The Future Exchange of Digital Engineering Data and Models: an Enterprise Systems Analysis

Thomas McDermott

Stevens Institute of Technology

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Sponsor: DASD(SE)

By
Tom McDermott (Stevens)
Molly Nadolski (Ga Tech), Paul Collopy (UAH), Chris Paredis (GT/Clemson)

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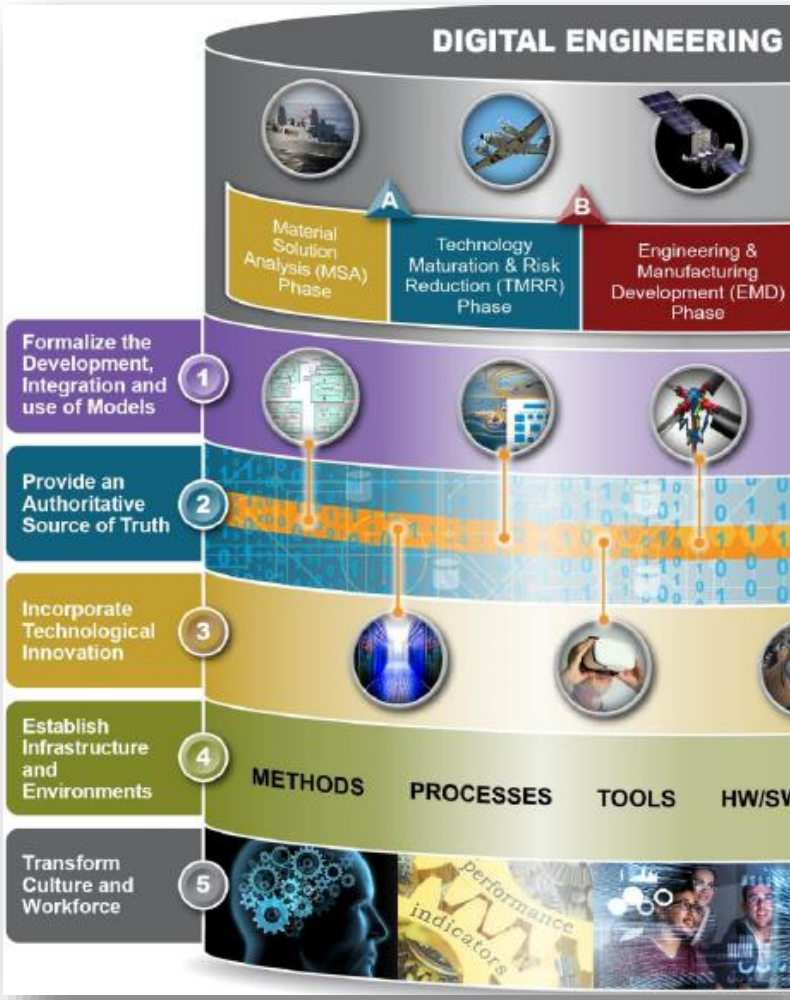
Agenda

- Background
- Methodology
- Systemigram: Digital Information Exchange
- Outcomes & Next Steps

SYSTEMS ENGINEERING RESEARCH CENTER

Digital Thread Enabled Acquisition



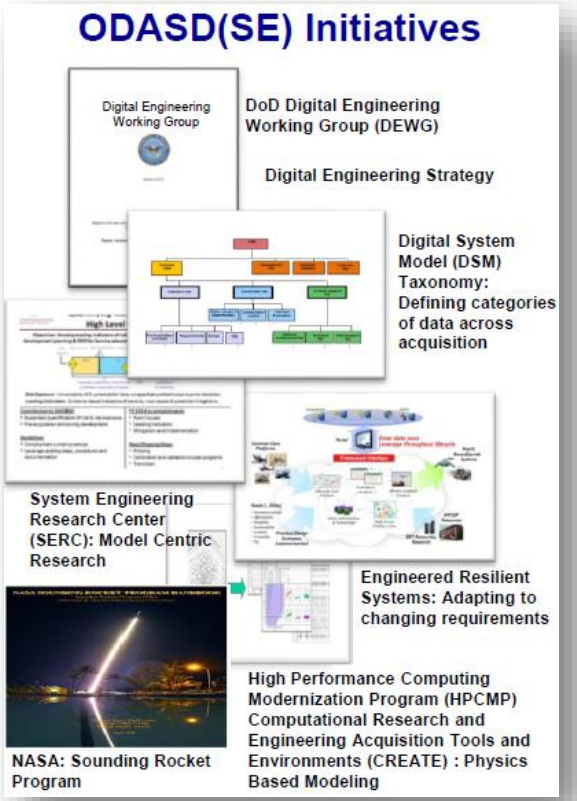
SERC Project RT-182: Digital Thread Enabled Acquisition

This research was conducted to evaluate the impacts of DE on current DoD acquisition enterprise processes. The following questions guided the research:

- What changes are likely to emerge from the transition to DE processes, methods, and tools?
- What are the enablers and barriers to such innovation in the DoD acquisition enterprise?
- What stakeholders will be affected and how will they likely embrace or oppose change?
- How might stakeholders be incentivized to embrace innovation and how will this be measured?
- What are the leading and long-term indicators of change?
- How might the value of such changes be predicted and measured?

