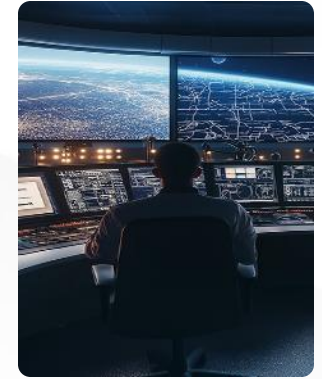
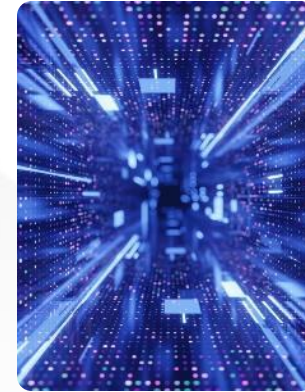


# ELEVATING DIGITAL ENGINEERING COMPETENCY

Dr. Heidi Davidz, Kim Nunn  
Intelligent Engineering  
September 17, 2025



# Elevating DE Competency:

An AI-Driven Metadata  
Analysis of Workforce Gaps  
and Systemic Failure  
Patterns in Systems  
Engineering

DE workforce gaps and systemic failure patterns persist

Enterprise architecture connects roles, competencies, interventions, dynamics

Optimize utilization of workforce to improve value delivery

*AI-Enabled Enhancements Throughout*

## Chasm to Overcome

*DE workforce gaps and systemic failure patterns persist*

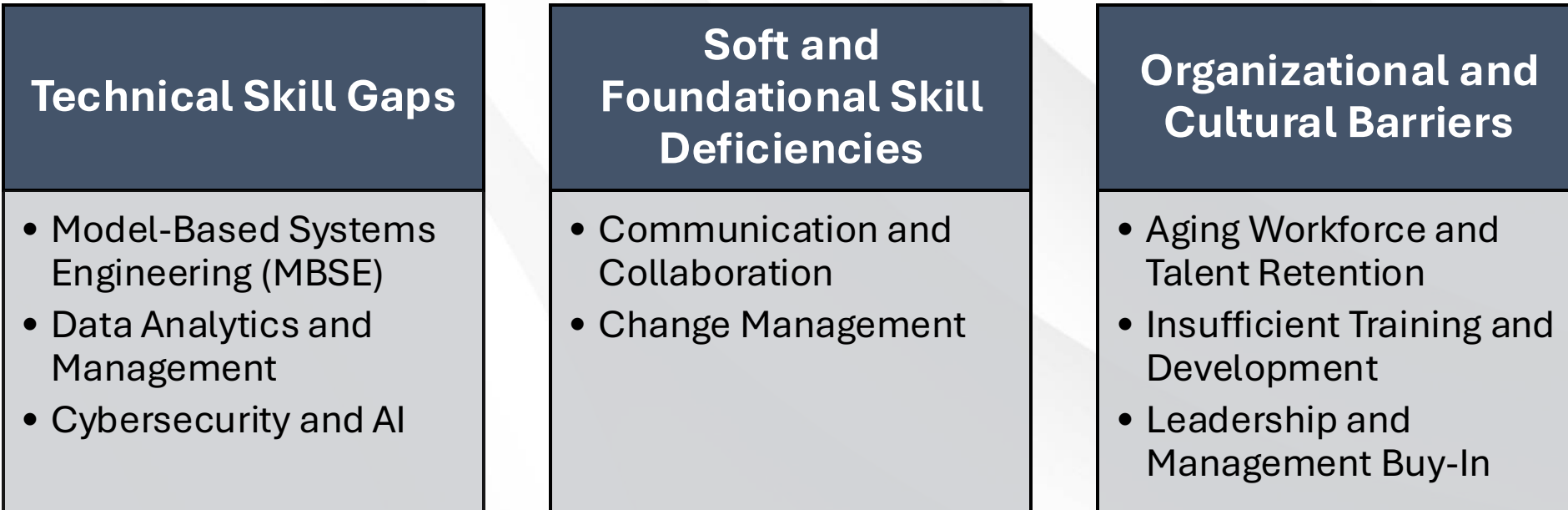
## Building Bridge

*Enterprise architecture connects roles, competencies, interventions, dynamics*

## Crossing the Gap

*Optimize utilization of workforce to improve value delivery*

# AI Metadata Analysis of DE Workforce Gaps



*Note: Generative AI results, validated with review of literature*

# AI Systemic Failure Patterns in Systems Engineering (SE)

Design and Technical Patterns	Organizational and Human Patterns	Process and Lifecycle Patterns
