



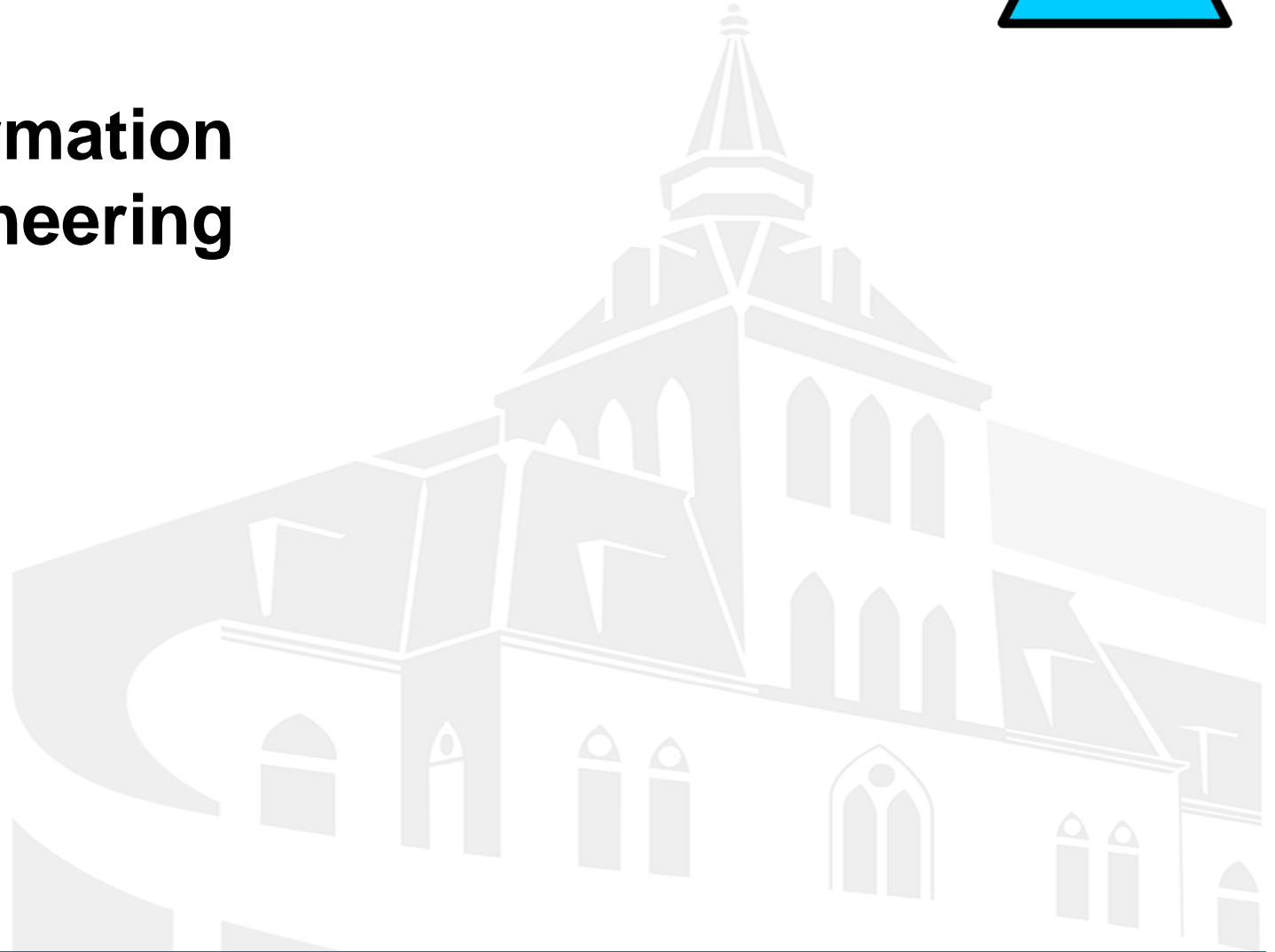
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# Governing a Digital Transformation for Intelligent Systems Engineering

*The promise of artificial intelligence and the need for effective governance to enable it.*

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Stevens Institute of Technology  
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# Who am I?

- Full Professor, Program Director, and Director of Graduate Studies at Stevens Institute of Technology, School of Systems and Enterprises; Visiting Professor at University of South-East Norway
  - DoD funded grant on redesign of JCIDS' governance and optimization of its requirement processes
  - DHS funded project on creating frameworks for designing embedded resilience within networks of Maritime Transportation Systems
  - FAA funded project on creating Agent-based Modeling and Simulation for Air Transportation in the United States
  - Lockheed Martin funded project on creating a Smart City in Antarctica
- Former Program Director and Business Consultant for non-governmental and non-profit sectors
  - BS in Industrial Engineering from Sharif University of Technology
  - MS in Industrial Engineering from University of Tehran
  - D.Sc. in Engineering Management from The George Washington University
  - Short-term consultation/projects to/for the World Bank, RAND, Eurasia Foundation, Freedom House, H.A.N.D. Foundation PARSA Community Foundation, etc.

