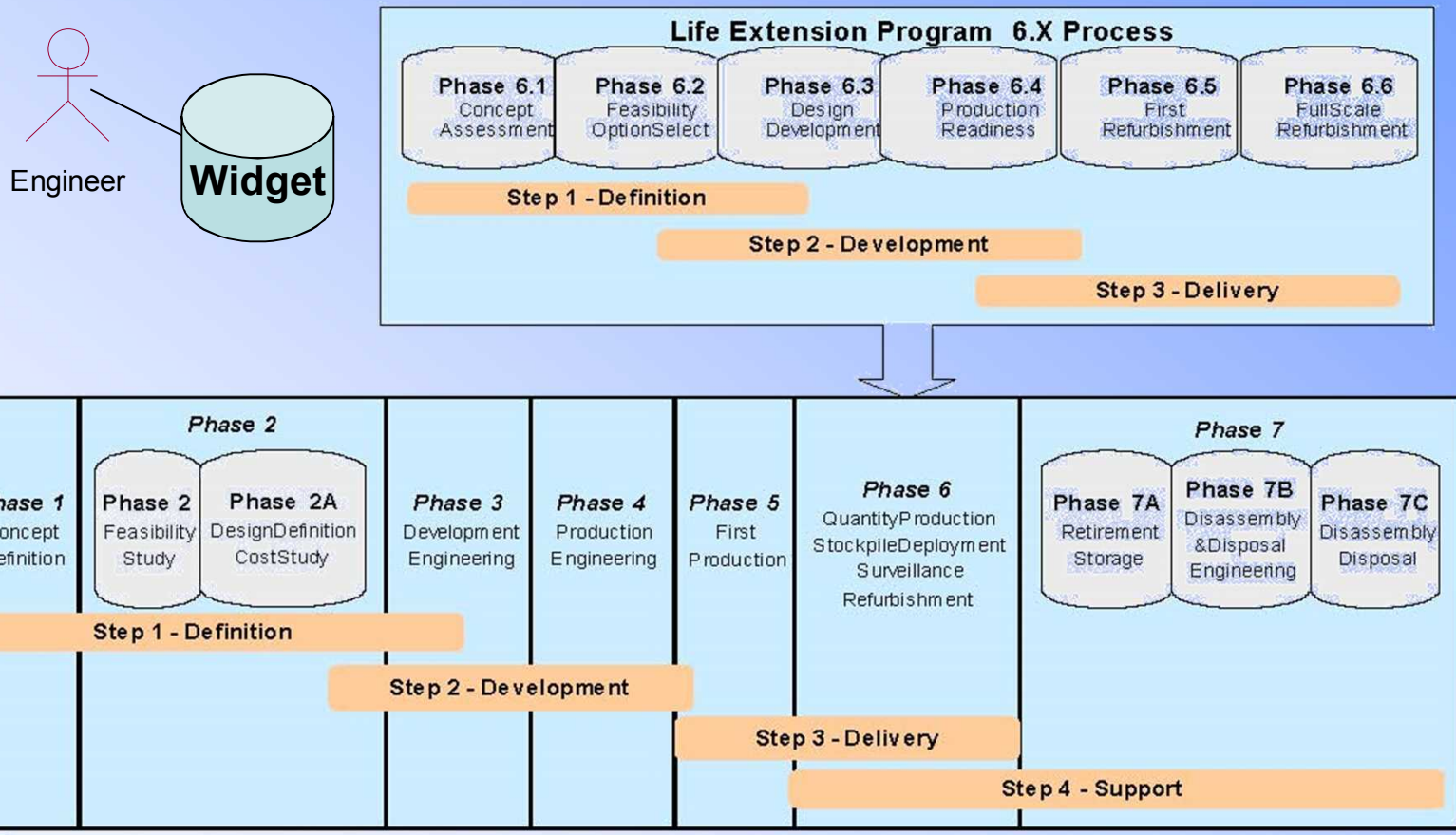

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Legacy M&S Approach

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- 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?