<ul style="list-style-type: none"><li>• Emergent Behavior</li><li>• Poor Human-System Interface</li><li>• Cascading Failures</li></ul>	<ul style="list-style-type: none"><li>• Normalization of Deviance</li><li>• Lack of Communication and Stakeholder Alignment</li><li>• The "Swiss Cheese Model"</li></ul>	<ul style="list-style-type: none"><li>• Inadequate Verification and Validation</li><li>• Unintended Consequences</li><li>• Single-Point Failure</li></ul>

*Note: Generative AI results, validated with review of literature*

# AI Systemic Failure Patterns in Executing SE

## Requirements Management and Communication Failures

- Incomplete or Ambiguous Requirements
- Requirements Creep
- Poor Communication

## Lack of a Holistic, Systems-Level View

- Sub-optimization
- Ignoring the Human Factor
- Ignoring the "Ilities"

## Management and Cultural Failures

- Schedule and Budget Pressures
- Disregard for Expertise
- Poor Change Management

*Note: Generative AI results, validated with review of literature*



# Additional Challenges of DE Workforce Execution

- Dysfunction metadata sensitive and difficult to access
- Individual competency not translating to team-level execution
- Training does not reflect real-world situation
- Organizational digital transformation has high failure rates (70-95%)\*
- Balance between digital literacy and industry experience\*

\* Source: AIAA, 2025

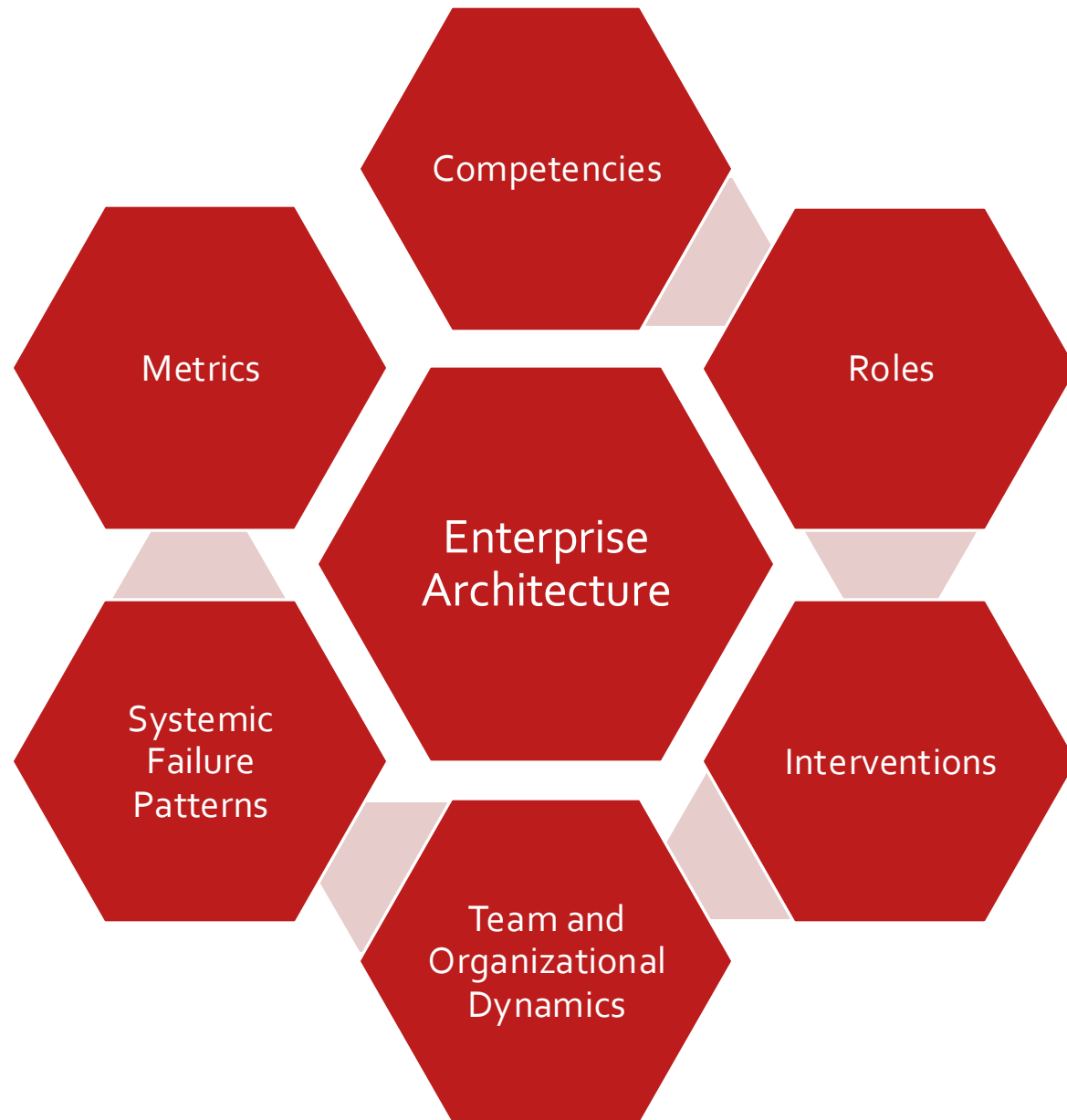
*Chasm to Overcome*  
*DE workforce gaps and systemic failure*  
*patterns persist*