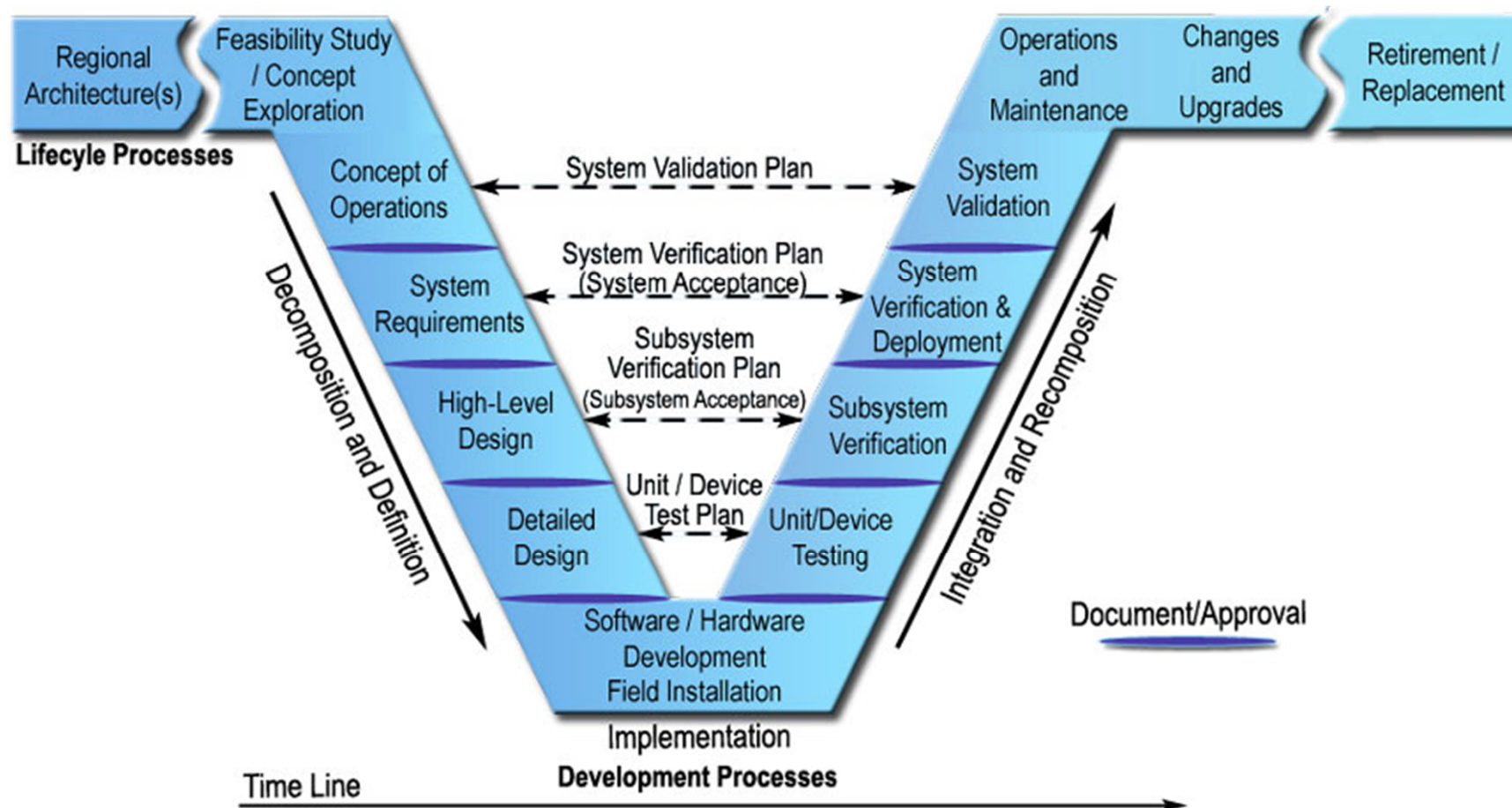


# Agenda

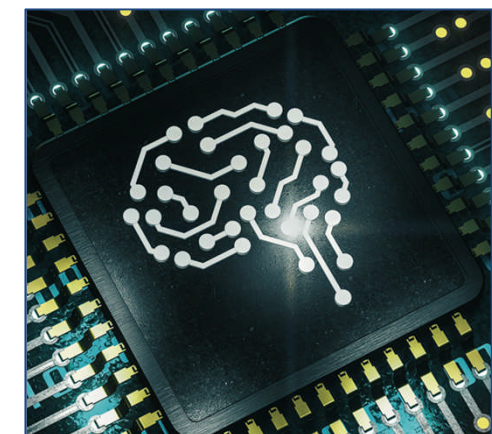
## AI, Systems Engineering, and Governance

- AI4SE
  - The promise of AI for better design.
- Case Study: Education and AI
  - The pitfalls of an unprepared society.
- Governing Digital Transformations
  - How to navigate the digital transformation for AI.
- Case Study: JCIDS
  - Opportunities for large scale change using AI and Systems Governance.