Specific Questions of Interest

- How will DE help the acquisition enterprise respond to the realm of the possible with warfighter needs?
- What are the opportunities that can be gained from deeper information in the authoritative source of truth?
- How will DE make the acquisition process more efficient and reduce rework?
- Can DE make it easier to ingest new processes and incorporate acquisition expertise into acquisition tools?
- How do DE documented architecture principles add value to development and acquisition processes?
- How will DE environments capture and maintain lessons learned within and across programs?
- How can DE improve the performance of the acquisition workforce, at every skill level?

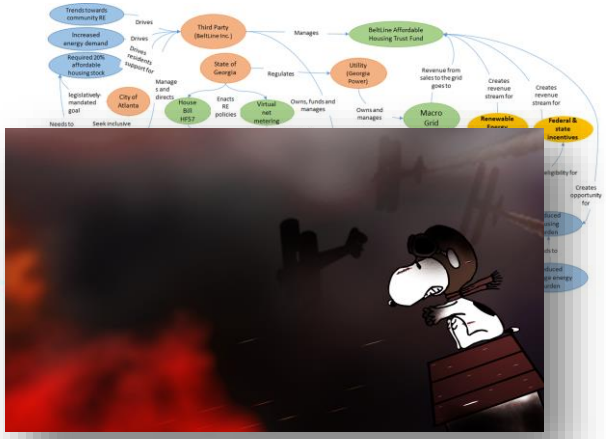


Engaging a New Conversation

storytelling and mapping tools to describe the future as a conceptual model

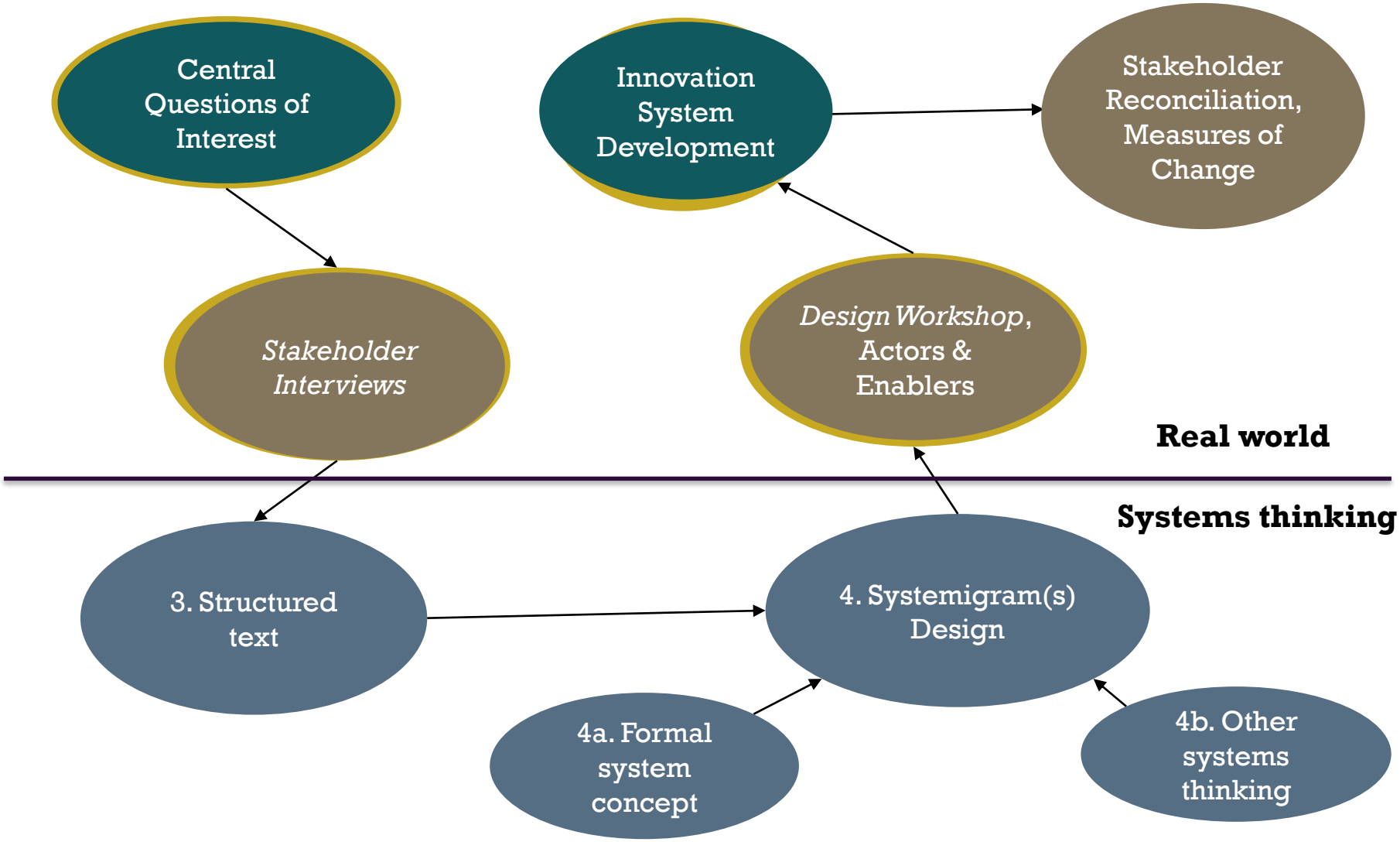
Individual Narratives & Statements

Anecdote Database



Meaningful Course of Action

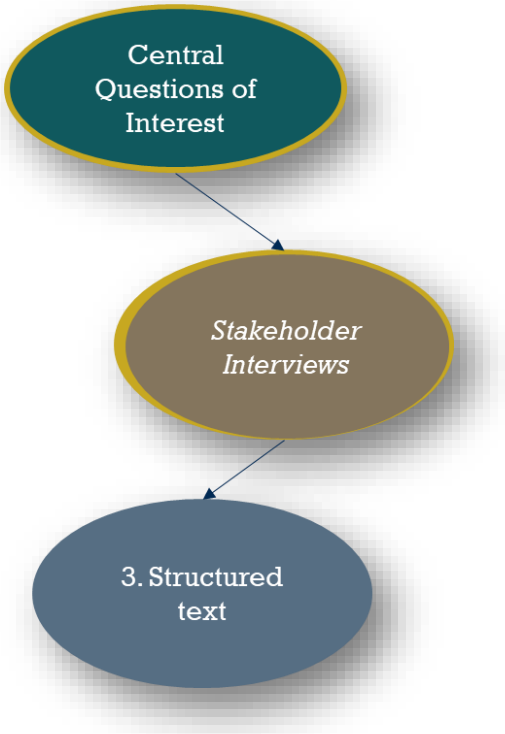
In Practice: Enterprise Systemigrams



A qualitative stakeholder-driven process to produce quantitative goals

Stakeholder Interviews & Research