Alternate State

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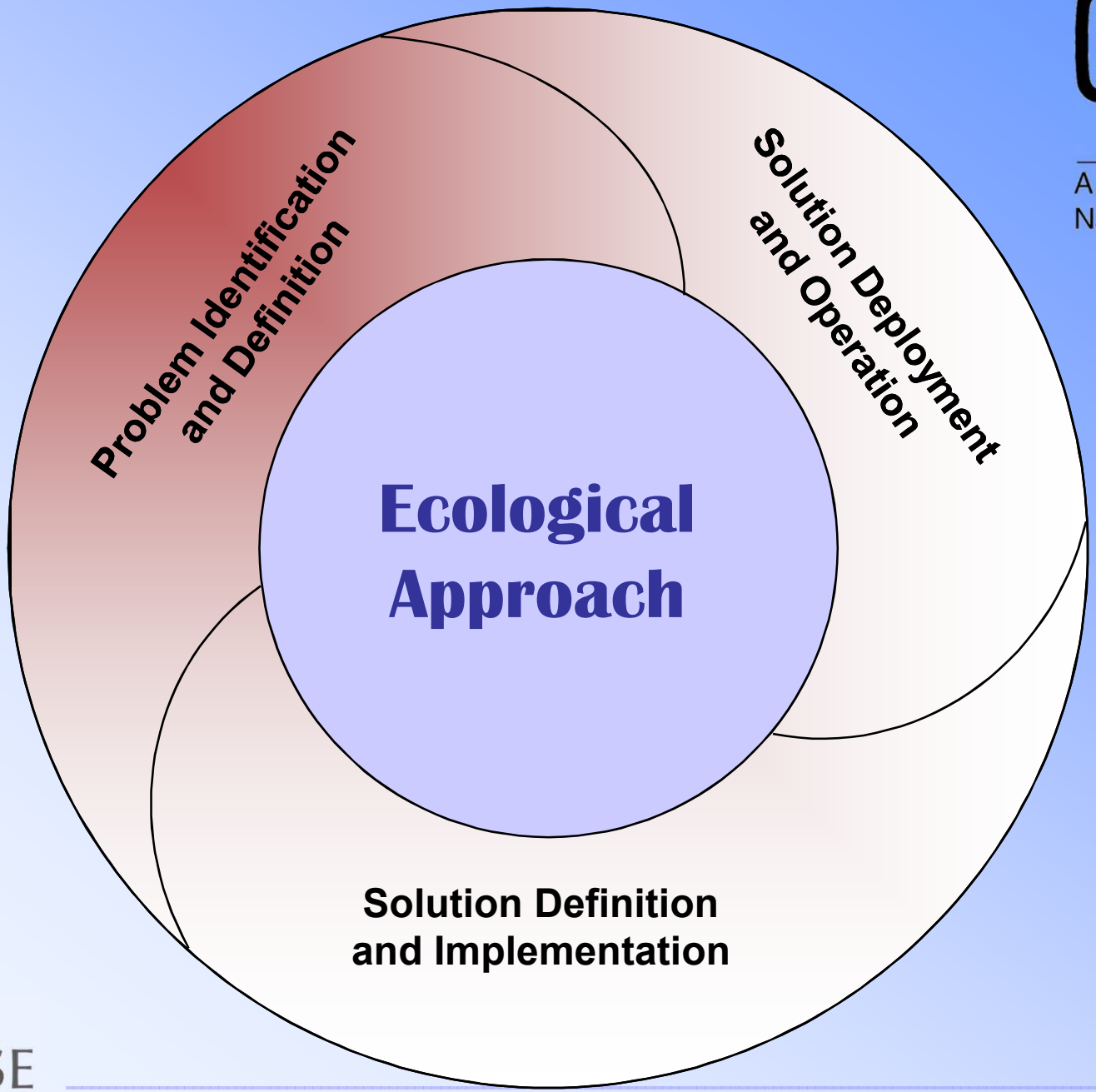
- Focus on domain or enterprise
  - No real end of life, unless something disruptive occurs
- Evolutionary approach to developing capability
- Multiple systems – multiple models all evolving

Evolutionary Domain-centric



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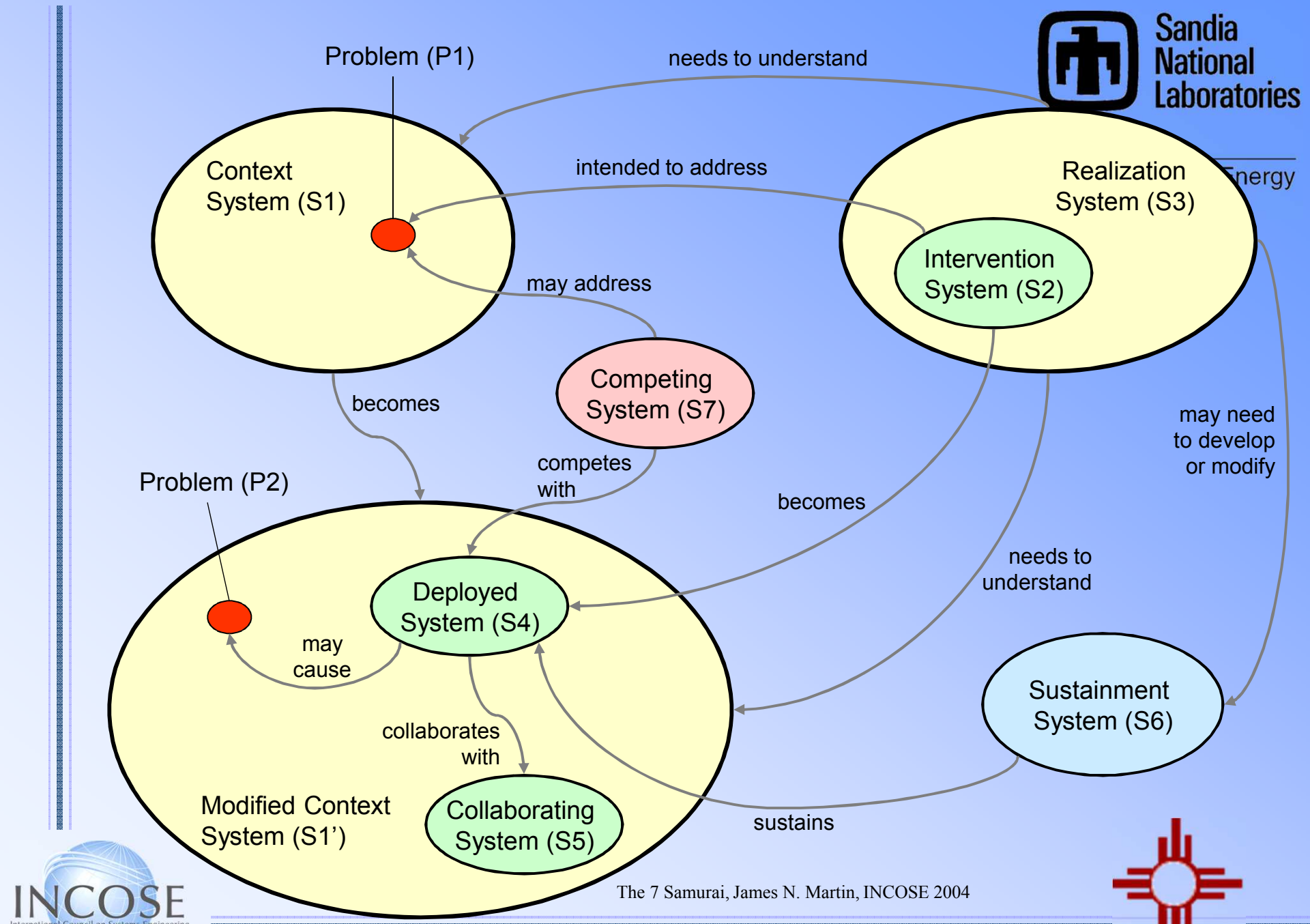

