

AFIT Digital Integration & Innovation  
Center of Excellence  
DICE – "We put the odds in your favor"

**Col Jason Anderson, PhD, AFIT/EN (Director)**

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**LtCol Paul Beach, PhD, AFIT/EN (Deputy)**



# First-Thank you

- It has been a long road, but all those previous efforts have been instrumental in standing up the Digital Integration Center of Excellence. Thank you for all the help!

# Why a Digital CoE

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"THE ENTERPRISE THAT DOES NOT INNOVATE AGES AND DECLINES, AND IN A PERIOD OF RAPID CHANGE SUCH AS THE PRESENT, THE DECLINE WILL BE FAST."

- PETER DRUCKER,  
AMERICAN-AUSTRIAN CONSULTANT -

We have a window of opportunity to accelerate changes now. And personally, I'd rather drive than ride; if we fail, it won't be for lack of trying. This is a journey and we are just starting.

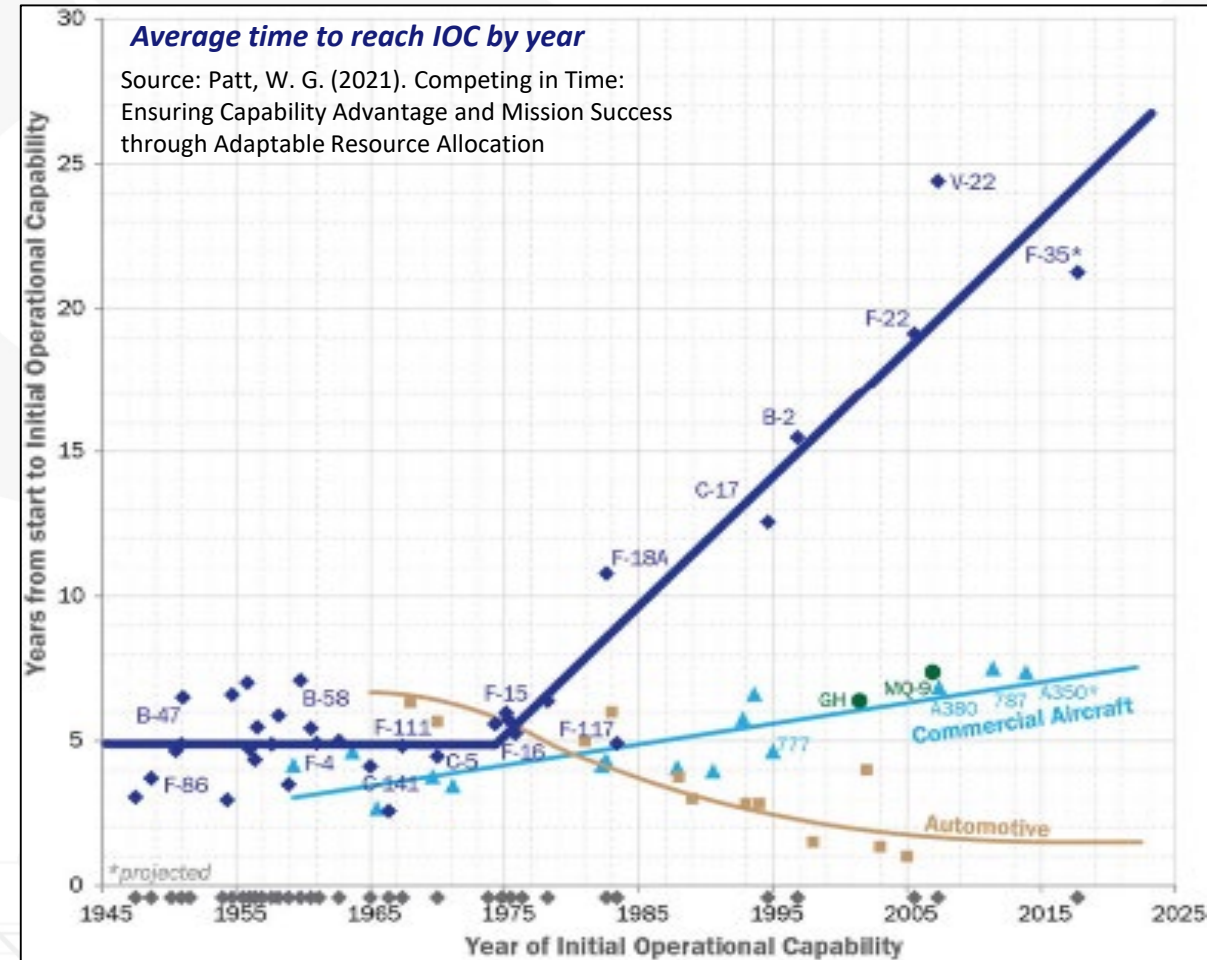
**General Charles Q. Brown, Jr.**



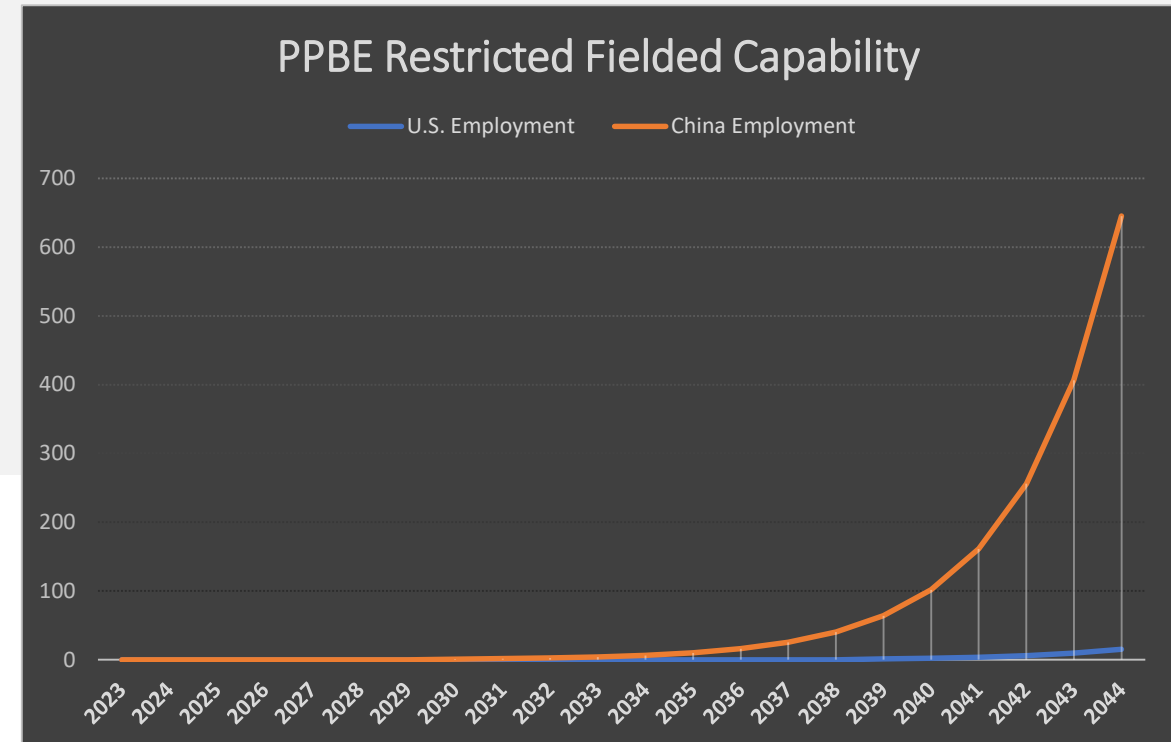
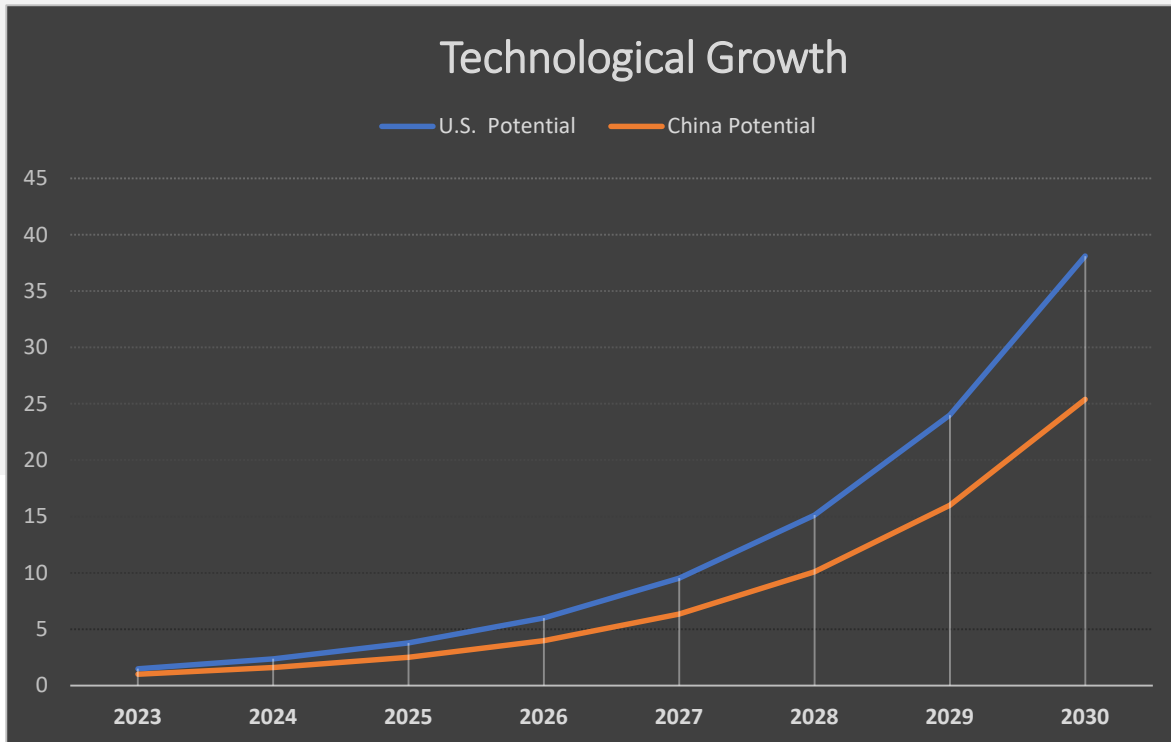
# Competing in Time