- 15 Project Visits Completed, 25 People Interviewed
  - DASD/SE
  - Aerospace Corp
  - JHU APL
  - SAF/AQ
  - Army PM-Aviation
  - Army Future Vertical Lift Program Office
  - Ground-Based Strategic Deterrent Program Office
  - SPAWAR San Diego
  - TARDEC
  - J8 JCIDS office
  - DOT&E
  - NASA-Langley
  - NASA-Marshall
  - JPL



- Also:
  - ~50 documents reviewed
  - 6 facilitated meetings with DASD/SE team

DE Transformation Systemigrams

Workforce and Culture

Much of the discussions around digital thread and digital engineering focuses on the technological and modeling aspects. While those are integral to the changing dynamics and processes, often overlooked is the human role and associated changes, and how it will shift and might change over time, as the broader system seeks to become more agile.

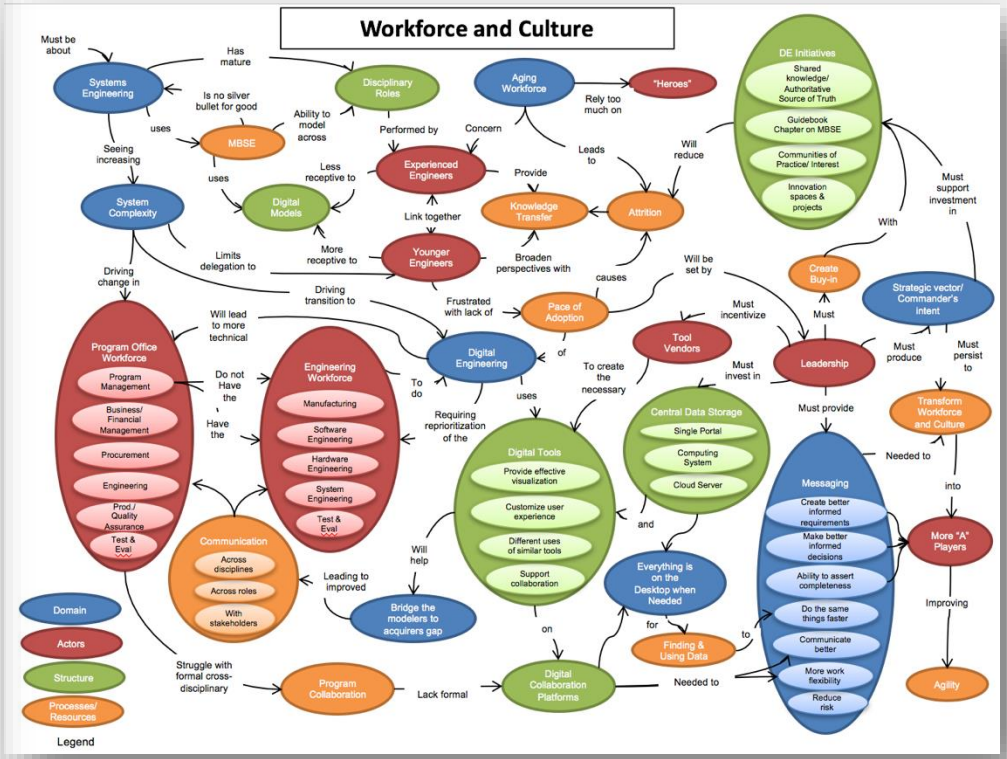
Most stakeholders and experts do agree there is a cultural change at play, along with needs for the workforce to adapt and change with the broader trends at play as well. There are divergences in perspective in regards to what this might look like, the change in the "old guard" to "new guard", whether or not there are workforce capabilities and the "talent" will look like.