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Energy

The 7 Samurai, James N. Martin, INCOSE 2004

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Manufacturing Enterprise Model

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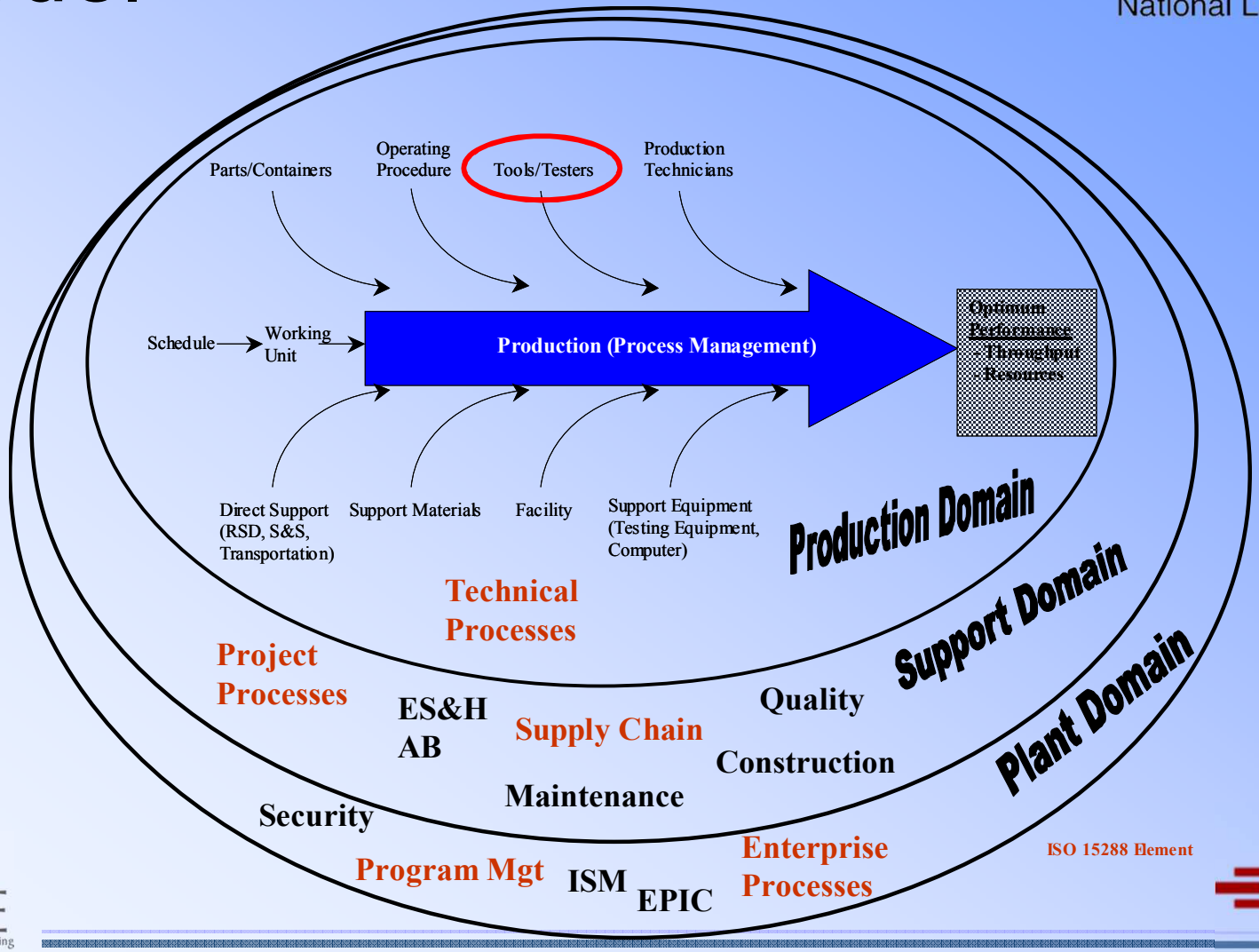
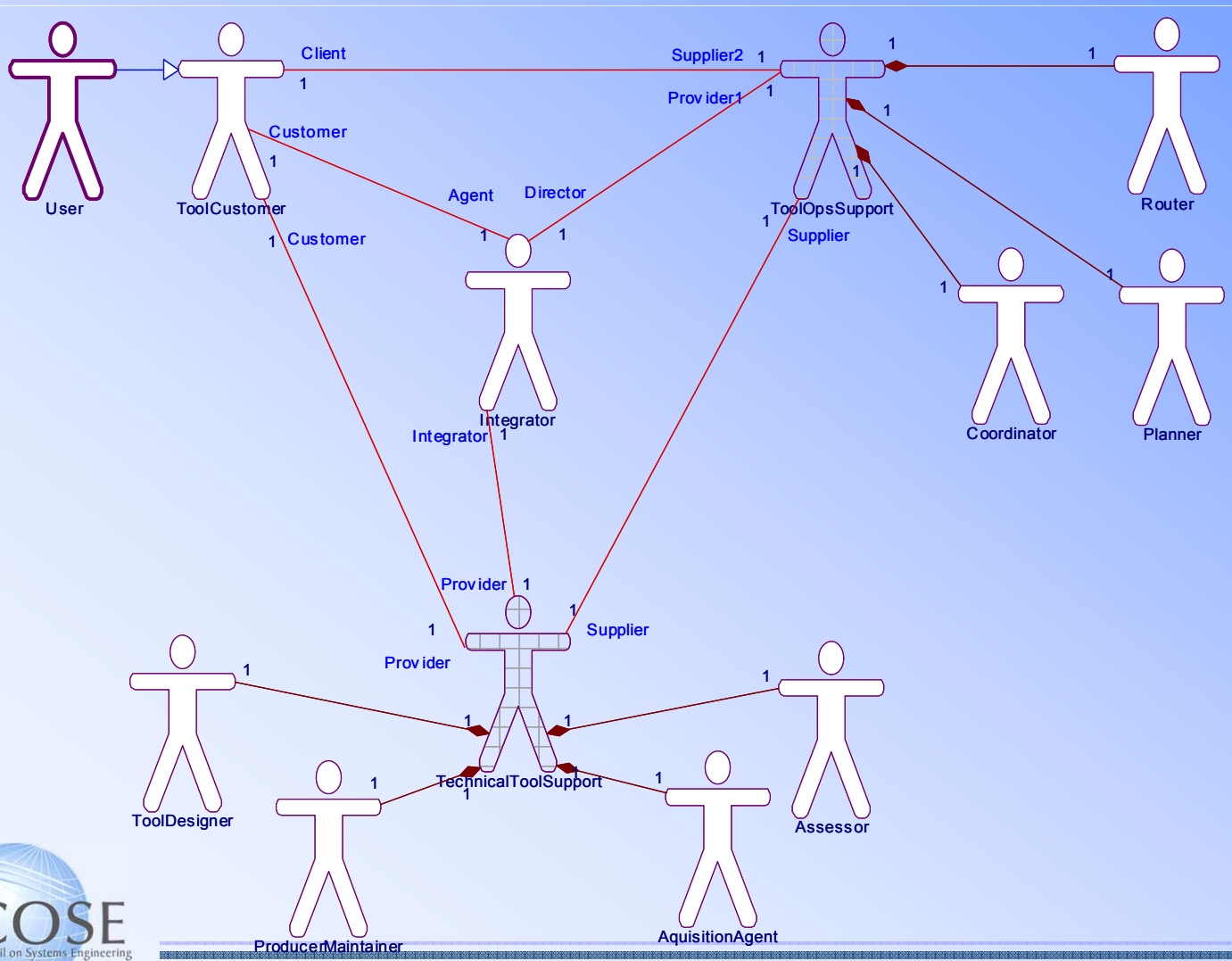