- “it takes the US on average sixteen years to deliver an idea to operational capability, versus fewer than seven for China”
- “The PPBE’s inflexibility increases the difficulty of rapidly shifting funding to emergent innovations”
- “Defense acquisition process and legacy defense industrial base approach struggle to accommodate timely adoption of these emerging technologies”
- “Competitive advantage in decision-centric operations (whether budgeting or on the battlefield) comes from the scale of available options, tempo of decision-making, and superior decision processes”

Digital Transformation yields smarter, faster decision making; but flexible funding and agility in HOW we resource is essential



# Competitive Advantage



**1.5x** U.S. Technological Advantage + **16** Year PPBE US Or **7** Year PPBE China = **42.6x** China Capability Advantage

# Better Capability, Faster



Prototype

Requirements

Analysis

DT & OT

SLEP

Modernize

DMSMS



Skyborg

- First flight in 36 mo from concept dev.
- Modularity enables >10 variations
- Digital models enables rapid design/test/validate cycles w/warfighter feedback



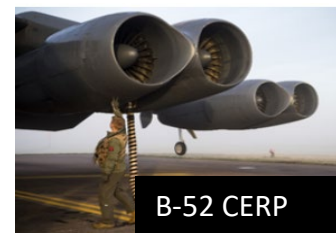
Sentinel

- >6B design variants analyzed to optimize performance
- ~6 month reduction in time to SRR
- VR based training for operators/MX



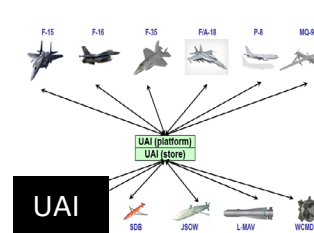
NGAD

- Months → Days for software development & release
- 1000's of high fidelity design iterations
- Months → Weeks prep time for acq. reviews
- Pivot w/evolving threat



B-52 CERP

- >60 day reduction in time to PDR w/shared digital tool environment
- Months saved in virtual validation of assembly & MX
- Virtual training opportunities for crews/MX



UAI

- >2 yrs, \$2M saved in ICD dev't and SIL testing for F-15/SDB II integration
- For NATO munitions: 19 & 15 months saved on wpn integration compared to 5 year nominal avg



A-10 Re-Wing

- ~1 yr saved in design qualification
- ~60% reduction in sustainment eng response time
- 2000 hrs of A/C downtime reduced to 700 hrs

Model Based System Engineering (MBSE)

Threat Informed Mission Modeling

Acquisition Data Management

Open Standards

Reference Architectures

**Foundational Supporting Capabilities**

Automated Certification Processes

Authoritative Sources of Truth (ASoT)

Enterprise Tools

PLM & linkage to Log-IT

Robust IT Infrastructure

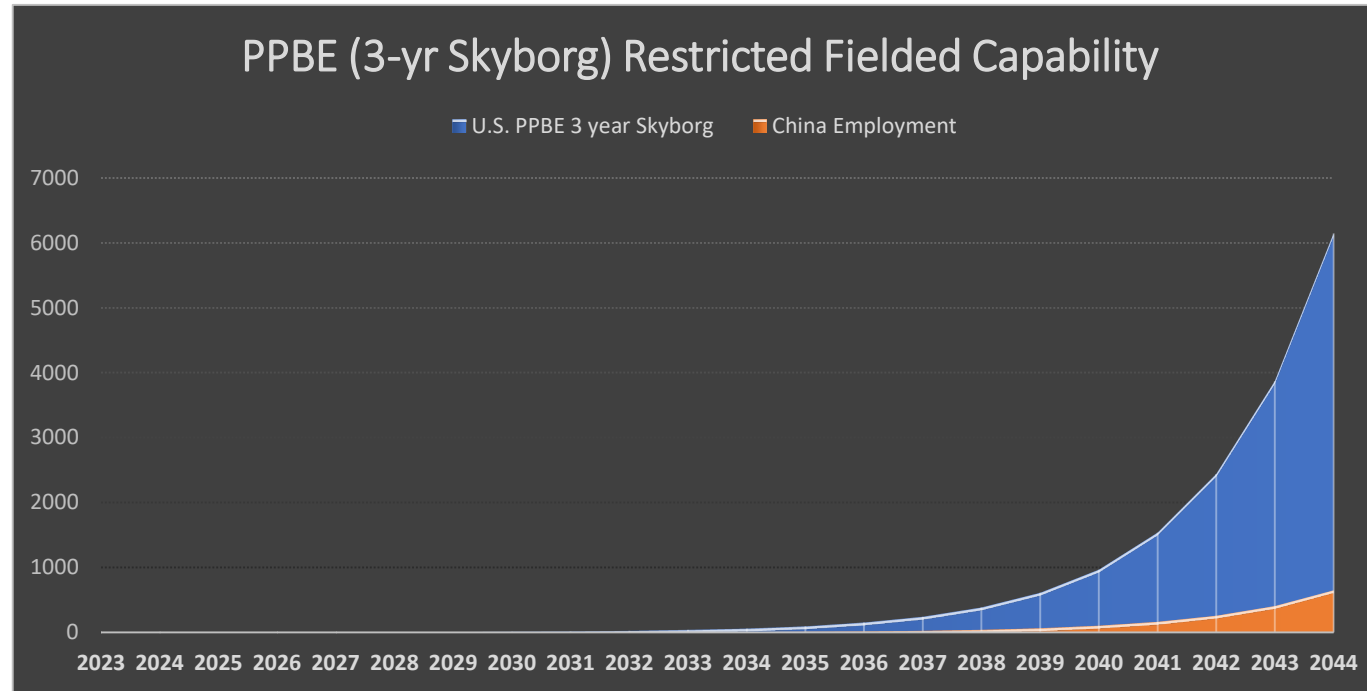
Workforce Training

Enterprise Policy & Governance

Digital Culture

Overcoming silo's and enabling enterprise scale requires enterprise investment

# Technological Advantage Overlayed w/ Skyborg PPBE



9.5x

U.S. Capability Advantage



# The Sensible Path

- Control that which you can control!
- - Does MBSE, DE, and Digital Integration Enable Faster Decision Making by Expediting Our Expansive Decision-Making Processes?