DE is a cultural change in and of itself. There are the new tools which bring in digital natives and will be a merger of new technology and existing experience. As such, the workforce shift will be substantial. There will be big struggles to learn new ways. The goal is having the models to feed the decision processes, which requires training of modelers and a new breed of decision makers. However, it's a challenge to get a large group of people to change. Culture change is not done without resistance or done overnight. There is an extraordinary advantage to maintain the status quo and temptation to "do it like how we did last time". Culture change is organizationally dependent and unchangeable.

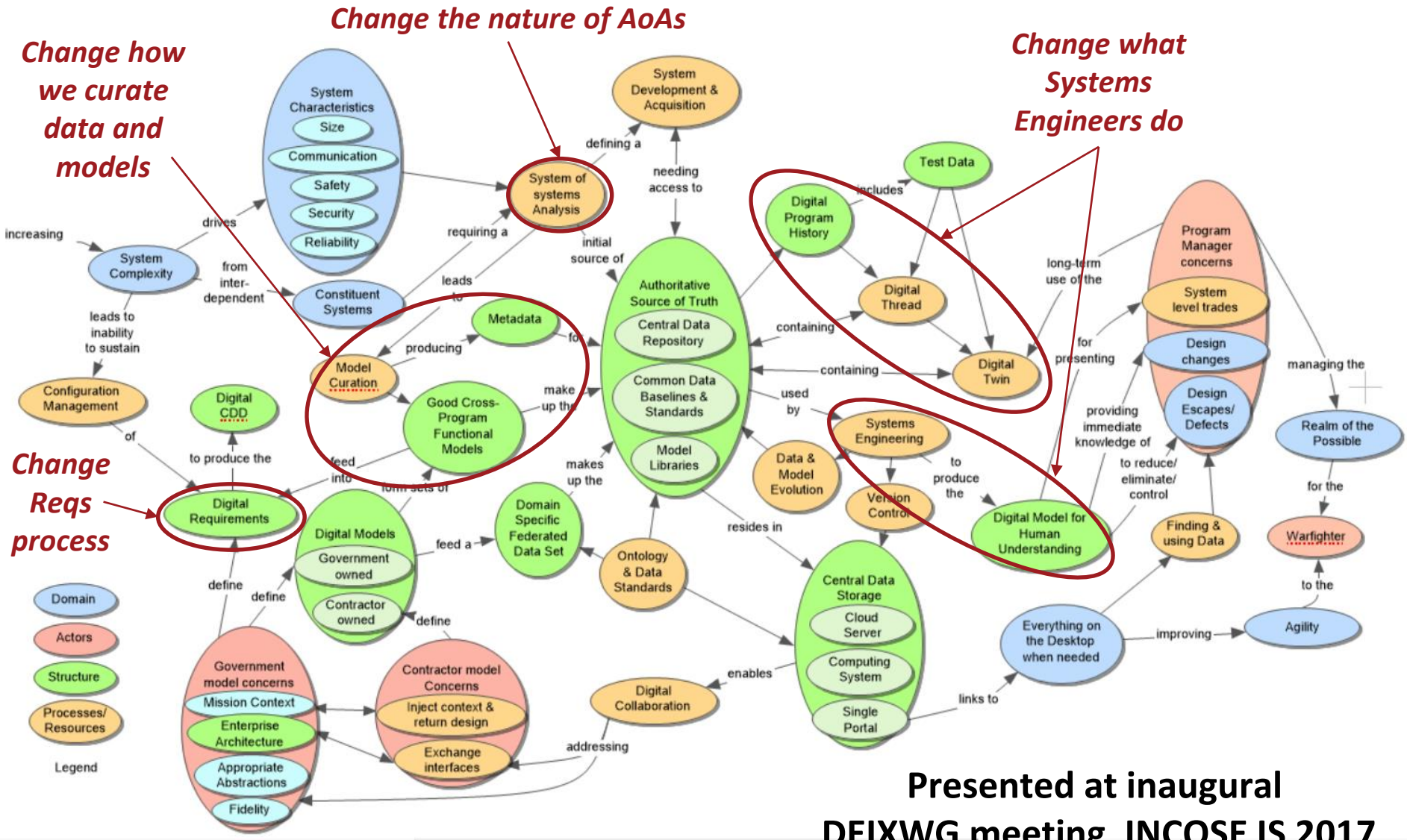
One of the bigger points of diversion amongst stakeholders is whether or not there is a workforce in place to grapple with the changes at play, and if so, whether there are capabilities to address the changes. On the one hand, DE is done today often times without the realization that is being applied. People who do models do it without thinking about it. However, there lacks the process and culture to bring together the emerging digital natives with grizzled veterans and their domain knowledge.

On the other hand, there is the belief that much of the workforce is an aged workforce that looks back at the way things were done rather than looking to the future. The younger group coming in also has shortfalls. The younger workforce is more skilled in a single discipline rather than a broad perspective. There needs to be an effort to better train the younger workforce to oversee multiple different domains to provide a more robust understanding of digital environment. However, bureaucracy and paperwork make it hard to train due to time constraints. Additionally, there is not enough money or time to train older workforce to train them how to use new tools as well.

This squeeze on resources also impacts the focus on SE, as discipline workforces are less and less SE focused and system implications. Labor is expensive and systems are expensive to implement. There are no expectations to think about larger system aspects from the onset. Hiring managers are worried about finding MBSE workers, but there should be more of an effort place finding systems engineers.