ISO 15288 Element

Tooling Stakeholders



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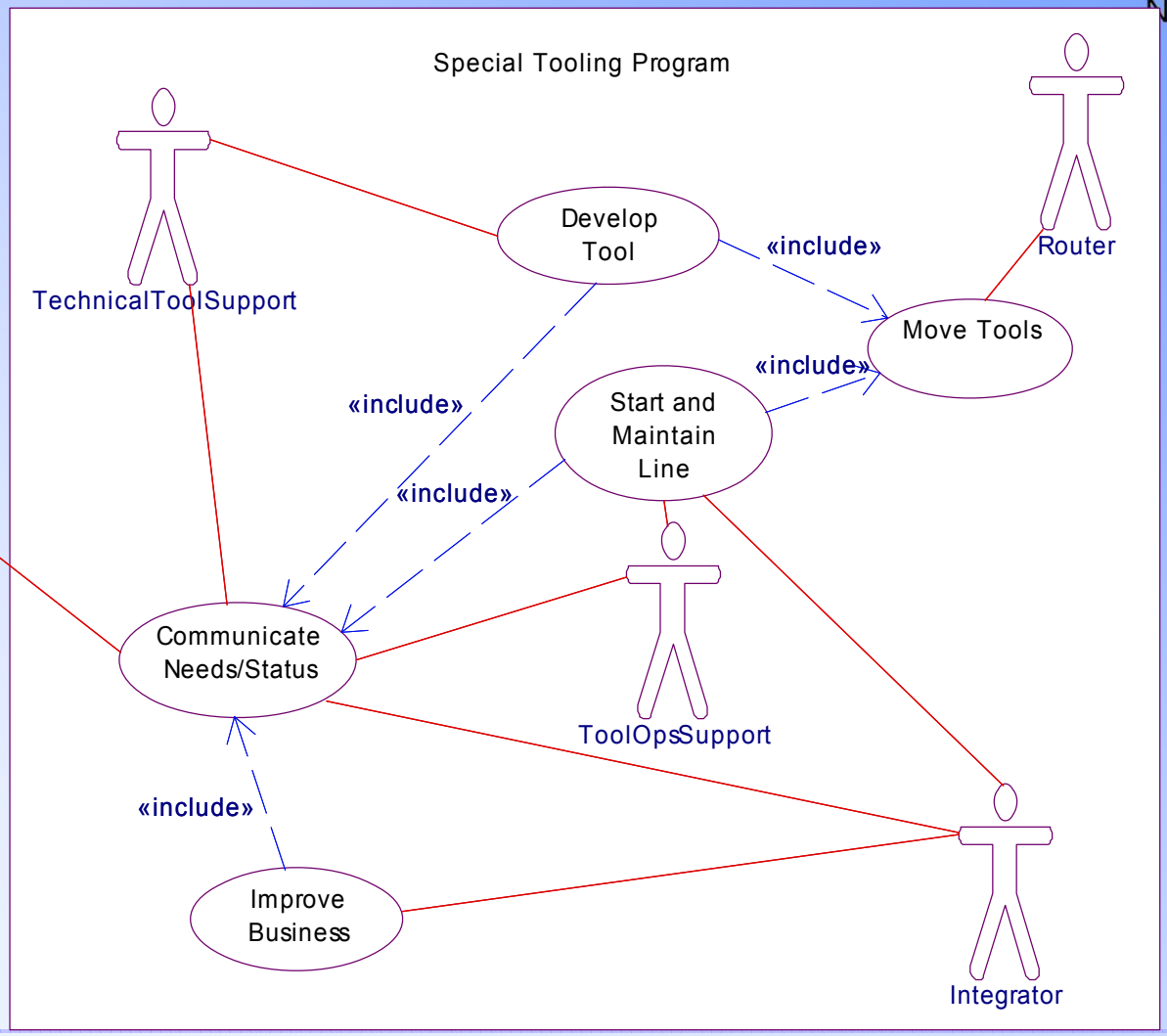
Behavioral Context