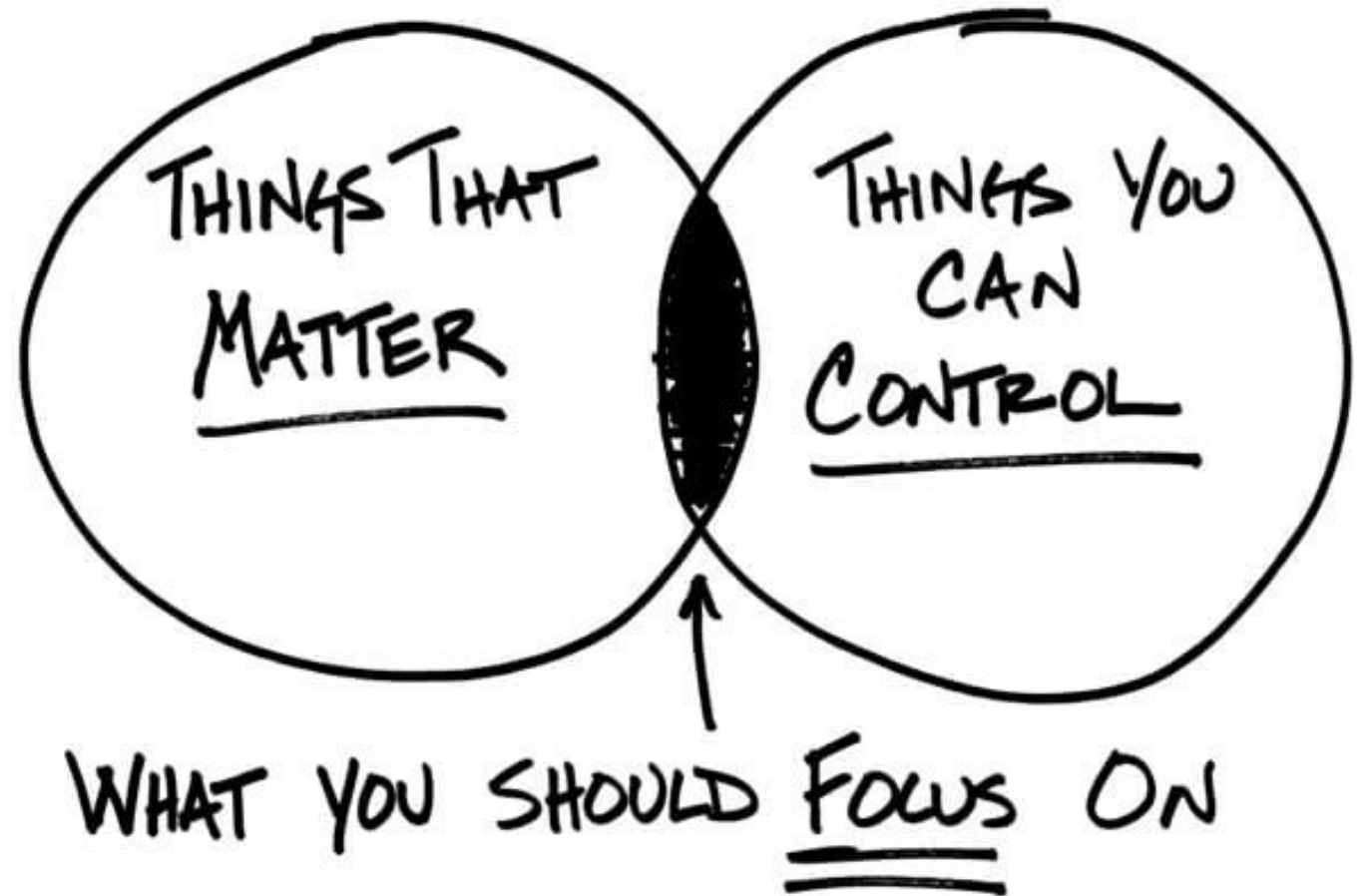
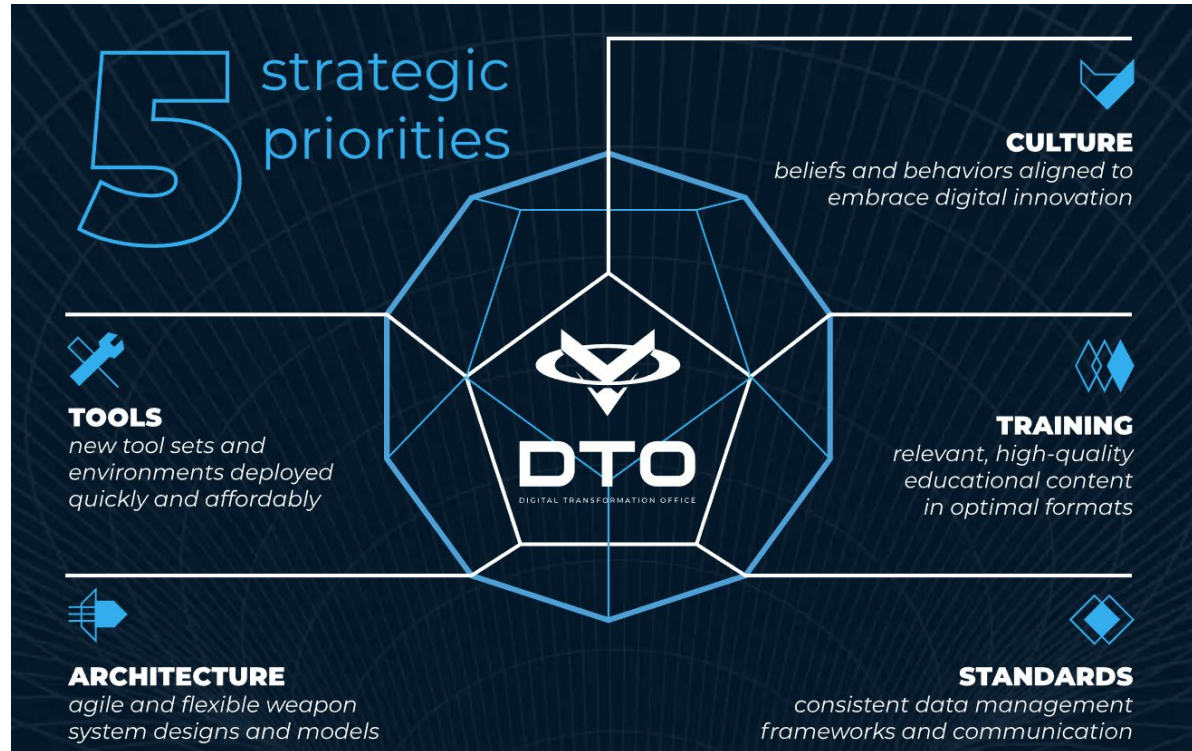


Image from <https://www.lutz.us/focus-efforts-control/>



# DICE: Four Lines of Effort with DTO Alignment



- LOE 1: Education Excellence
- LOE 2: Research and Tech Transfer
- LOE 3: Consulting
- LOE 4: Best Practices

# LOE 1.1: Continuing Education

Digital Acquisition & Materiel Management continuing education provided by the School of Systems & Logistics (AFIT/LS)

- Primarily funded by SAF/AQH (DAWDA)
- "Digital" context in many existing courses and workshops