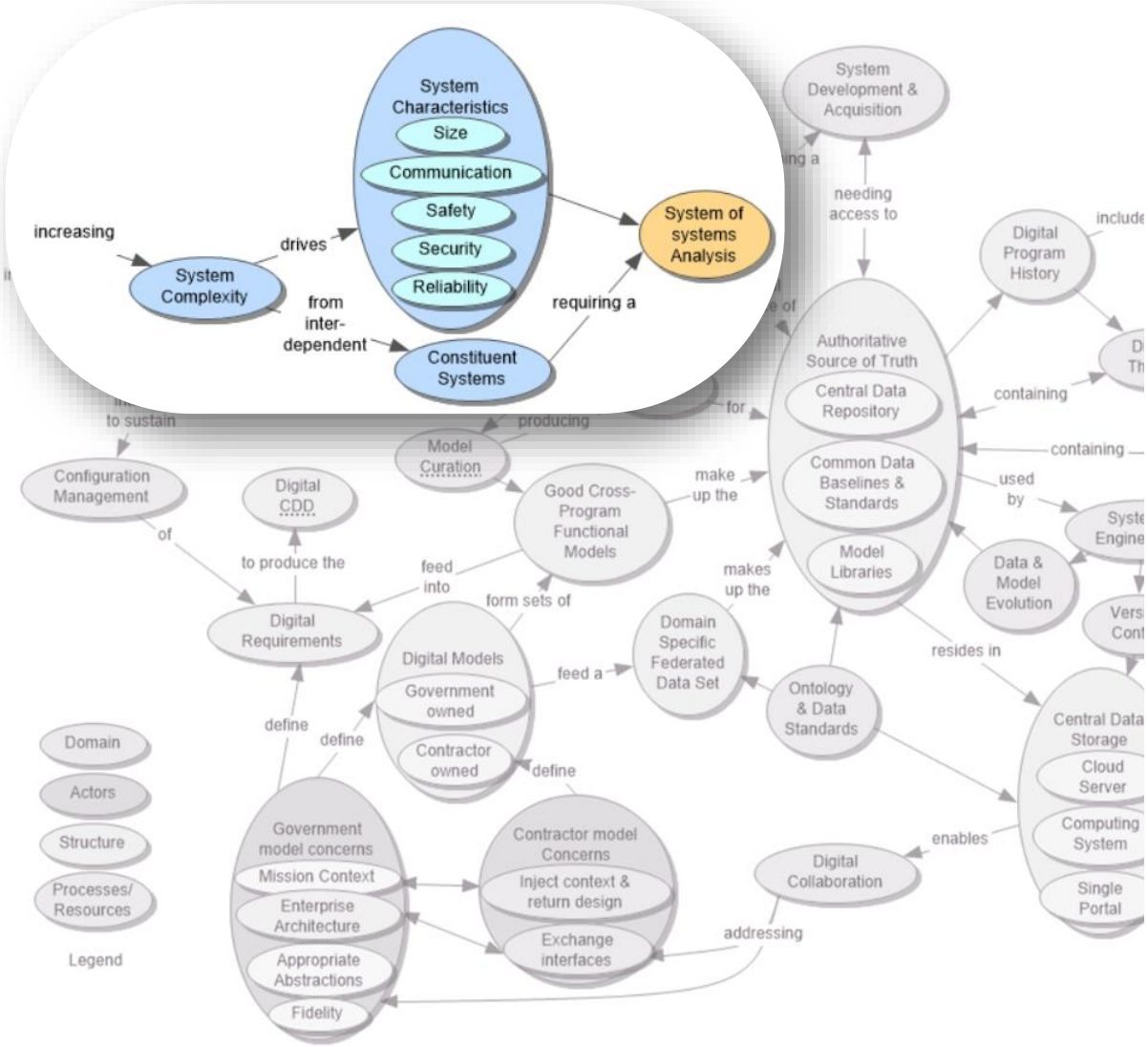


Digital Information Exchange



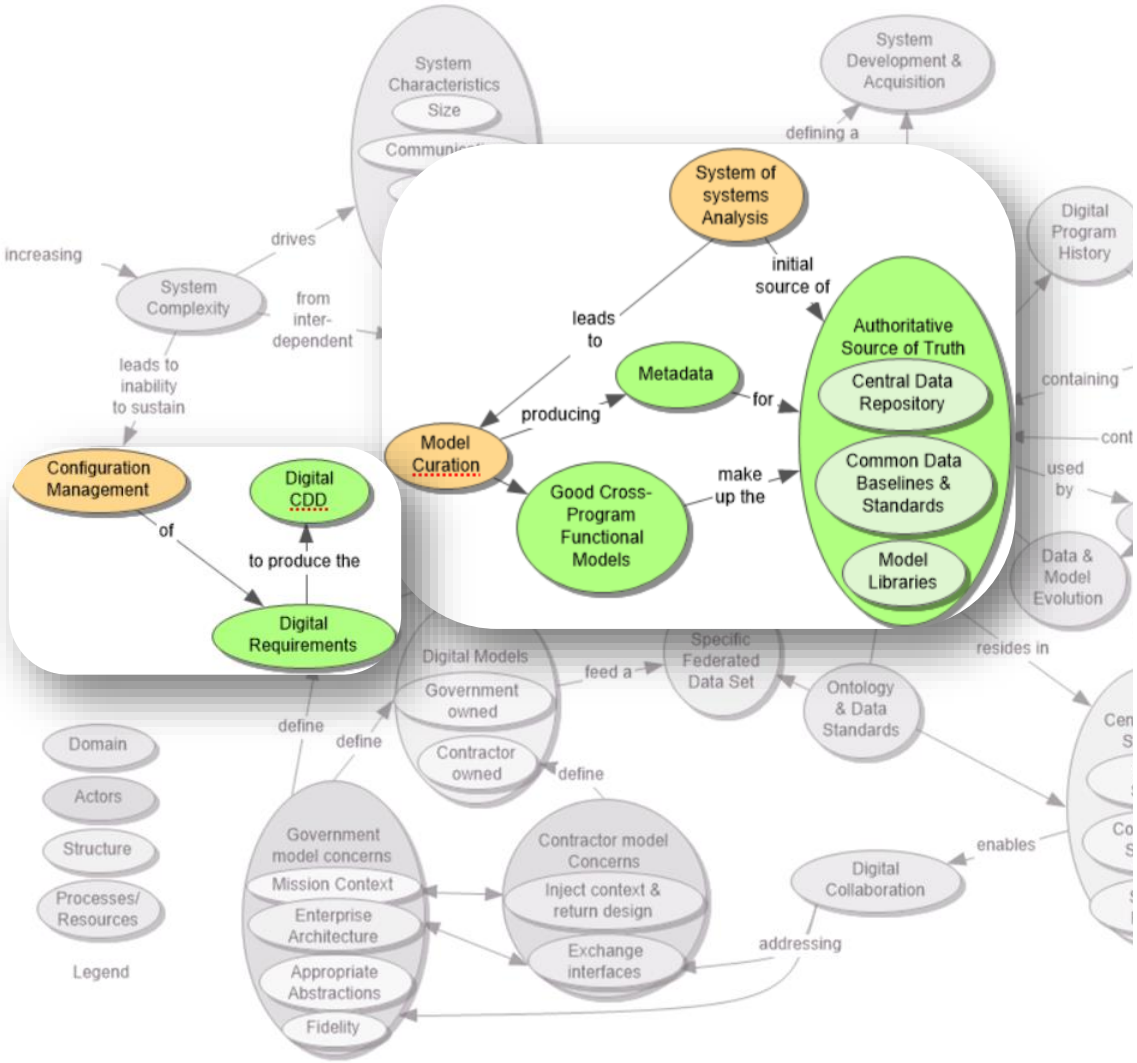
Presented at inaugural DEIXWG meeting, INCOSE IS 2017

SoS Analysis



- The story starts with increasing system complexity
- Need for a robust Systems-of-Systems (SoS) analysis to define the development and acquisition program
  - —responsibility of the system acquirer
  - —full enterprise architecture
  - —initial source of data and models for the Authoritative Source of Truth (AST)