Goals of Modeling

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- Use the SE toolbox to develop a comprehensive integrated model of the Pantex Special Tooling Program
- A capstone view of the Special Tooling Program that all participants can relate to
- Identify Opportunities for Improvement
  - Enterprise
  - Operational
  - Workflow
  - Measurement
  - Information Systems

Model is an Organizational Asset

Enterprise & Information Changes

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- Enterprise Changes
  - Refine and expand enterprise model
  - Add dynamic simulation capability
- 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

Operational Changes

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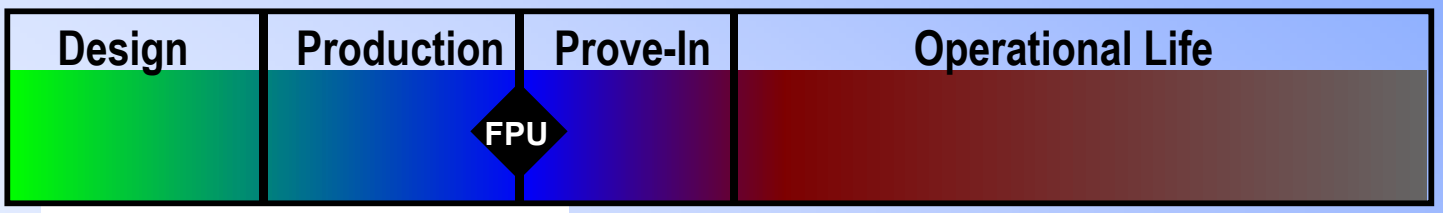
- Use Model to Guide Operational Changes
  - Standardization of workflow across all shops
  - Formalization of tool production and prove-in processes (transition from design to operational life)

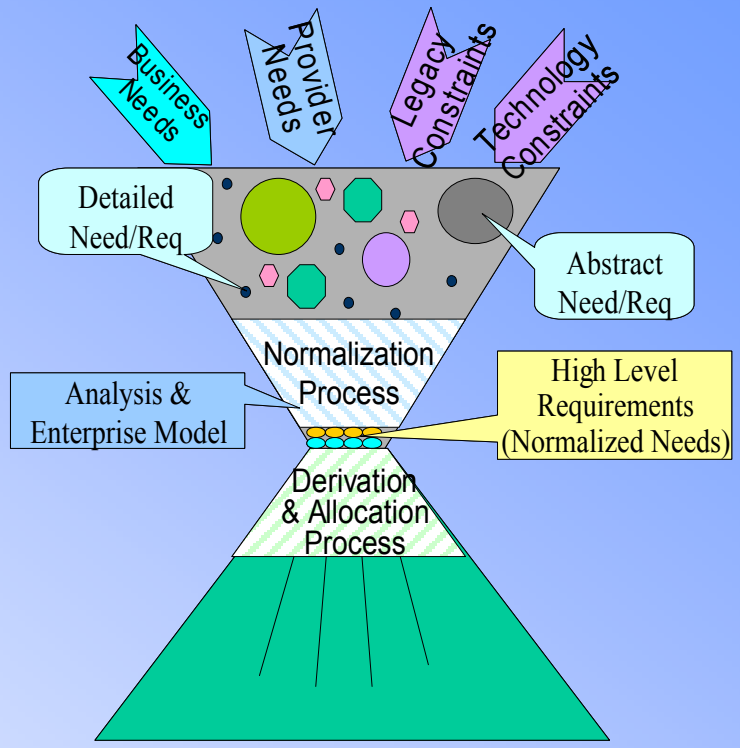


  - Improve accuracy and quality of work orders

Analysis of Model Guides its Evolution

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

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- 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