# Artificial Intelligence for Systems Engineering (AI4SE)



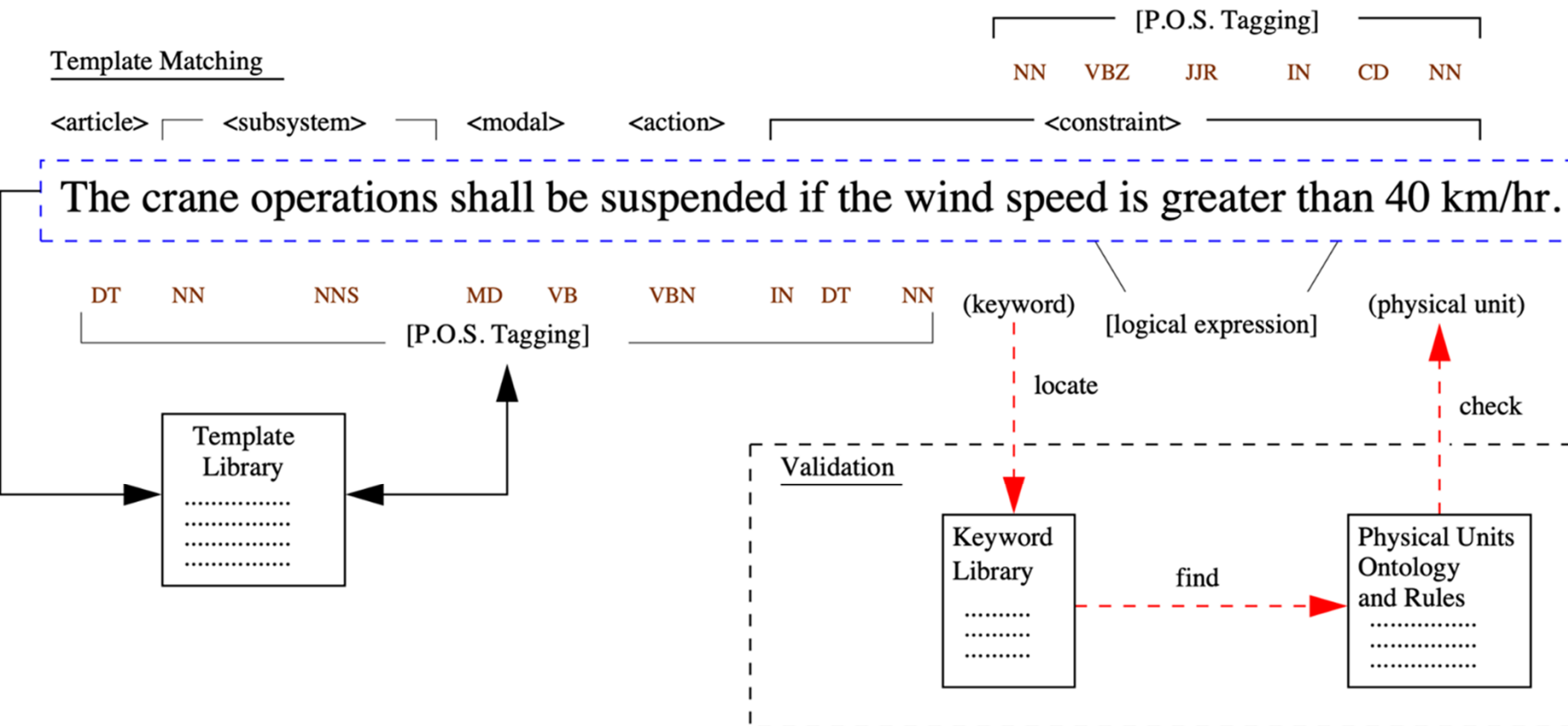
Artificial Intelligence can enhance systems engineering practices across the entire system lifecycle, from concept development to deployment.





# Natural Language Processing for Requirement Validation

Requirement: 5.2



Borjigin, S. G., Austin, M. A., & Zontek-Carney, E. J. (2022)



# Reinforcement Learning For Mission Engineering

In simulated environments actors can learn best strategies that later inform the development of requirements for military acquisition.



Kelly, E., Pevey, K., & Roach, D. (2022)