**Building Bridge**  
*Enterprise architecture connects roles,*  
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*Crossing the Gap*  
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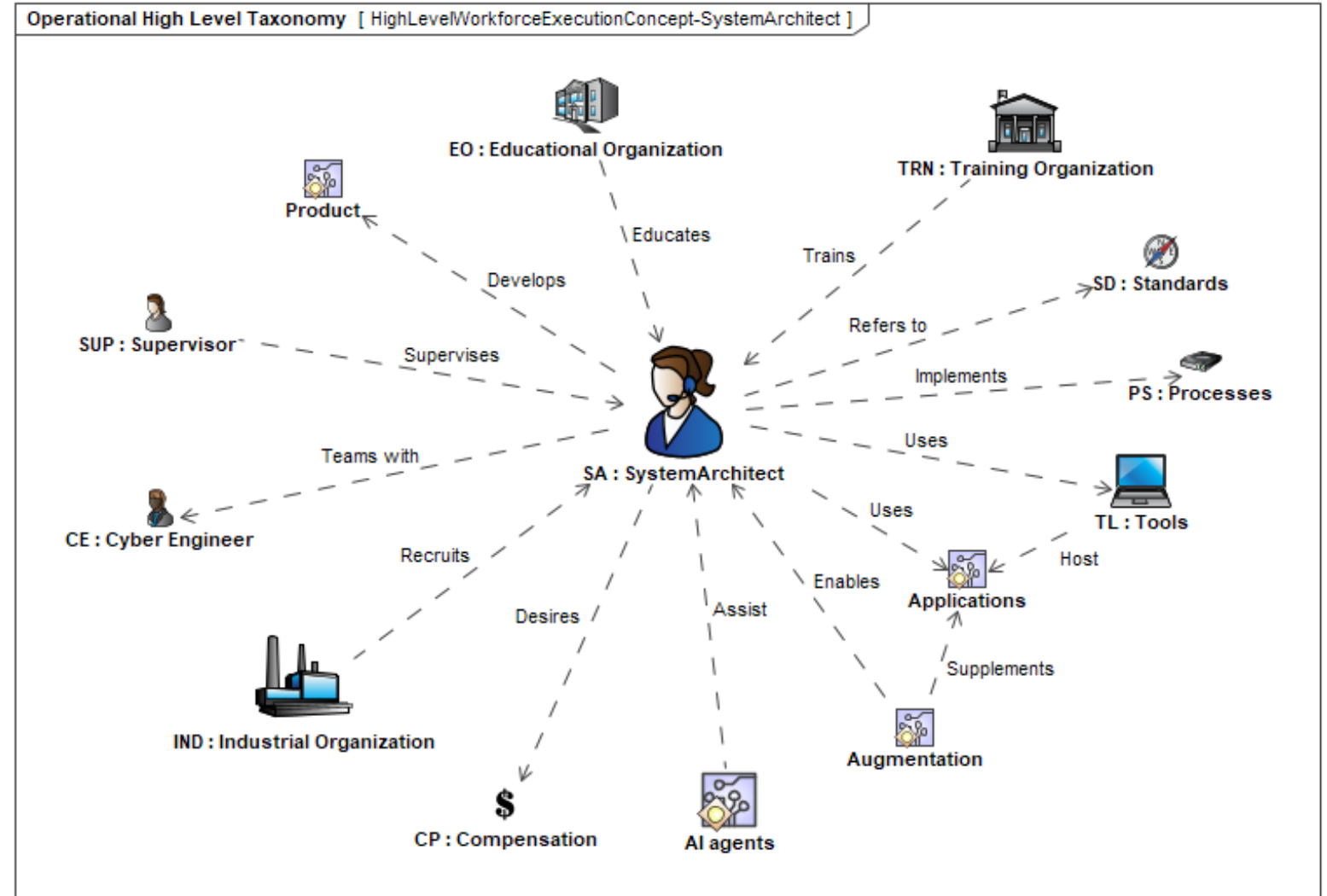