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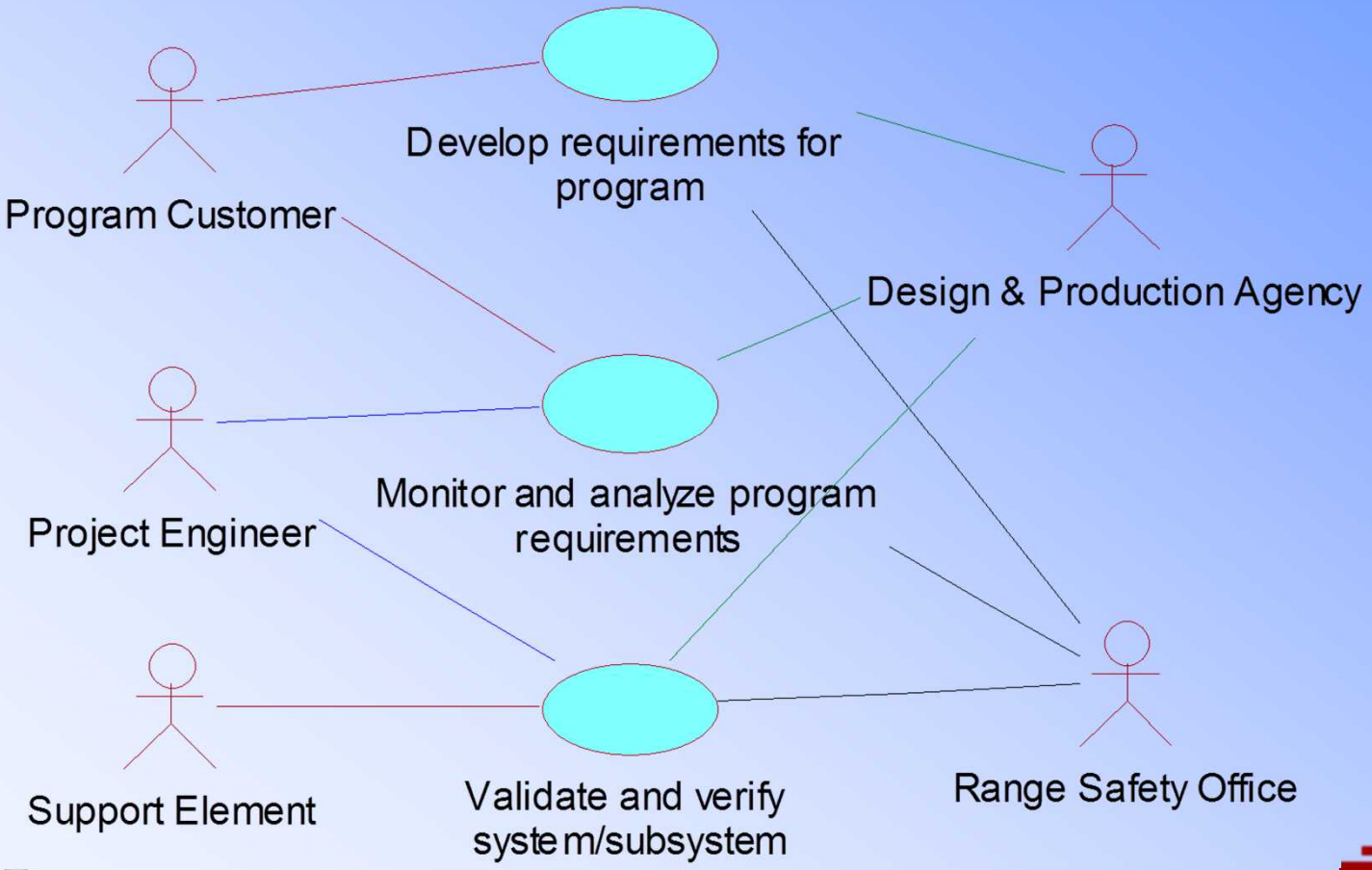

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Flight Test Range Stakeholders