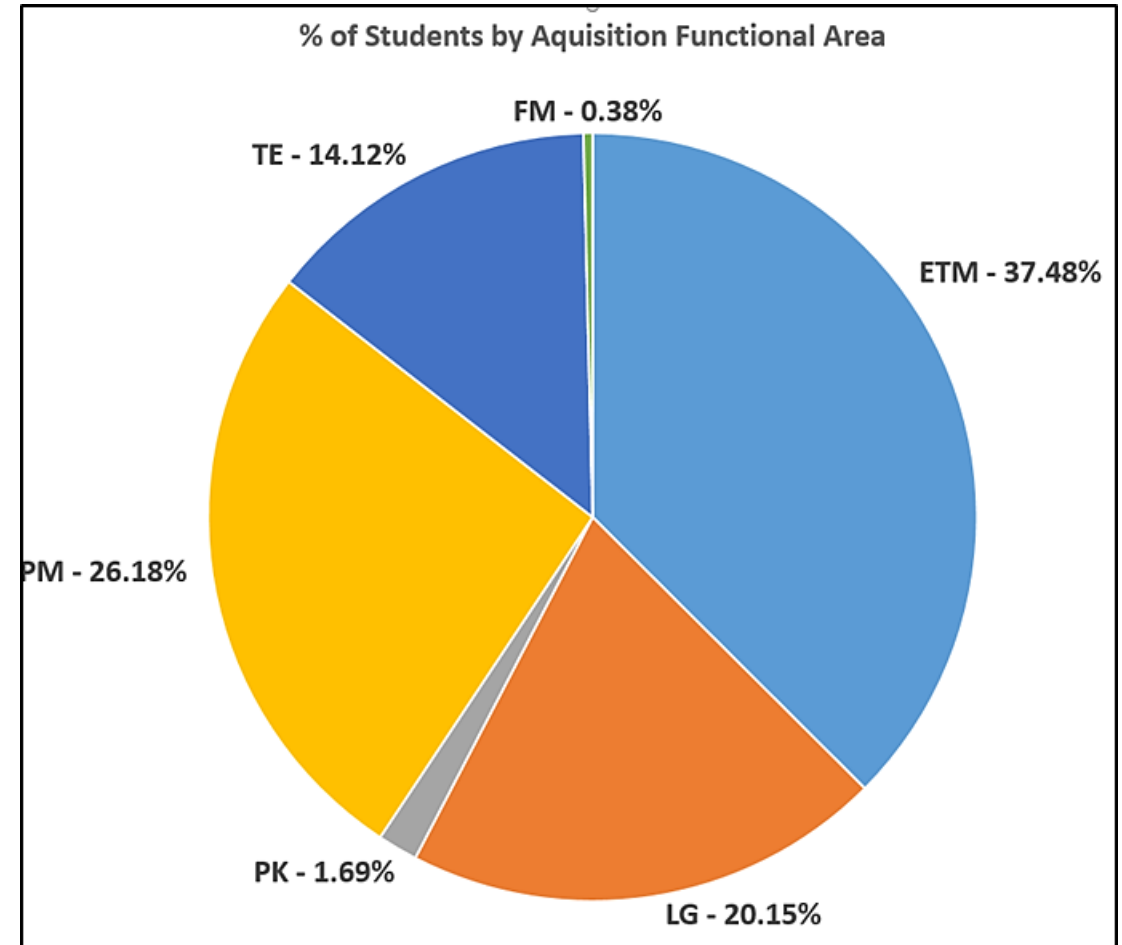
## Highlighted education:

- WKSP 0732: Current Topics in Digital Acquisition & Digital Materiel Management
- WKSP 0696: Applied MBSE Using SysML
- SYS 282: Management of the Systems Engineering Process
- Avolve Learning Paths



# WKSP 0732: Current Topics in Digital Acquisition and Digital Materiel Management

- Multiple offering, various topics
- Over 600 students taught since March 2022
- Multifunctional student attendance (see pie chart)
- Subject matter expert presenters



# WKSP 0732: Current Topics in Digital Acquisition and Digital Materiel Management

## 2022 Topics

- Digital Acquisition Overview Awareness
- Test and Evaluation within the Digital Transformation
- Introduction to User Experience (UX) Design
- Digital Acquisition and Risk Management
- Modeling and Analyzing System Requirements
- Unified Architecture Framework (UAF) Versus the Department of Defense Architecture Framework (DoDAF)
- A Short Introduction to the Unified Architecture Framework (UAF)
- Using the Systems Modeling Language (SysML) within the Unified Architecture Framework (UAF)
- Updates on Digital Engineering and Test & Evaluation from the DE T&E Summit
- Parallel Modeling Networked Cooperative Autonomous Munitions
- Model-Based Request for Information Strategies
- Using Avolve for Digital Transformation Education
- Development of a Model-Based Framework on User Toolkits
- A Systems Thinkers Look at the Digital Transformation
- Model-Based Monte Carlo Simulations

## 2023 Topics (Currently scheduled thru May)

- An Agile Mindset and Manifesto
- Acquisition / Engineering Transformation & Modernization
- Risk & Requirements Collaboration in Digital Materiel Management
- A Short Introduction to the Unified Architecture Framework (UAF) v1.2
- Using SysML for Requirements Management
- A Systems Thinkers Look at the Digital Transformation
- DAF Digital Guide Website Review
- Design Trade Studies Using SysML
- Agile Model-Based Systems Engineering
- Using Avolve for Digital Transformation Education

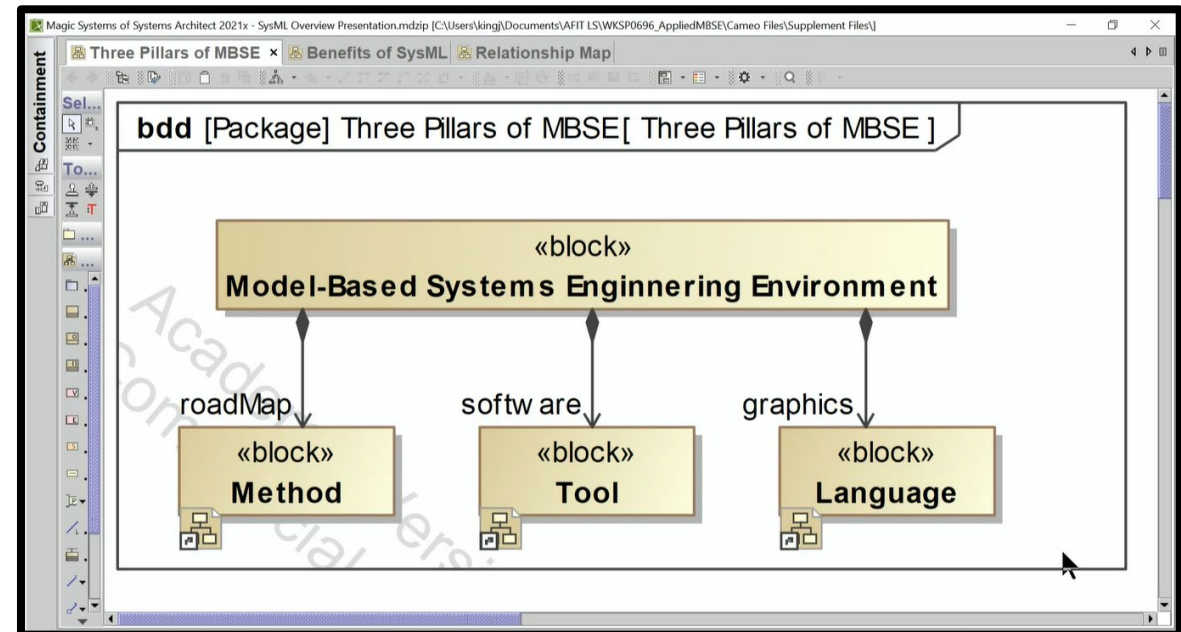
To sign up for an offering(s), go to <https://forms.osi.apps.mil/r/UXuQfpZM64>. This sign-up form is accessible via DAF365/AFNET.

Recordings of previous offerings is found on the Avolve website at <https://avolve.apps.dso.mil>. Type in the topic name in the search bar.