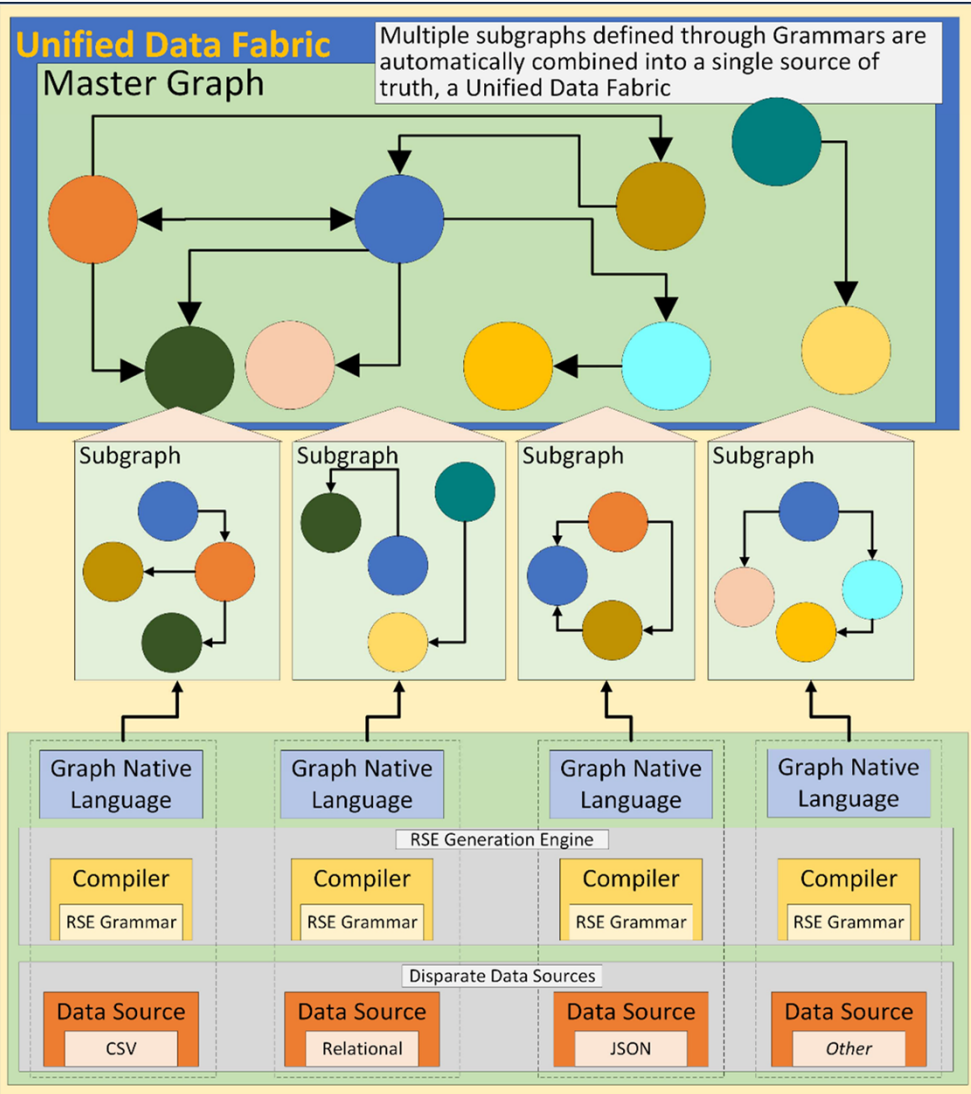
# AI4SE Antecedents - Digital Transformation

Unify enterprise data to enable AI practices.

Digitize historical systems engineering data to set a baseline for initial models

Positive feedback loop wherein AI4SE enables more digital transformation.

MITRE. (2022)







# Navigating the AI4SE Transformation - Governance

J

How is ChatGPT changing the education industry?



As an AI-powered language model, ChatGPT is contributing to the education industry in a few ways:  

1. **Access to Information:** ChatGPT can provide students with access to a vast amount of information on a wide range of topics, which can help them learn more effectively and efficiently. Through platforms like chatbots and Q&A websites, students can ask ChatGPT questions and receive answers instantly, providing them with access to information that they might not be able to find on their own.
2. **Personalized Learning:** ChatGPT can help personalize learning for individual students. By using natural language processing, ChatGPT can understand a student's needs and tailor its responses accordingly. This can help students learn at their own pace and focus on the topics they need the most help with.
3. **Collaboration:** ChatGPT can help facilitate collaboration among students, teachers, and researchers. For example, ChatGPT can be used to provide feedback on student work, help teachers grade assignments, and assist researchers in analyzing data. This can help foster a more collaborative learning environment and promote the sharing of knowledge.
4. **Innovation:** ChatGPT is also helping to drive innovation in the education industry. With its ability to understand natural language, ChatGPT is being used to develop new tools and applications that can improve learning outcomes. For example, ChatGPT can be used to develop chatbots that can answer student questions, analyze student data to provide insights into student performance, and provide personalized learning recommendations.

Overall, ChatGPT is changing the education industry by providing students with access to information, personalizing learning, facilitating collaboration, and driving innovation.



## Cheating by students using ChatGPT is already on the rise, surveys suggest

## NYC education department blocks ChatGPT on school devices, networks

By Michael Elsen-Rooney | Jan 3, 2023, 6:32pm EST

Here are the schools and colleges that have banned the use of ChatGPT over plagiarism and misinformation fears





# Systems Governance

## Mechanisms for Achieving Enterprise Goals

01

The goal of the education system is to prepare students for a successful life.

02

The introduction of artificial intelligence is disrupting how we achieve that goal.

03

This demands a rethinking of how we educate entirely.

04

More generally, proper governance is key in digital transformation.



# Systems Thinking for Systems Governance

01

Think of the system as a whole rather than the sum of its parts.