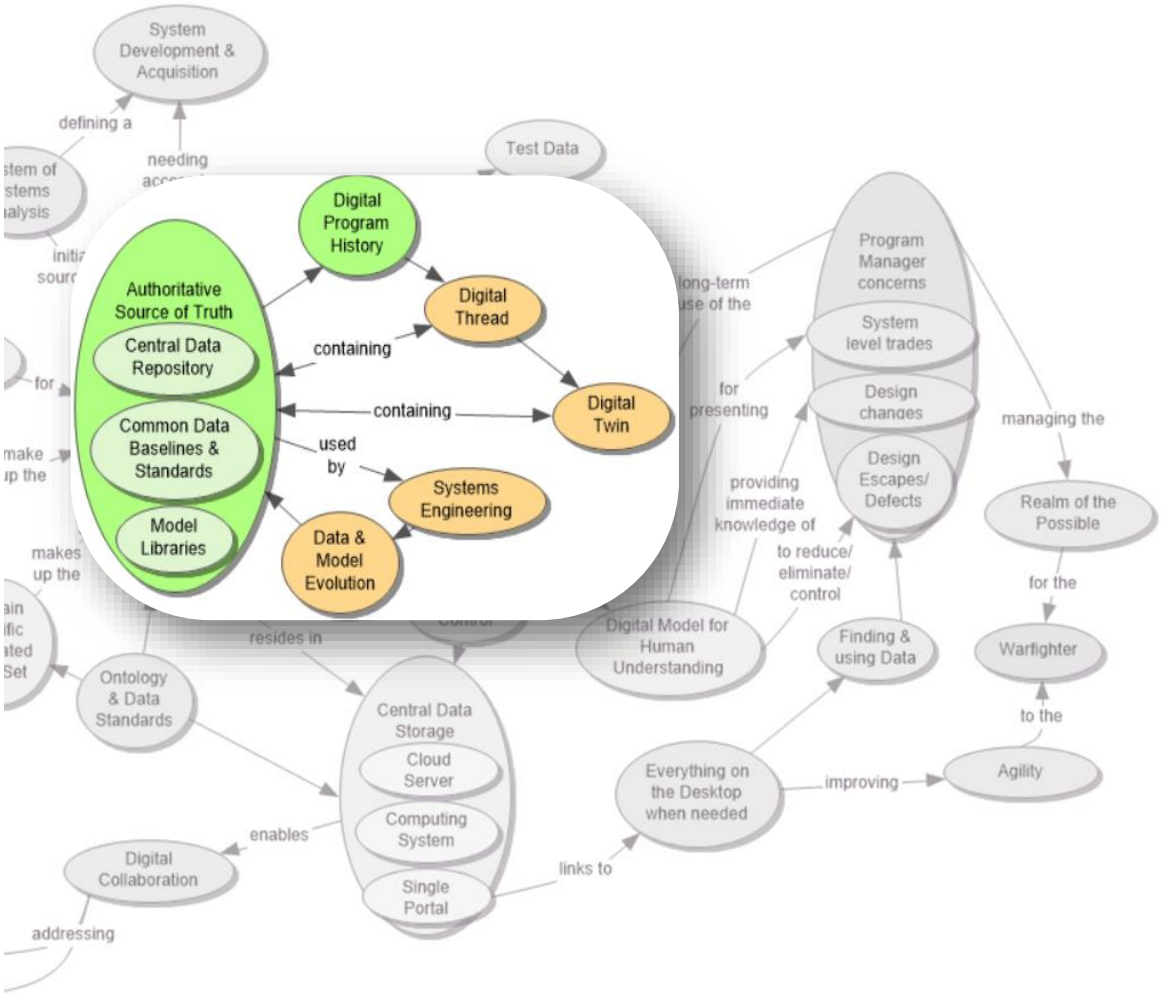
Model Curation and Certitude



- "good cross-program functional models" are selected for inclusion in the collection of models that make up the AST
- concept of a "good model" in this context is an evolutionary process
  - understanding and normalizing the appropriate abstractions and fidelity
  - government data and model set is provided to the contractor in the acquisition process
- will produce the initial requirements baseline for a program

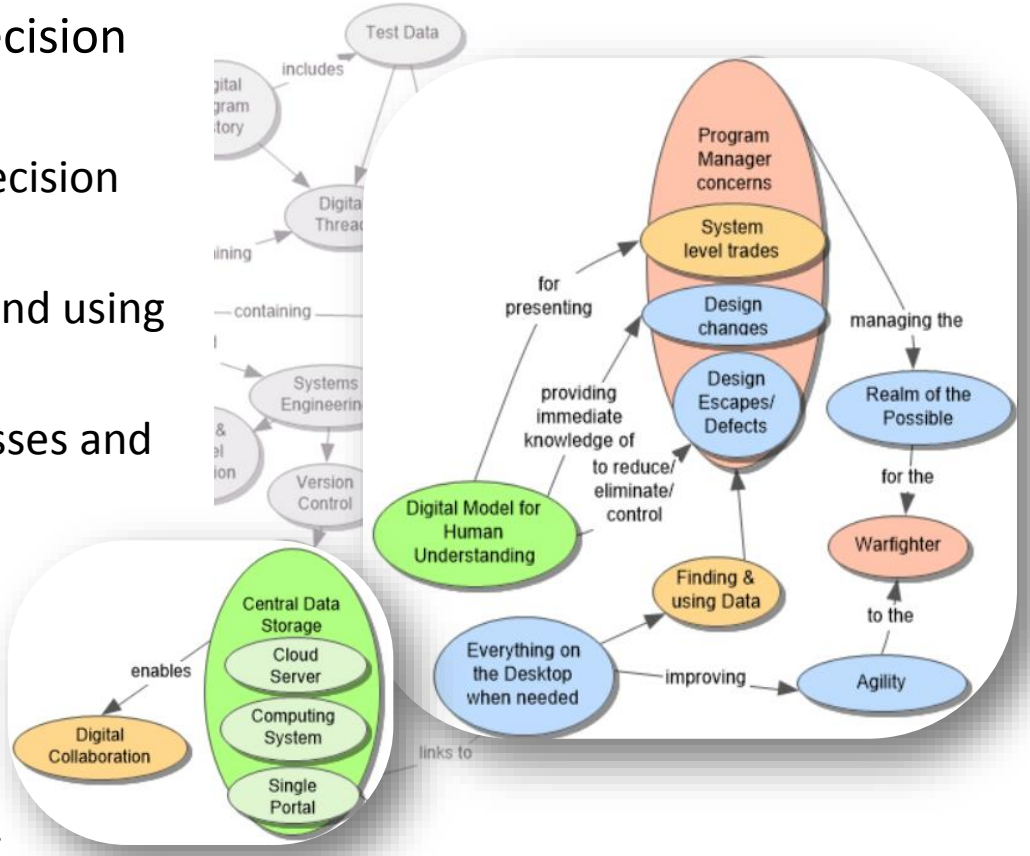
Future System Engineering Role

- primary role of a future systems engineer:
  - data and model evolution
  - version control of the curated model federation
- follows the program lifecycle as a digital program history
  - program decision artifacts: the “digital thread”
  - full lifecycle artifacts: the “digital twin”
- need robust data and model development investment in the early phases of a program