# Build the Bridge Using Enterprise Architecture

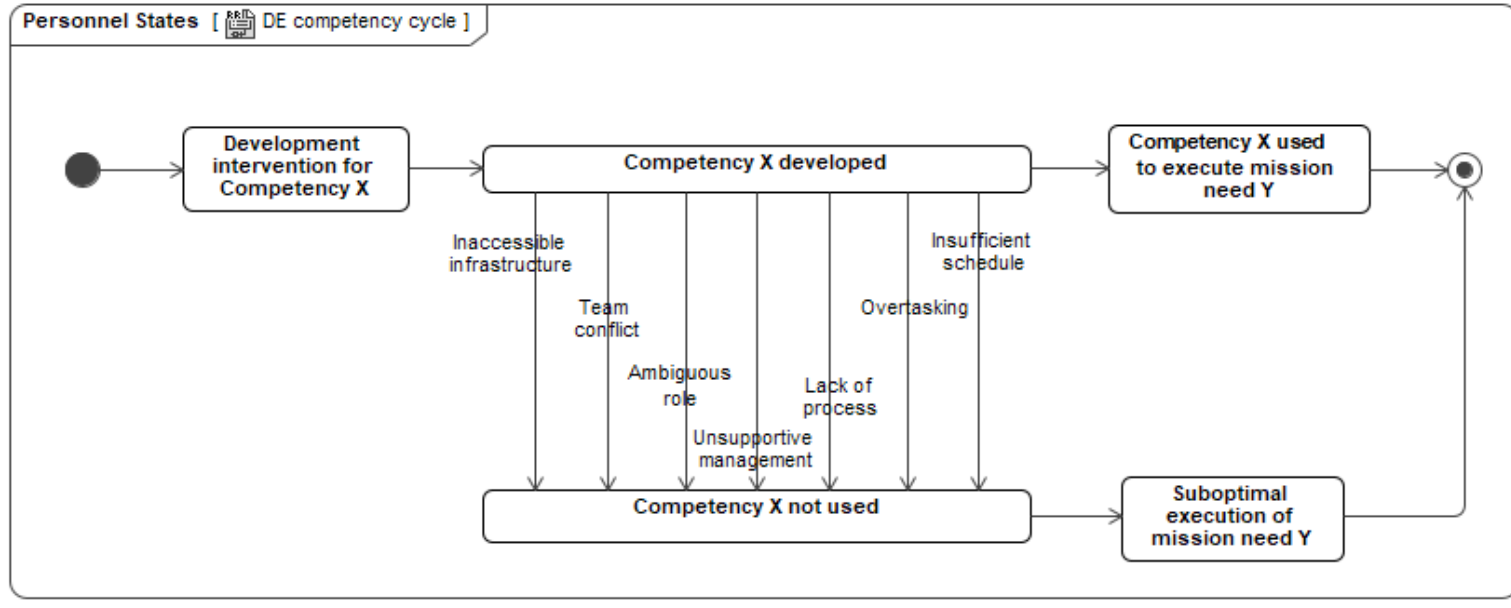


# Capture Influences

- Show interactions with multiple organizations, resources, systems
- Understand influences, positive and negative