02

Event → Release of ChatGPT

03

Patterns → Digital tools enabling cheating

04

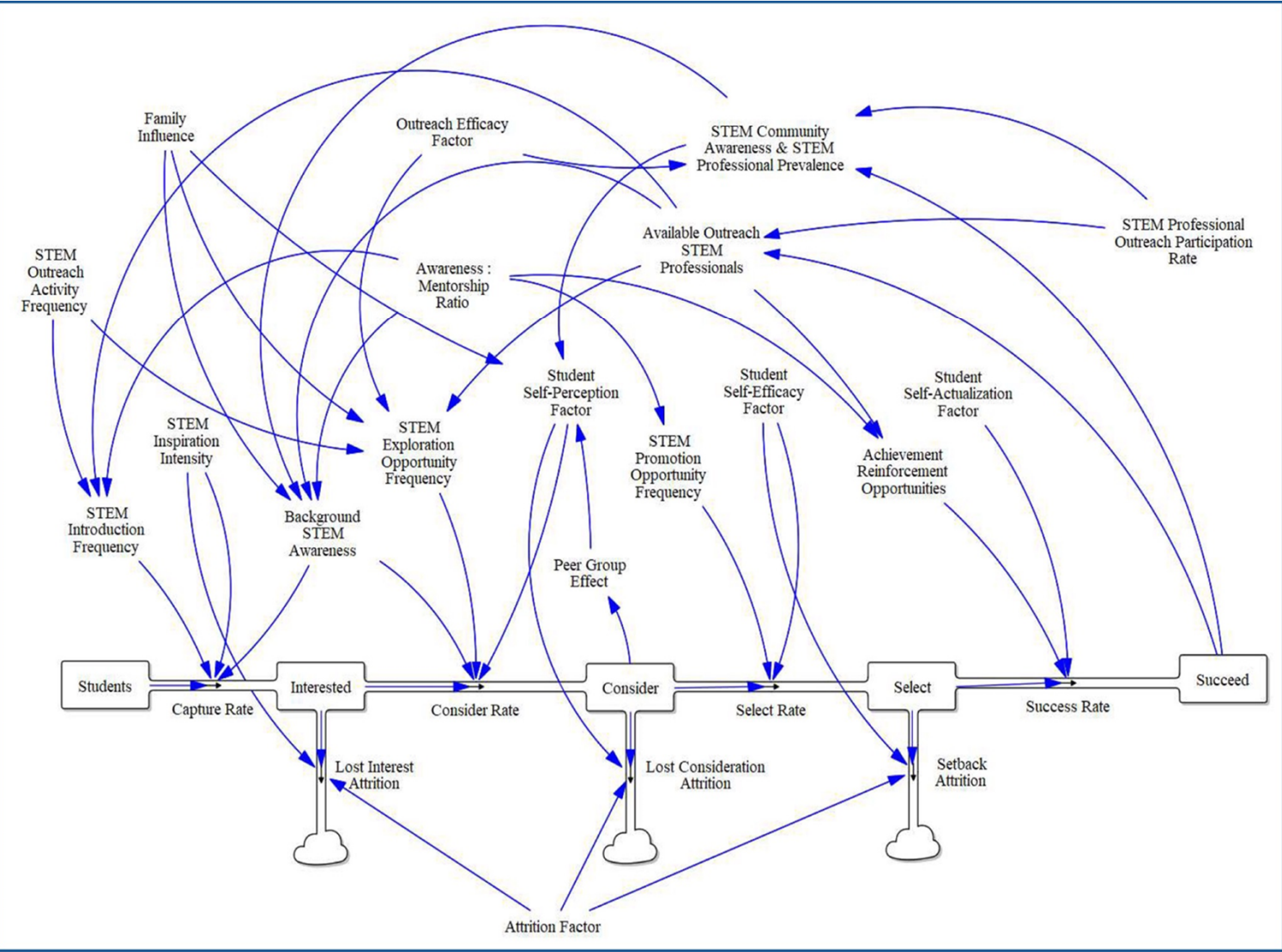
Structures → WE ARE HERE

05

Can we create new structures to account for AI in education and maintain the goal of education at the same time?



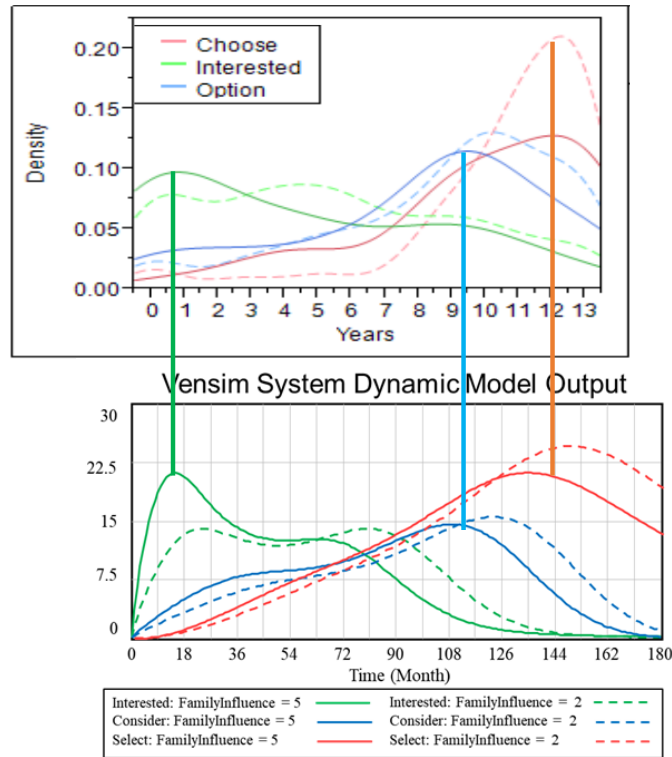
# Systems Dynamics



Operationalize systems thinking with systems dynamics.