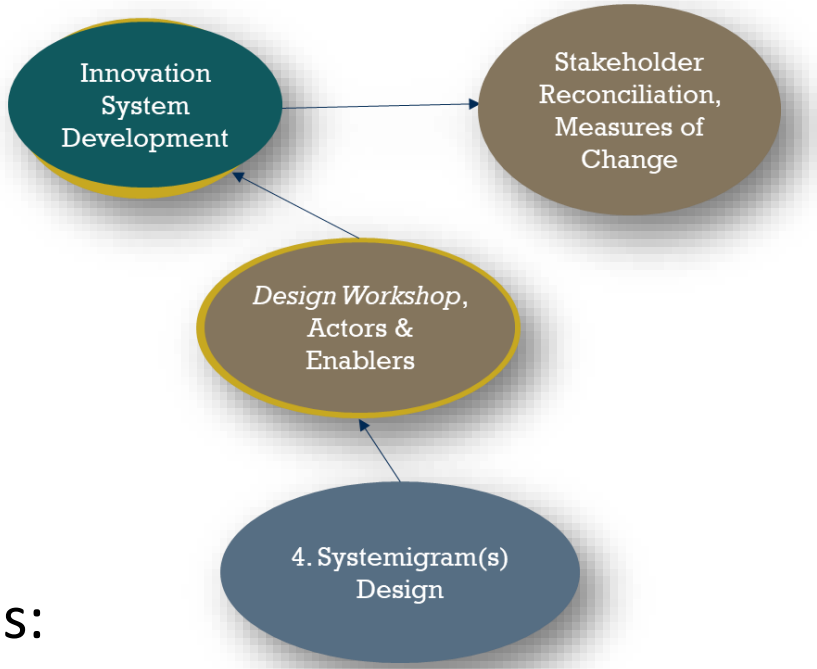
Program Manager Concerns

- outcome is a “digital model for human understanding”
- supports the program manager decision data
  - — everything on the desktop of the decision makers when needed
  - — automating the process of finding and using data
  - — creating more agile decision processes and delivery of new system functions
- Use: rapidly explore, simulate, prototype, and deploy new functional capabilities to the warfighter
- Tools: user interfaces that present digital engineering content and serve the stakeholders’ unique needs



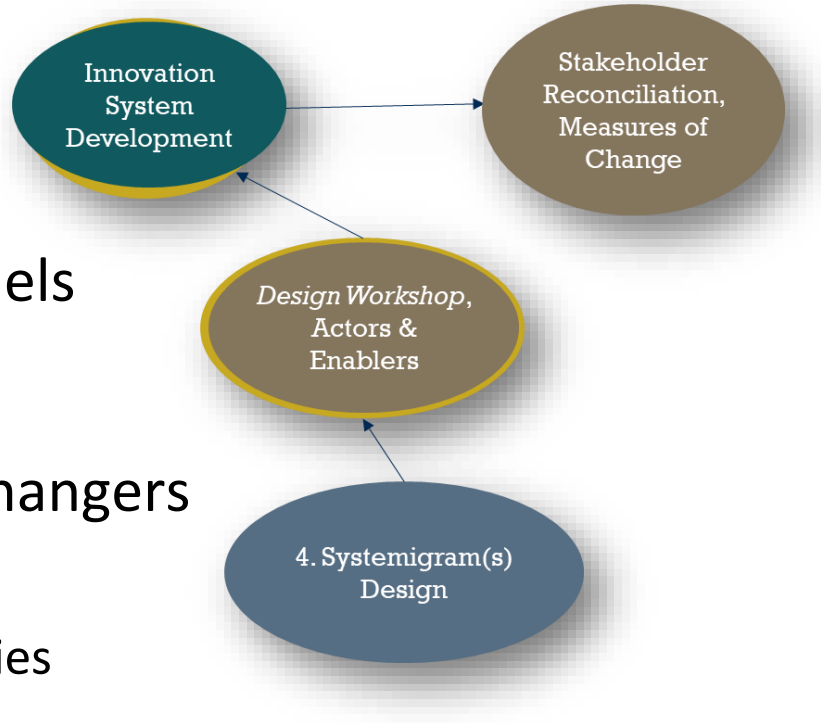
Outcomes and Next Steps

- Created holistic model of DoD Acquisition Enterprise change as DE is gradually adopted
- Good agreement across stakeholders on the nature of the strategy
- Descriptive modeling process reveals scope of change
- Testing insights in multiple forums using Systemigrams
- Base models informing other activities:
  - —Digital Engineering Working Group (DEWG)
  - —Digital Engineering Information Exchange Working Group (DEIXWG)



Next Phase – DE Metrics

- Theme: "A Program Office Guide to Successful DE Transition"
- Work with several DoD program offices, contractors, and tool providers
- Identify measures of success, and define multi-level measurement models
  - —Near- and long-term change indicators
- Identify potential innovation game-changers
  - —Define enablers and barriers to innovation
  - —Define cross-sector innovation opportunities



Further Needs

- **Model Curation and Certitude.** Must develop a rigorous approach to verify, validate, and accredit the models that are incorporated into the Authoritative Source of Truth, particularly quality and range of valid use.
- **Metadata standards for the Authoritative Source of Truth.** Extend SET work on ontologies and metadata/metamodel libraries and tools.
- **Innovation.** Need to encourage breakthrough innovations in DE processes and tools. A tolerance for creativity and safe experimentation, completions of innovation impact studies and roadmapping, and investment in methods, processes and tools must be sustained
- **Human Capital.** This will be a significant shift in the workplace, leading to an "IT/Data Savvy" workforce. Training programs must evolve with the strategy.

Questions?

Thank you!