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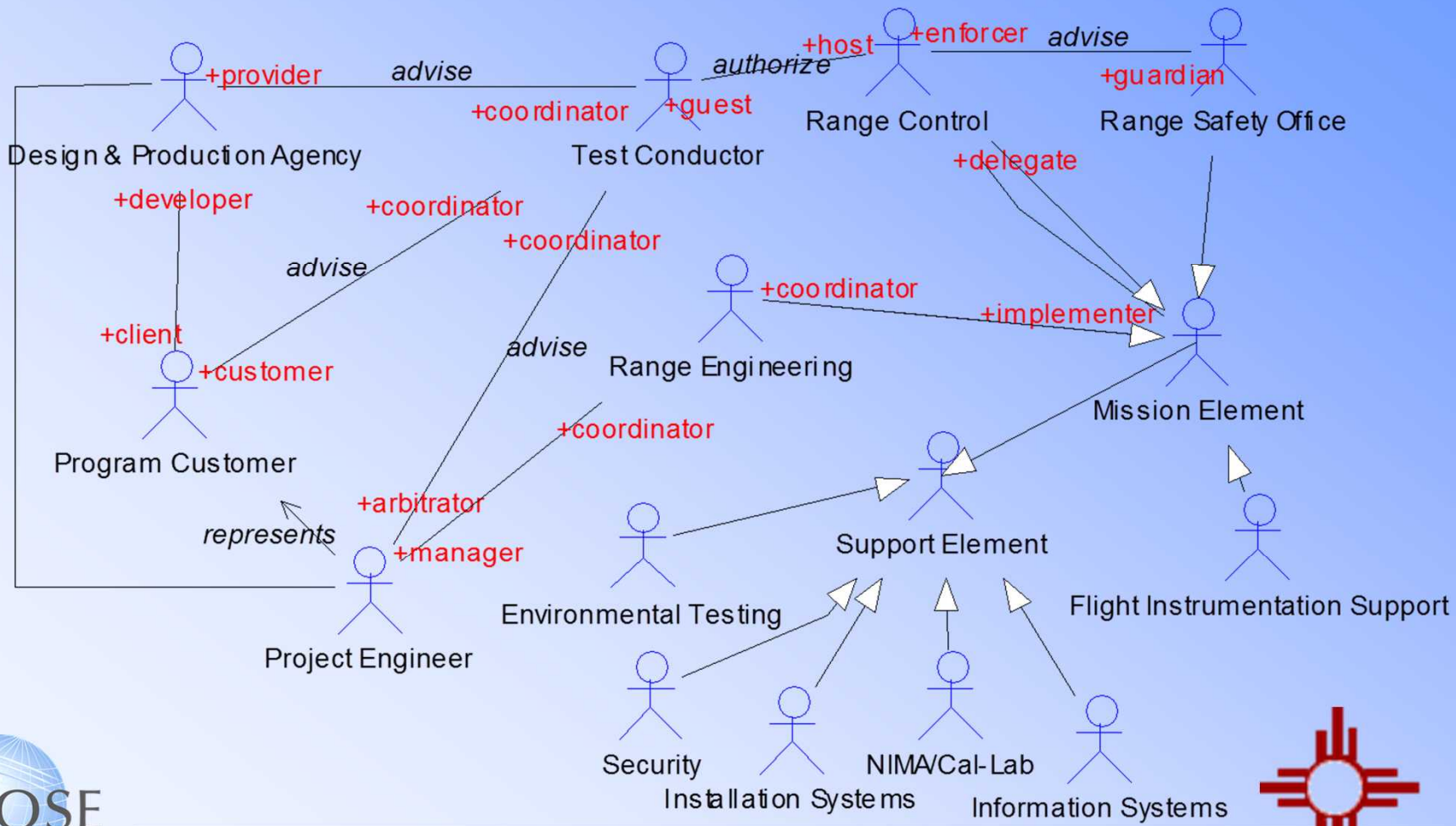

JSF Logistics Use Cases

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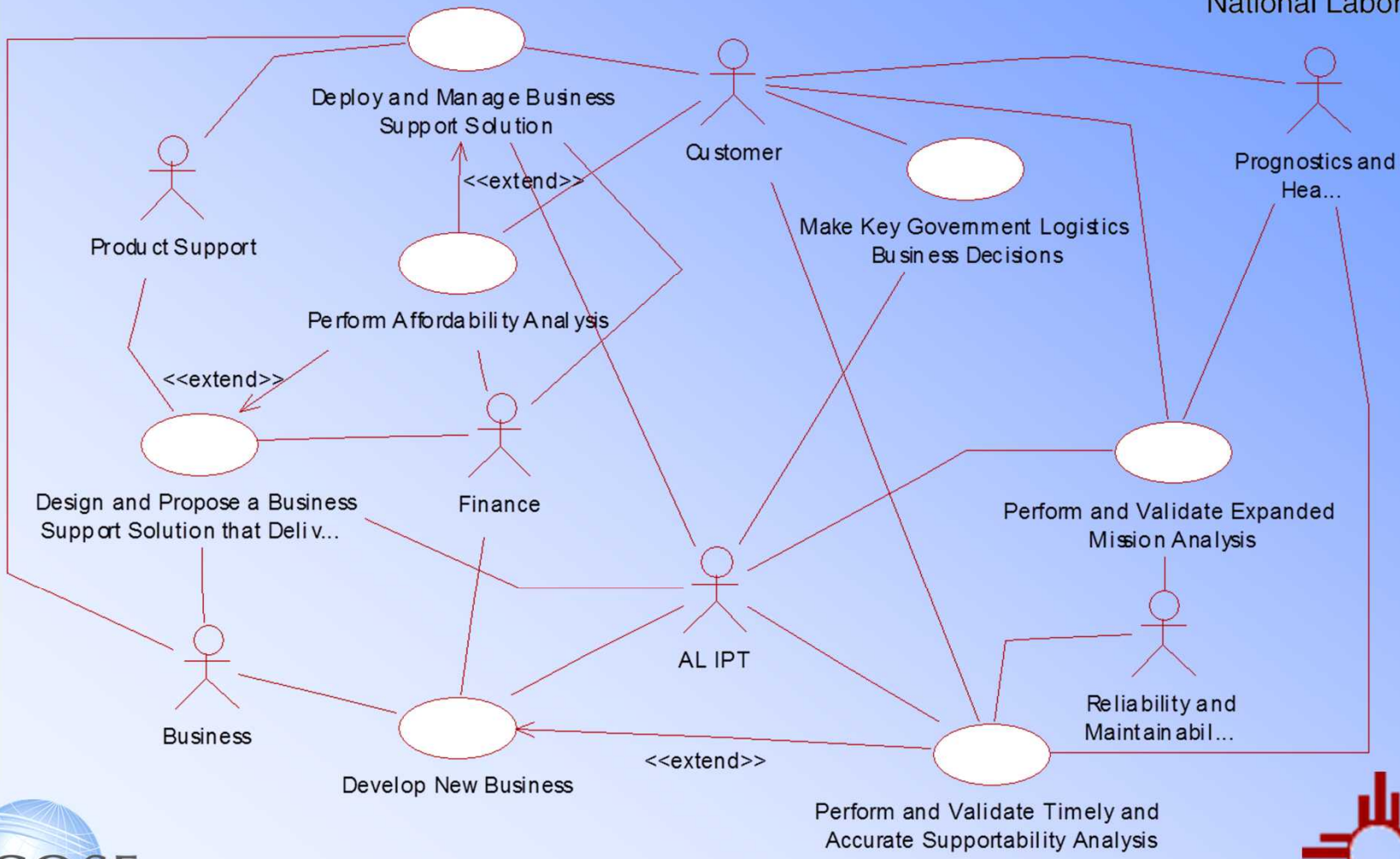