# WKSP 0696: Applied MBSE Using SysML

- Hands-on intro for all functional career fields
- Teaches foundations of how to create and use a system model using the SysML language and the CATIA Magic Systems of Systems Architect (formerly Cameo Systems Modeler) tool
- <https://www.afit.edu/LS/course.cfm?c=353>

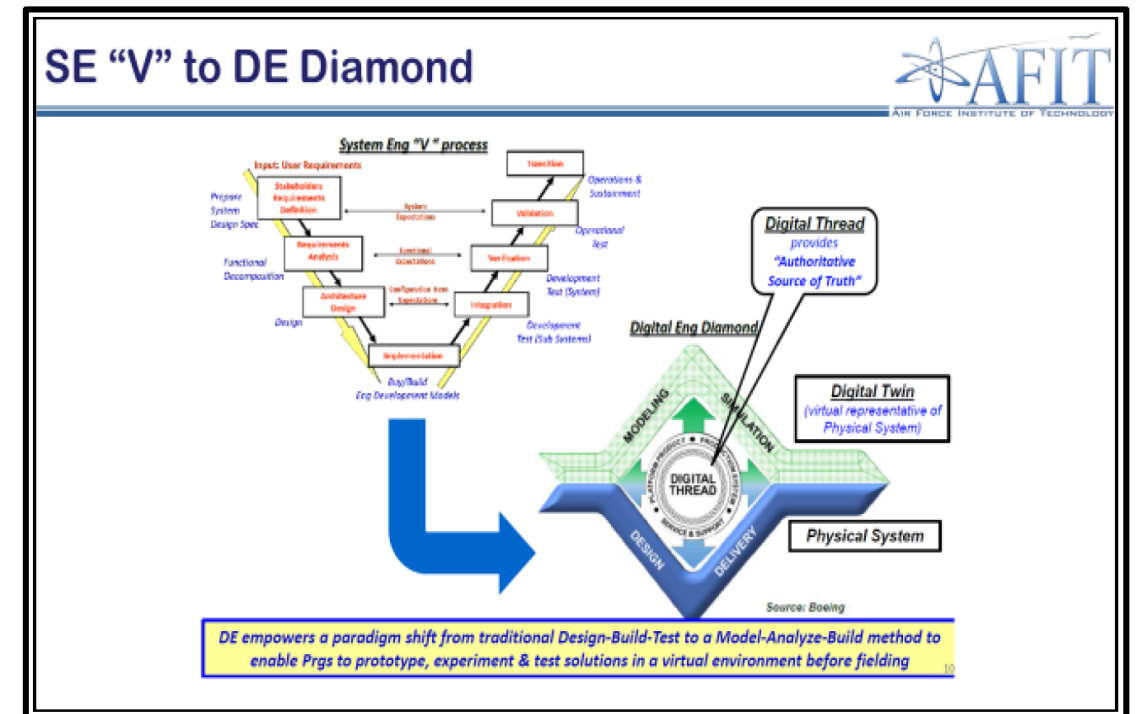
Location	Offering #	Start Date	End Date
WPAFB, OH	23I	14 Mar 2023	15 Mar 2023
Live Internet	23J	04 Apr 2023	07 Apr 2023
Live Internet	23K	02 May 2023	05 May 2023
WPAFB, OH	23L	31 May 2023	01 Jun 2023
Edwards AFB, CA	23M-O	21 Jun 2023	22 Jun 2023
Live Internet	23N	25 Jul 2023	28 Jul 2023
WPAFB, OH	23O	29 Aug 2023	30 Aug 2023
Live Internet	23P	19 Sep 2023	22 Sep 2023



# SYS 282: Management of the Systems Engineering Process

- Presents activities and tools for implementing and managing the SE process during various phases of the system life cycle, and the interactions between SE and all disciplines/functions
- <https://www.afit.edu/LS/course.cfm?c=85>

Location	Offering #	Start Date	End Date
Kirtland AFB, NM	23G-O	21 Mar 2023	23 Mar 2023
WPAFB, OH	23H	11 Apr 2023	13 Apr 2023
Tinker AFB, OK	23I-O	18 Apr 2023	20 Apr 2023
Live Internet	23J	01 May 2023	19 May 2023
Lackland AFB TX	23K-O	06 Jun 2023	08 Jun 2023
Edwards AFB, CA	23L-O	27 Jun 2023	29 Jun 2023
Robins AFB, GA	23M-O	11 Jul 2023	13 Jul 2023
Offutt AFB, NE	23N-O	08 Aug 2023	10 Aug 2023
Peterson SFB, CO	23O-O	22 Aug 2023	24 Aug 2023
Live Internet	23P	11 Sep 2023	29 Sep 2023



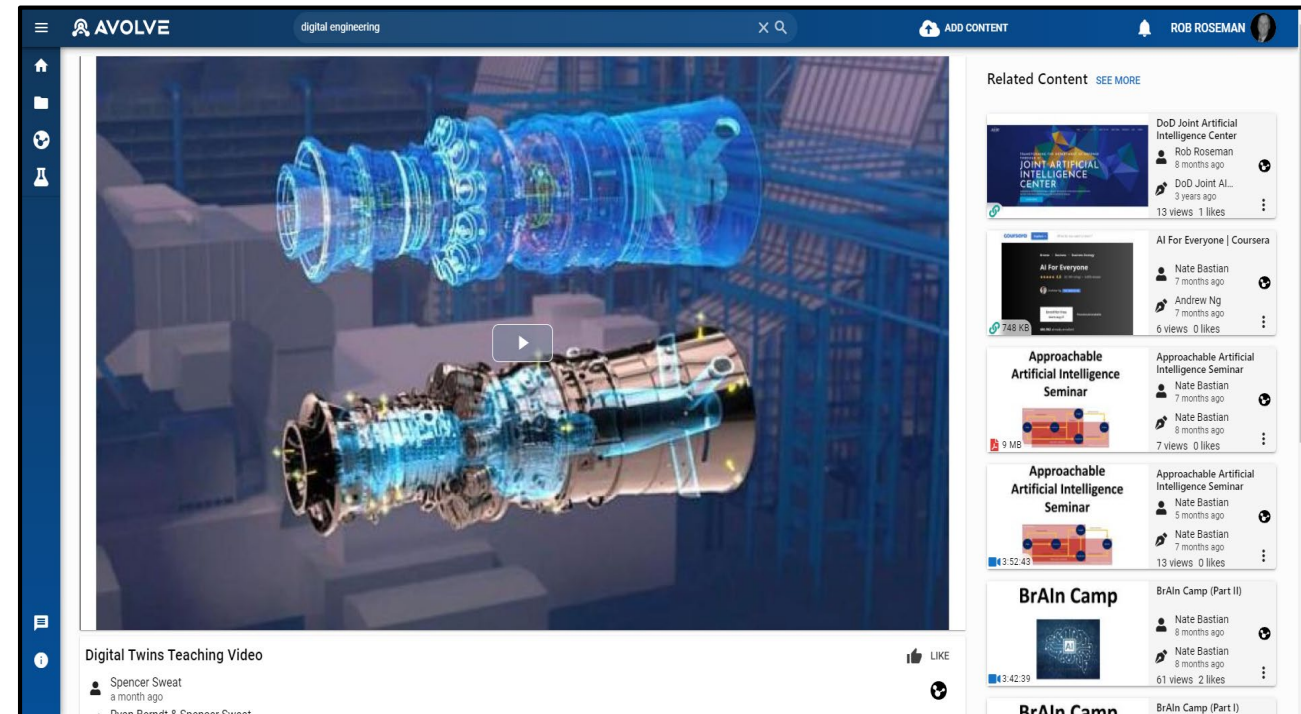
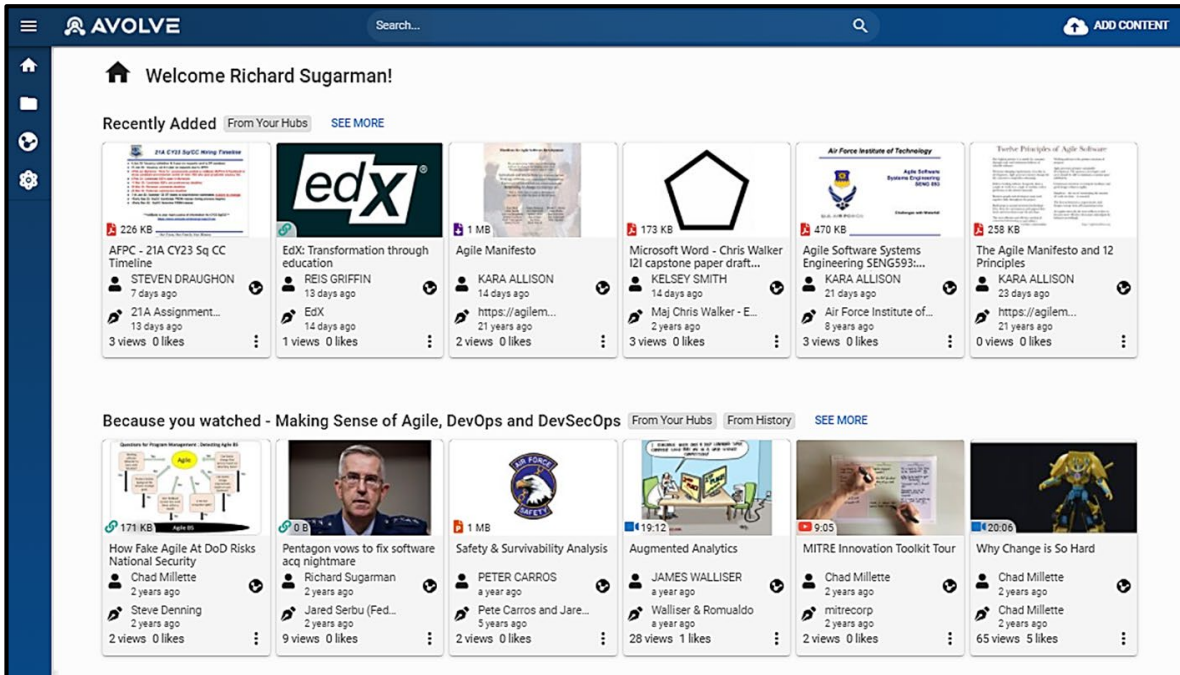