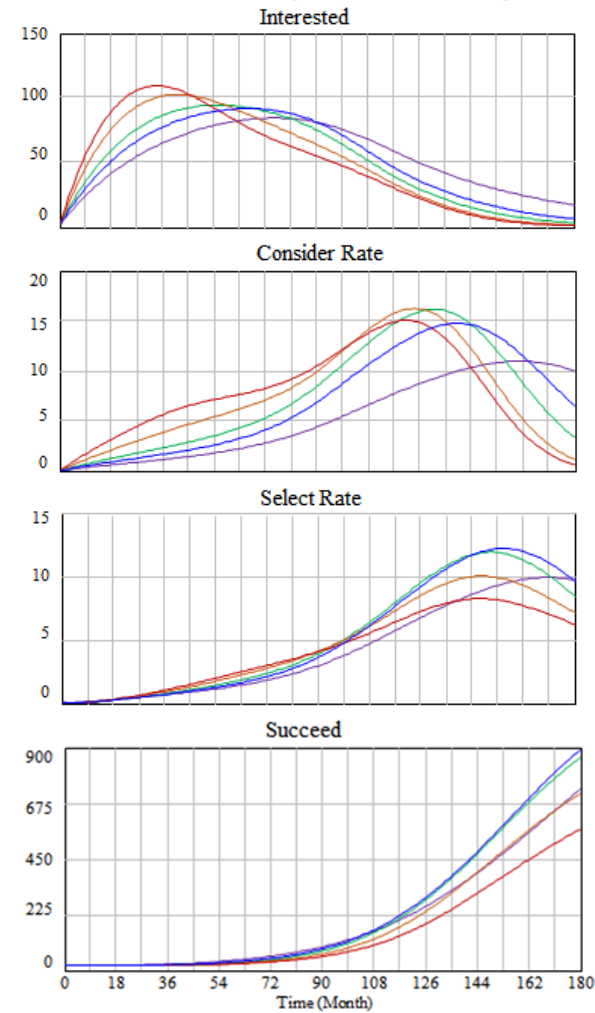
Appel & Mansouri (2022) Use systems dynamics to model the STEM outreach and career pipeline for K-12 education.