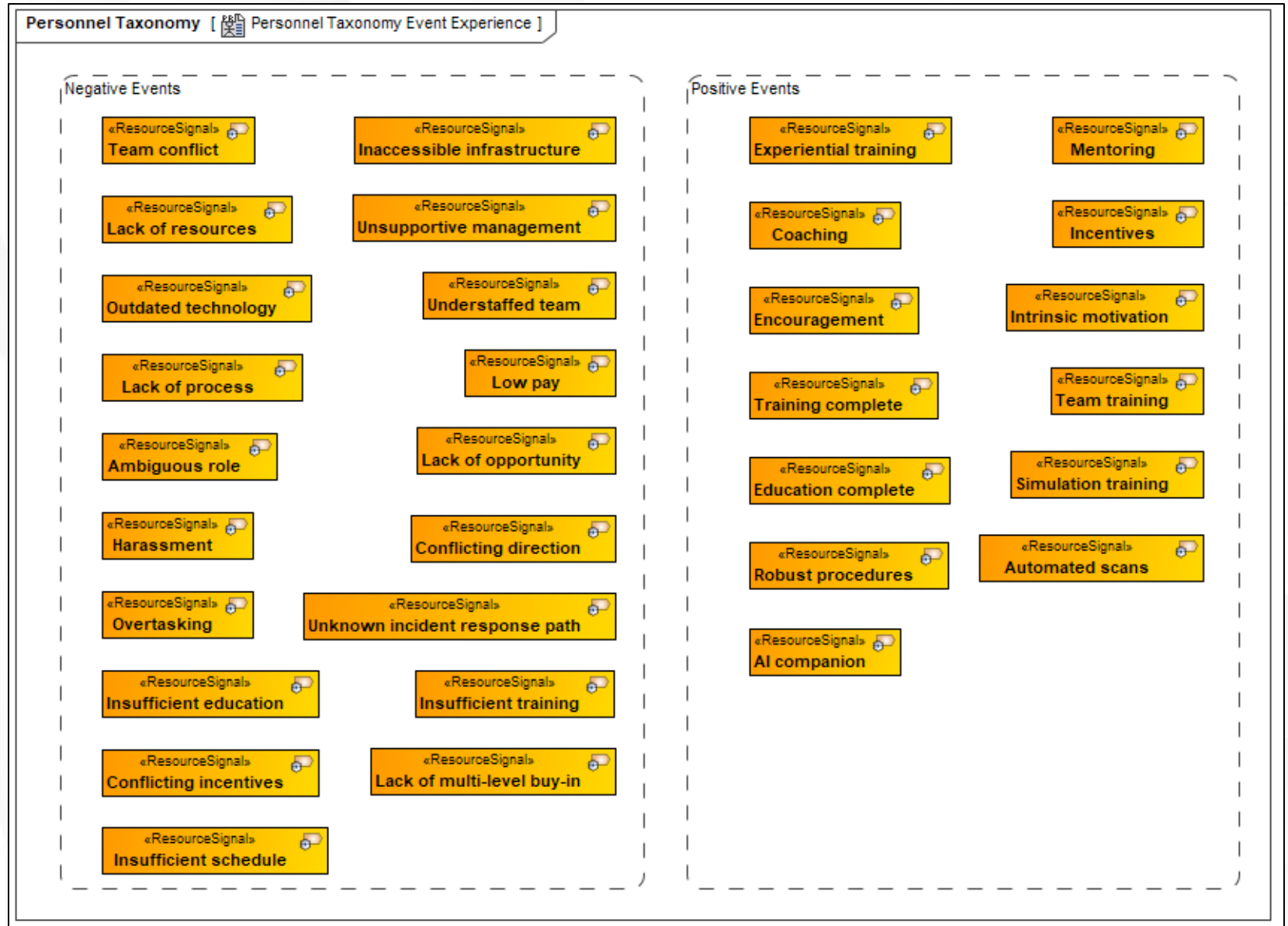
## Example Competency Cycle



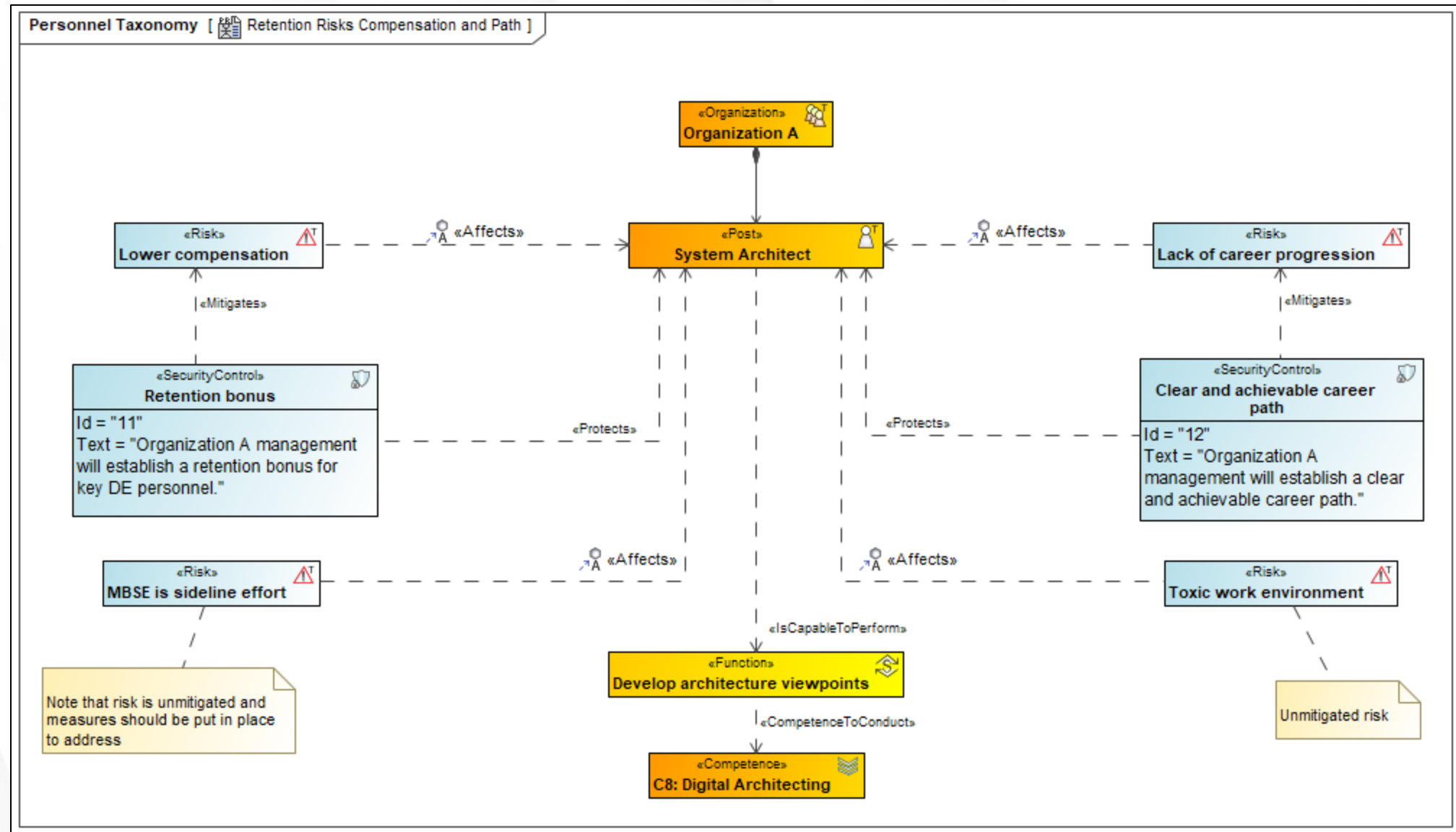
- Workforce gaps and failure patterns deplete competency effectiveness
- Evaluation of cycles can determine improvement opportunities

## Events in Path

- Workforce performance influenced by events
- Understand these interactions to intensify positives and limit barriers



# Map Dynamics



# Holistic Workforce Development Strategy

- Integrate needs, development initiatives, retention incentives
- Modeling highlights any gaps in existing approach and enables automated AI analysis
- Encourage feedback and refine through retrospectives





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**Crossing the Gap**

*Optimize utilization of workforce to improve value delivery*



# Crossing the Gap as an AI-Enabled DE Manager

- Customize for context
- Develop and execute plan
- Collect metrics for visibility
- Use data & AI to fine-tune approach
- Be iterative and adapt to change
- Right-size level of complexity





# Opportunities

- Through integrated data fabric, connect architecture to actuals for analytics
- Use chatbot to identify gaps in planned strategy and performance
- Feed company-sensitive dysfunction data to local AI tools for failure patterns
- Scrape program and enterprise data for dynamic skills development needs
- Continuous knowledge expansion through AI-powered advancements



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# References

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Contact Us: [IntelligentEng@MANTECH.com](mailto:IntelligentEng@MANTECH.com)

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