# AVOLVE

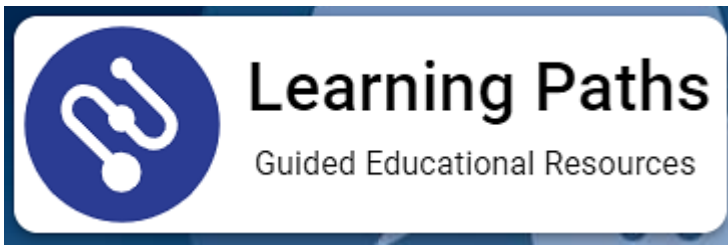
# https://avolve.apps.dso.mil

- Content sharing application with Netflix/YouTube-type of look & feel
- Crowd-sourcing of content, increased accessibility to DoD-focused content

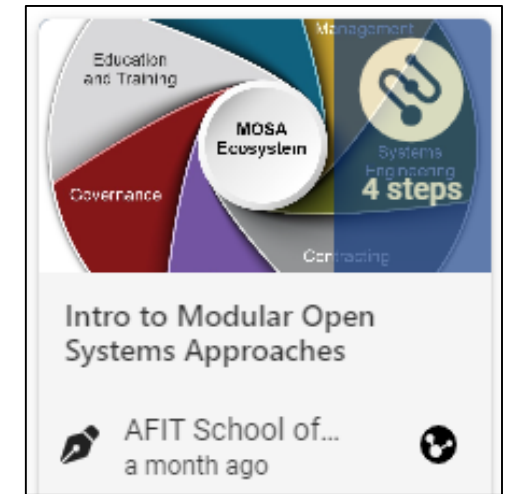
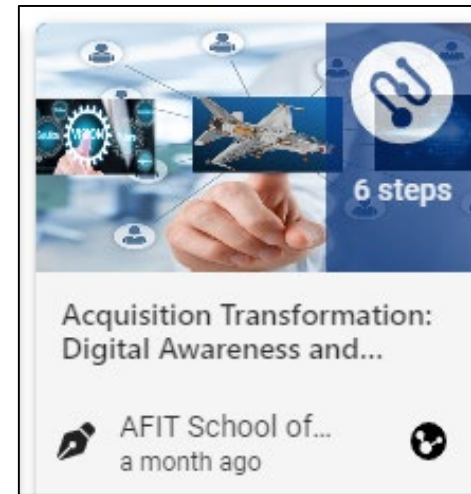


- Content organized into domain “hubs” & “tag” searchable
- Knowledge-centric vs. Organization-centric
- CAC authenticated – IL-4 certified





- Curated paths of content designed to support Agile Airman concepts
  - Learner-centric
  - Competency-based
  - Accessible anywhere/anytime
- Three Digital-related Learning Paths available now:
  - Acquisition Transformation: Digital Awareness and Overview
  - Intro to Modular Open Systems Approaches
  - Foundations of Agile and DevOps



### Path Description

This Learning Path is provided for foundational Acquisition Transformation awareness education. Digital Acquisition content is presented for self-study, a collection of resources to help understand, collaborate on, and impact how the DAF is modernizing acquisition methods and tools based on provided guidance. Please note that organizational networks and locations may limit connectivity access to allow you to view some linked content. In addition, internet content owners of the linked content have control and update of that content. The DAF Digital Guide referenced content is subject to revision change, the current version is available on the website: <https://usaf.dps.mil/teams/afmcde>.

### Learning Objectives

- Understand the "Why" and benefits of transforming acquisition
- Contrast available reference information and tool applications
- Know what transformed Acquisition Benefits have been achieved to date on select programs
- Present Lessons Learned & Success Stories from several programs who are transforming their acquisition processes, employing digital tools and methods
- Provide links to guidance and policy that define and support digital acquisition transformation

### Learning Path Steps

Select a step to navigate to content

1. Why Digital and Now? [SHOW DETAILS](#)
2. Where to begin? Information & Tools Overview [SHOW DETAILS](#)
3. Digital Acquisition Benefits and Tools impacting Cost, Schedule, & Risk [SHOW DETAILS](#)
4. Lessons Learned and Success Stories [SHOW DETAILS](#)
5. Digital Guide, Guidance & Policy [SHOW DETAILS](#)
6. Knowledge Assessment [SHOW DETAILS](#)

Log into Avolve at <https://avolve.apps.dso.mil>  
Click on Learning Paths on left-hand menu

# LOE 1.2: Graduate Education – Systems Engineering

- Graduate Systems Engineering Certificate (SEC)
  - Online or resident
  - Standalone or part of a degree program (SE or other)
  - 4 core SE classes, 16 credits
- Masters of Science, Systems Engineering, ABET (GSE)
  - In-residence: nominally 18 month program, 72 credits (12 hours/qtr)
  - On-line (part-time): nominally 3 years long, 48 credits (4 hours/qtr)
  - Thesis required for both on-line and in-residence students
- Masters of Engineering, Applied Systems Engineering (ASE)
  - Nominally a 3 year program for on-line students, 48 credit hours
  - Like GSE but replaces thesis with analysis track and capstone project
- Doctoral Systems Engineering (DSE)
  - Nominally a 36-month program, including 1-2 years of research



# Systems Engineering Certificate

## **SE Foundations**

(SENG 520)

## **Agile Software**

(SENG 593)

## **Architecture**

(SENG 640)

## **Select One**

## **Advanced Topics**

(SENG 670)

## **Project Management**

(SENG 610)

## **Systems Core**

4 Classes

4 hours each

Core Systems Engineering Tools

Building Block for our Family of Systems Engineering Programs

# Systems Engineering (GSE)

## Independent Research Focus (Thesis)

**SE Foundations**  
(SENG 520)  
**Agile Software**  
(SENG 593)  
**Architecture**  
(SENG 640)  
**Select One:**  
**Advanced Topics**  
(SENG 670)  
**Project Management**  
(SENG 610)

**Statistics**  
MATH or STAT at 500  
or higher  
**Research Methods**  
(RSCH 630)

### Systems Core

4 Classes  
4 hours each

### Thesis

3 Quarters  
4 hours each

**Thesis**  
Intensive independent  
research effort  
leveraging toolsets  
gained through  
coursework.

### Research Tools

2 Classes  
4 hours each

### Specialization

3 Classes  
4 hours each

**Specialization**  
Human Systems  
Space Systems  
Cyber Systems  
Advanced Systems Analysis  
Small Unmanned Aerial Systems\*  
Navigation  
Test and Evaluation\*\*

\* In-residence only

\*\* Separate selection process

# Applied Systems Engineering

## Tools Focus (Capstone)

**SE Foundations**  
(SENG 520)  
**Agile Software**  
(SENG 593)  
**Architecture**  
(SENG 640)  
**Select One:**  
**Project Management**  
(SENG 610)  
**Advanced Topics**  
(SENG 670)

**Statistics**  
MATH or STAT at 500  
or higher  
**Analysis Track (pick  
one)**  
Advanced System  
Analysis  
Test and Evaluation\*\*

### Systems Core

4 Classes  
4 hours each

### Capstone Project

1 Class  
4 hours

### **Capstone**

Independent research  
project leveraging  
toolsets gained  
through coursework.