## V&V

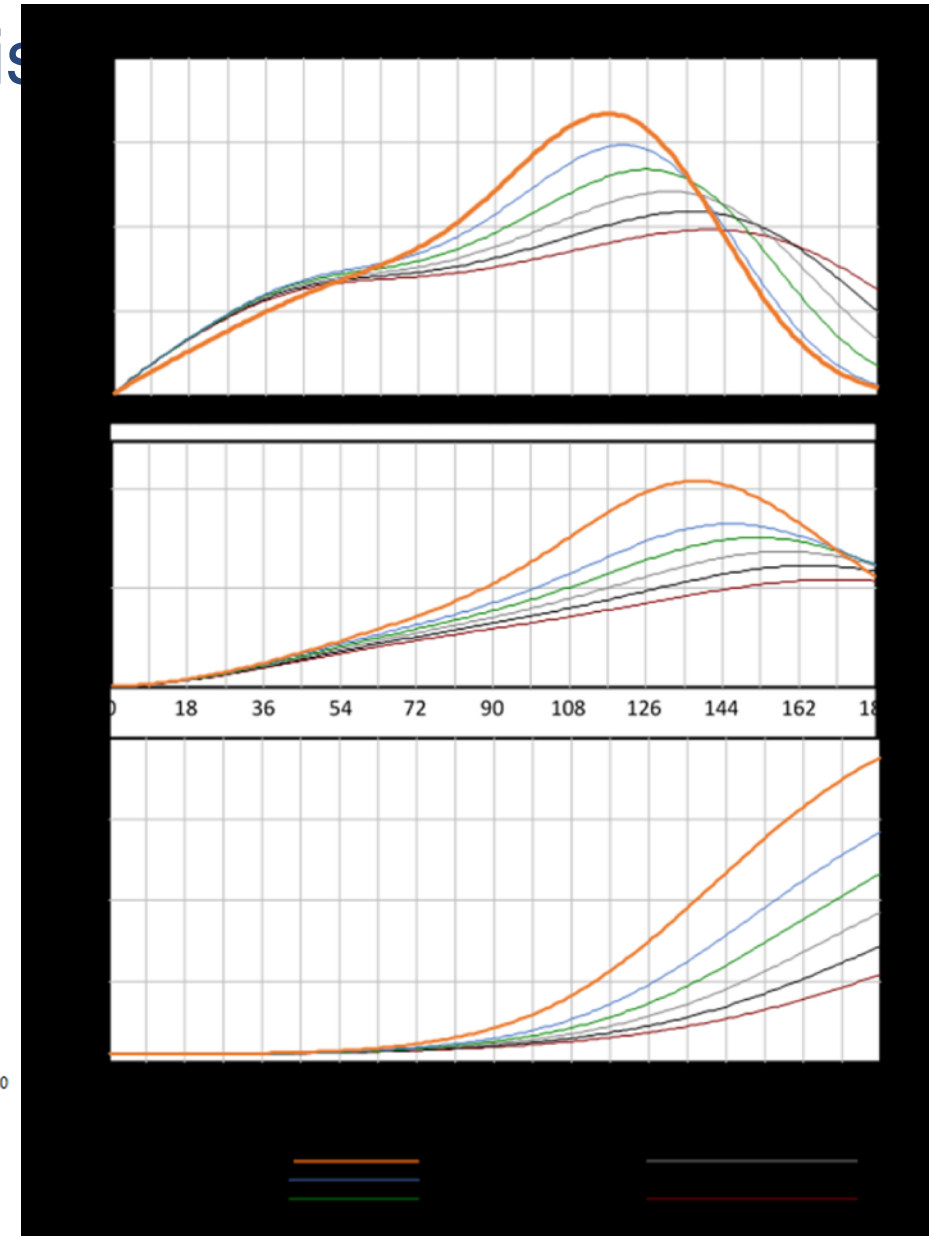


Vensim system dynamic model  
sensitivity analysis of background  
STEM awareness factors on career  
progression comparing Family  
Influence factor

## Sensitivity Analysis



Vensim Sensitivity Analysis of the  
Awareness to Mentorship Ratio Variable





# Systems Engineering: Enabling Digital Transformation

Chami et al. (2018) describe the components of MBSE adoption:

Coordination of...

1. Language
2. Method
3. Tool
4. Personnel

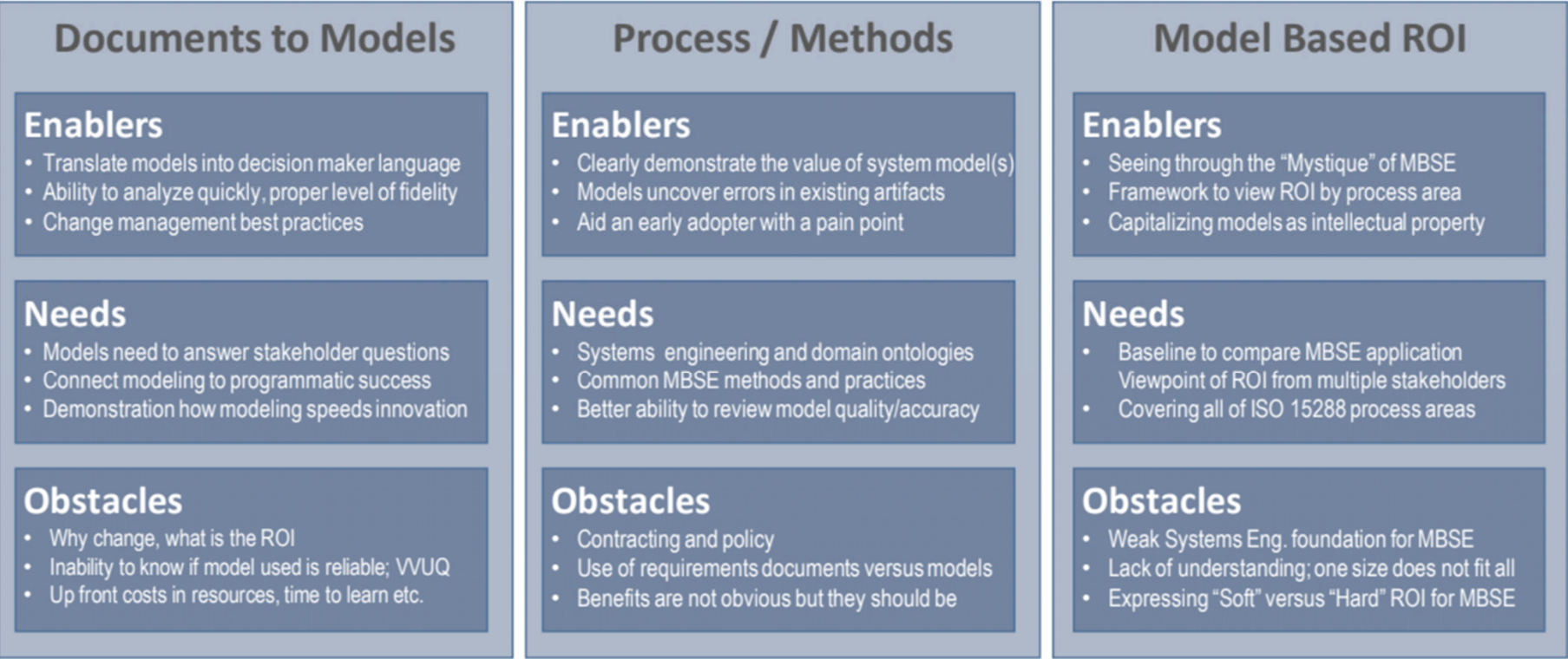


Figure 6: INCOSE CAB Enablers, Needs and Obstacles for Model Based by categorical area



# JCIDS, Personnel, and AI4SE

The Joint Capability Integration and Development System is the means by which the United States military can write requirements to coordinate acquisition between branches to achieve interoperability and economies of scale.