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JSF Logistics Stakeholders

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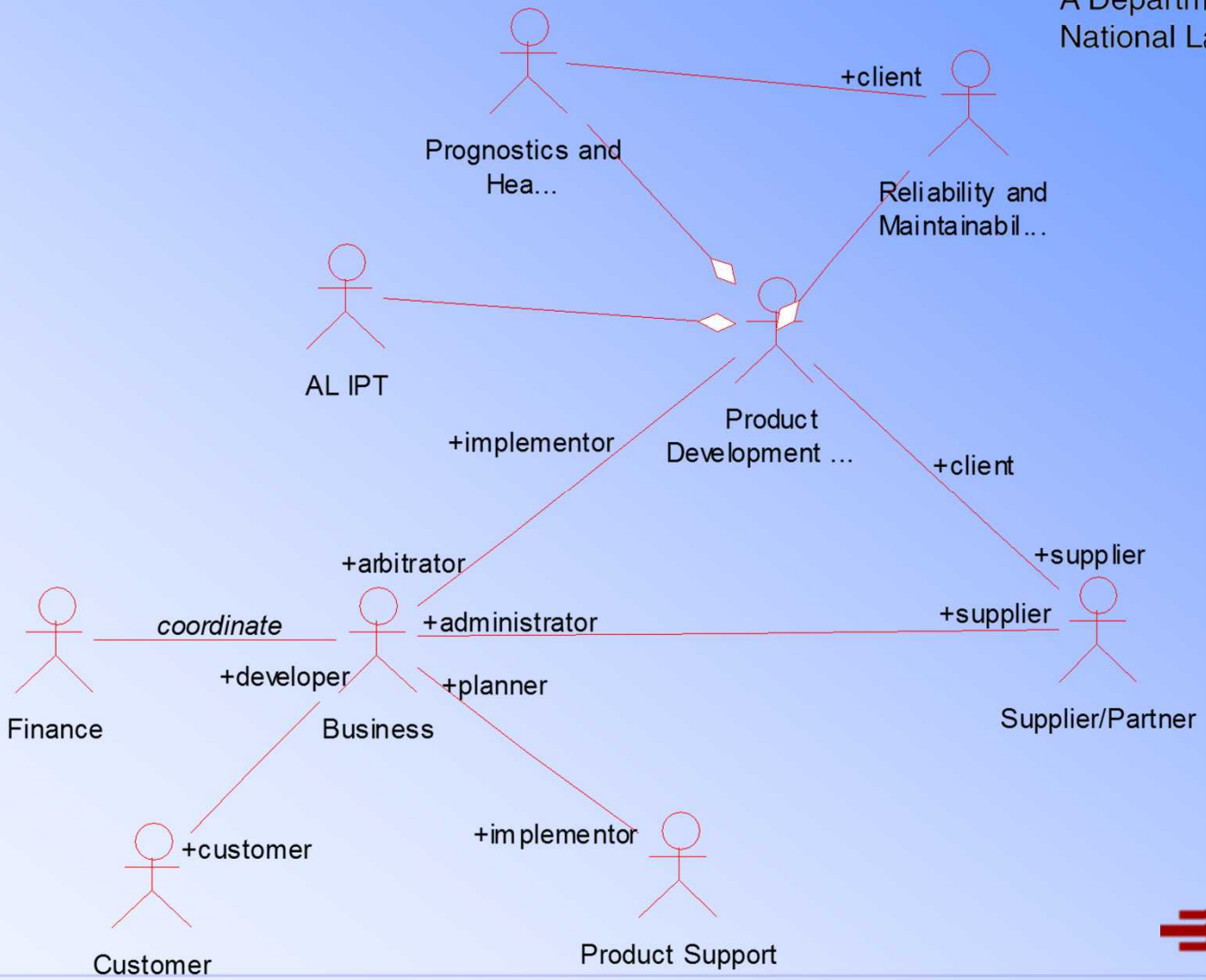

MBSE Inhibitors/Enablers (1)

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- 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 Inhibitors/Enablers (2)

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- 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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Abstract

Systems or rather solutions to problems or opportunities exist in a context. That context is set in a domain. Examples of domains are Point of Sale (POS) Systems, Aviation, Home Automation, Homeland Defense, etc. In order to properly develop and evolve the service effectiveness of a set of systems that operate in a domain, models become critical. An "ecological" approach of developing the effectiveness of services in a domain is proposed in this presentation. Instead of developing point solutions based on a set of "symptoms" that present themselves, if domain models are used to analyze and predict results, then augmented based on deployed solutions in order to develop the next generation of solutions, the Systems Engineering community would be ahead of the power curve in incrementally evolving and integrating systems.

The key of course is substantial investment in high fidelity domain models that are maintained over time and instrumentation of domains in which deployed solutions exist. This ecological approach will be presented as well as examples of domain models that have been developed using UML and SysML as potential candidates. These domain models require more layers to completely realize the gains possible. This is the challenge put forth to the MBSE community, how can we reach this ecological approach to evolving domains using Model Based Systems Engineering?