### Analytical Tools

1 Stat + 3 course track  
4 hours each

### Specialization

3 Classes  
4 hours each

### **Specialization**

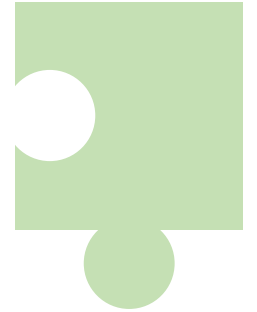
Human Systems  
Space Systems  
Cyber Systems  
Advanced Systems Analysis  
Small Unmanned Aerial Systems\*  
Navigation  
Test and Evaluation\*\*  
Nuclear\*\*\*

\* In-residence only

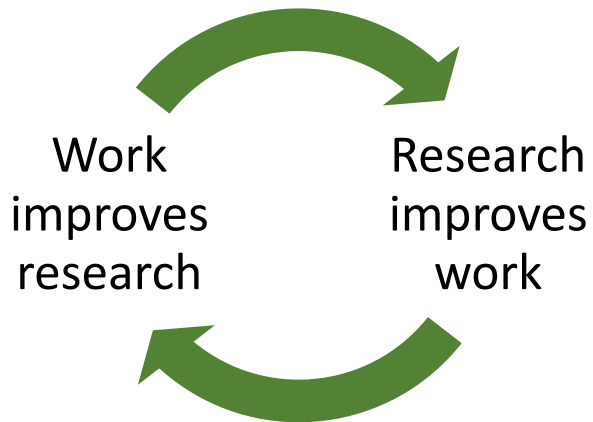
\*\* Separate Competitive Process

\*\*\* ASE program only

# Research



- We seek out defense-focused relevant topics for student research (thesis and capstone)
- Ideally research topics are tied to your work; the work-research virtuous cycle



- ASE: SENG 798 (4 hour capstone – 1 quarter)
- GSE: SENG 799 (12 hour thesis – at least 3 quarters)

# How long does it take? How many students?

	FA23	WI24	SP24	SU24	FA24	WI25	SP25	SU25	FA25	WI26	SP26	SU26
40 RS	SE Core/Certificate				STAT	Domain Track			Analysis Track			Capstone
40 DL	SE Core/Certificate				STAT	Specialization			Methods	Thesis		
20 DL	SE Core/Certificate				Degree Follow-on to meet student's needs							
20 DL	SE Core/Certificate				Degree Follow-on to meet student's needs							
20 DL	SE Core/Certificate				Degree Follow-on to meet student's needs							

- AFIT resources (RS): We have 40 resident (RS) openings each fall. Priority to military assignment system.
- AFIT resources (DL): We have 20 distance learning (DL) openings each fall. Priority to any sponsored students.
- AFMC/ENS (DL): 20 openings each fall and spring (40 total). Priority to AFMC sponsored personnel.
- Digital Center (DL): We have 20 DL openings each Winter and Summer (40 total). Priority to AFMC.
- Total annual starts: 140
- Year round quarterly starts for online, fall starts for in residence



# Who can legally be an AFIT student

- Air Force and Space Force Personnel (all civilian and military)
- All federal government (ex. NASA, DOE, DHS)
- Any DoD CAC holders (ex. Air Force contractors)
- Critical infrastructure (ex. ODOT)



# Capacity and Tuition – How is it paid for?

Program Capacity – How many students can we support

- Existing military and civilian faculty at the institute are funded through institutional requirements
- ‘Buy the section’ – contractor and civilian over hire faculty can be secured with sponsor funding – the funding opens additional spaces for students

Tuition (online and part-time students)

- All USAF/USSF personnel (mil and civ) - AFIT graduate education is ‘tuition waived’
- All others pay tuition

Tuition (residence)

- Sponsors (ex. SAF/AQ, AFMC) can ‘buy’ a section and expand capacity
- All USAF/USSF personnel (mil and civ) - AFIT graduate education is ‘tuition waived’
- All others pay tuition
- There are service commitments for full-time students per AFIs and U.S. Code



# Would you like to know more?

- (937) 255-3636 ext:4626
- <https://www.afit.edu/ENV/>



# LOE 2: Applied Research

- Model Integration

- Python
- AFSIM
- MATLAB
- Engineering Sketch Pad

- Reference Architectures

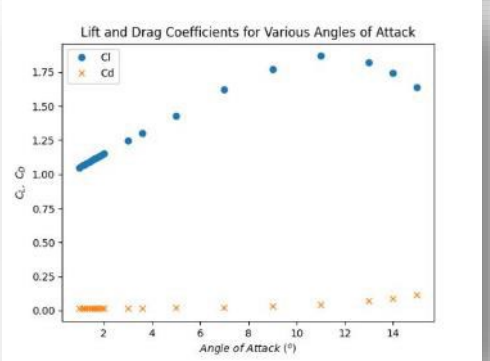
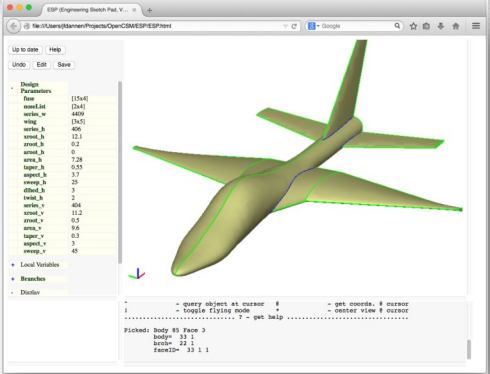
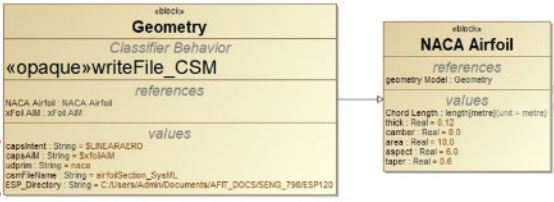
- Human Systems
- Weapons, UAS, CubeSat
- Automated Processes
- Digital Twins

- Transition: Legacy to Digital

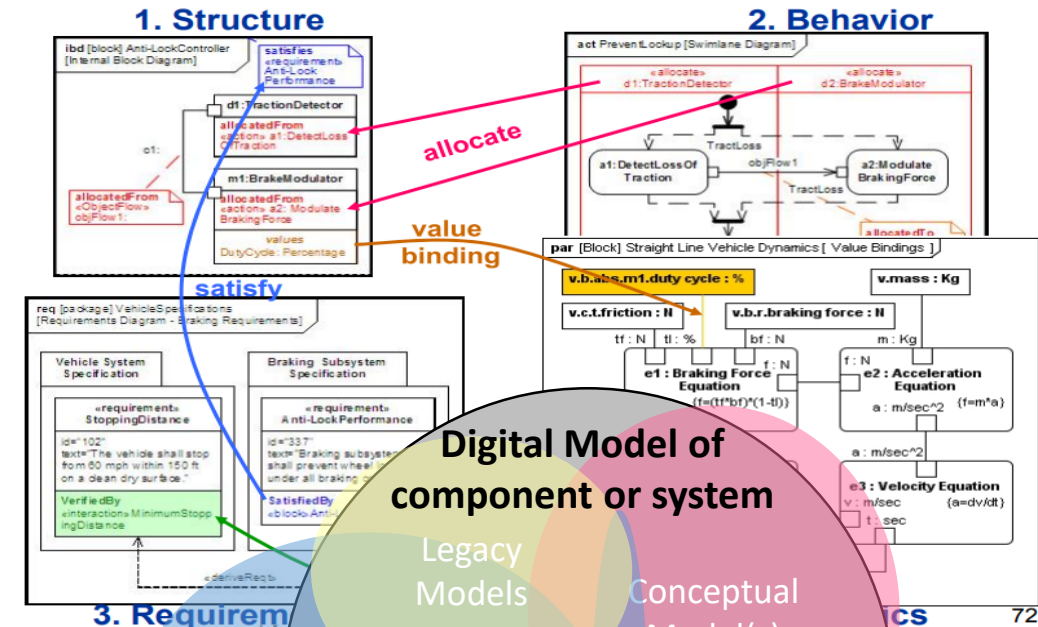
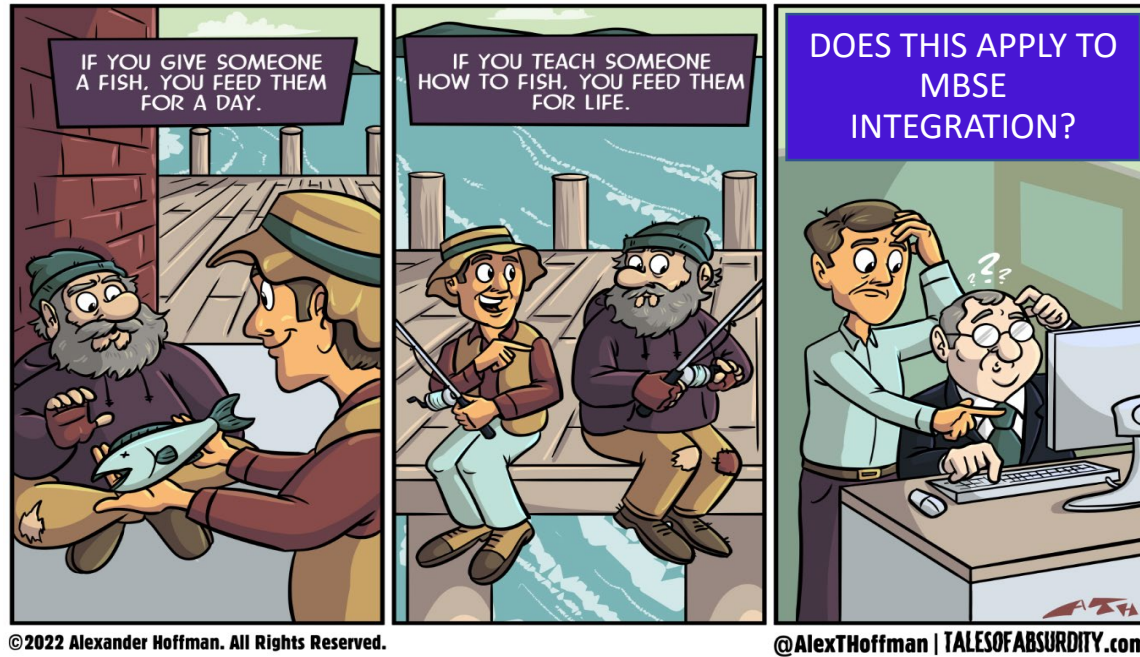
- Air Worthiness and Test
- Requirements and Acquisition
- Model Validation