The system suffers from overwhelming schedule slippage.

Projects are delayed by years, potentially, as they are stuck in this process.

JCIDS utilizes document based requirements currently.

Q: Why don't they adopt AI4SE?

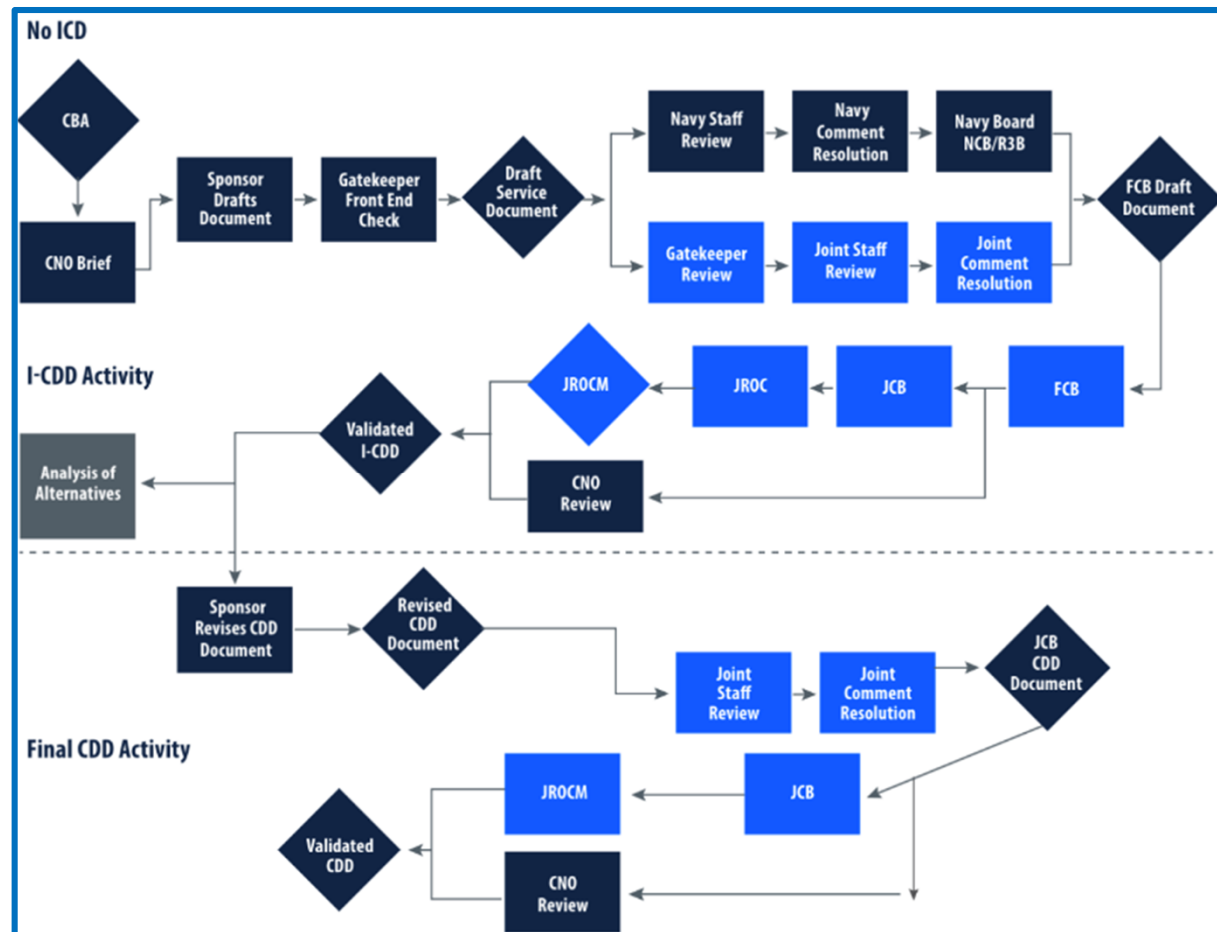
A: Currently, the officers who write the requirements are doing so on a short-term basis as part of a requirement to earn a higher rank.

We are researching how we can change the governance of the US military to better integrate AI4SE into the requirements generation process, which will reduce acquisition waste, a.k.a tax dollars.





# JCIDS, Personnel, and MBSE



We have developed discrete event simulations to consider how process changes will improve the process, but improvements are not significant enough to be satisfied.

We found a discrepancy in the ownership of the JCIDS process.

If no one is responsible for the process, then there is no incentive to improve.

By taking a step back and thinking about end-to-end governance, we are positioning JCIDS for better digital transformation, rather than piecemeal adjustments.



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