- Mission

- Mission engineering
- Wargaming
- Reverse engineering

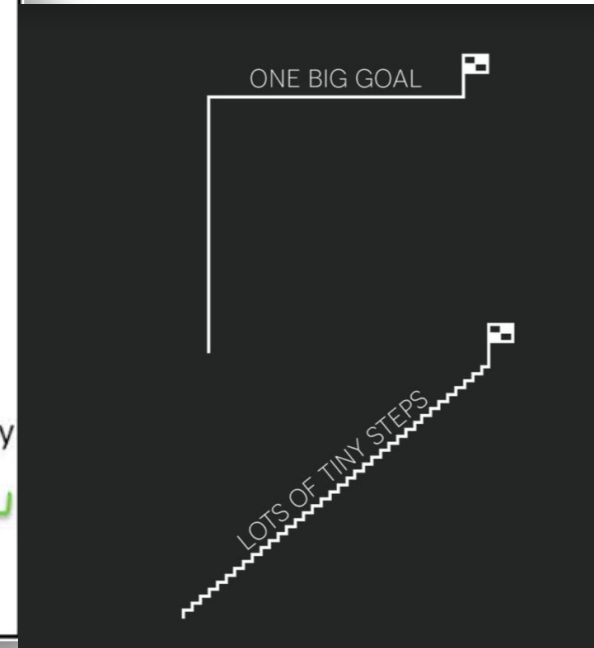
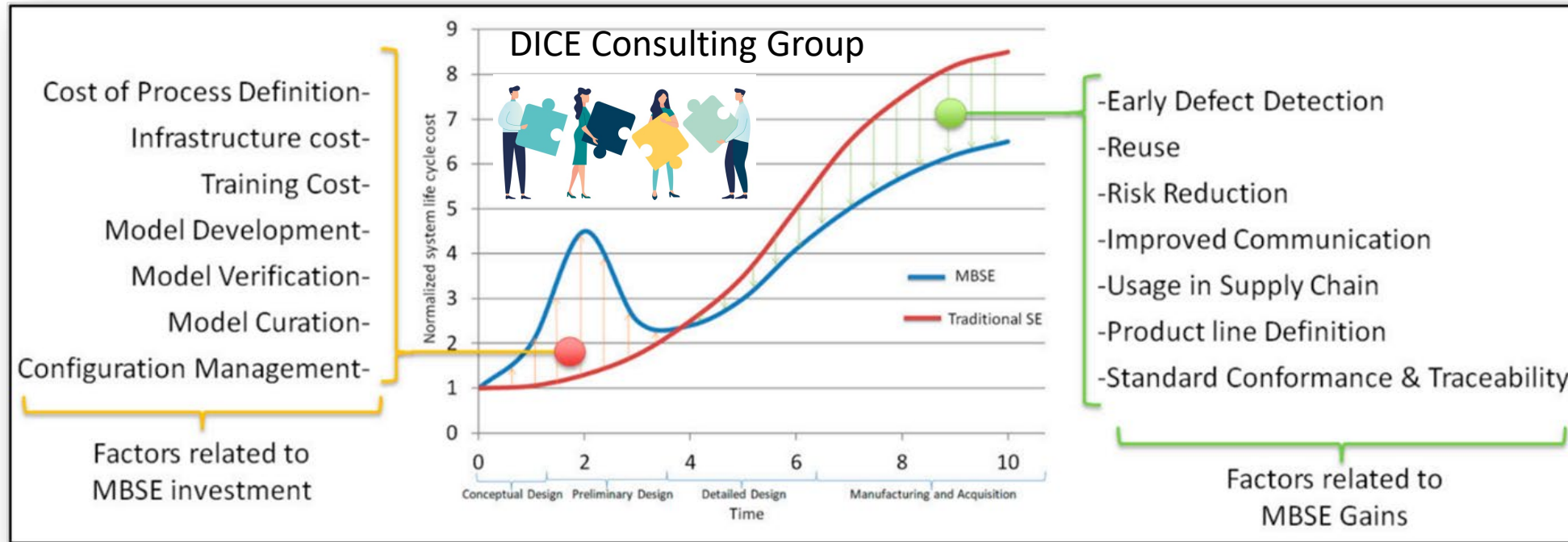


# LOE 3: Consulting Development Art of the Feasible

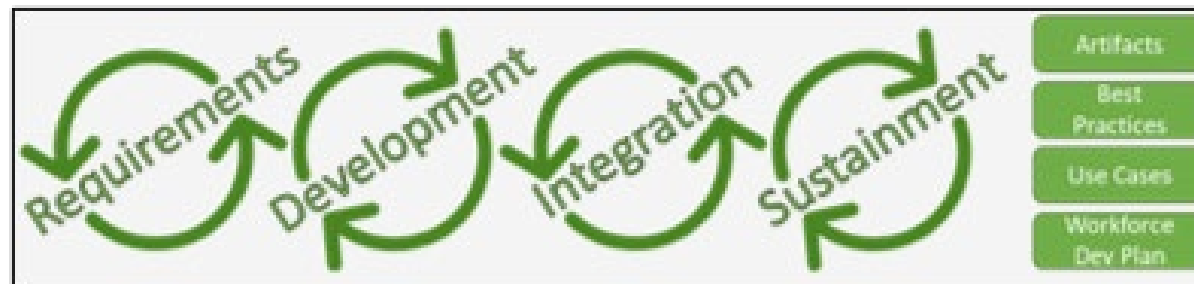


Friendenthal, S, Moore, ... SysML™) Tutorial, 2009

# LOE 3: Consulting



Ref: Madni, A. Purohit, Shatad (2019) Economic Analysis of Model-Based Systems Engineering. *Systems*, 7(12), 1-18



Goal – Provide AFMC Programs Execution, Education, and Sustainment Capabilities w/r to the Digital Transition



# LOE 4: Best Practices

- LOEs 1-3 culminate into Best Practices for the Digital Transformation
- Useful Artifacts
  - **Annual Digital Symposiums** That Integrate **Best Practices, Research Efforts, Use Cases, Education,** and synergized **Collaboration** with **Industry, Government, and Academia**
  - Annual Publications and Repository of **Accessible MBSE Research** (Typology, with Artifacts)
  - Inform education, training, consulting, and policy (Standardization)



<https://blog.contendersolutions.com/5-it-management-best-practices-for-success-2021>



Q/A



DALL-E Art