

SYSTEMS ENGINEERING RESEARCH CENTER

*Simulation Training Environment for
Digital Engineering (STEDE)*

NDIA S&ME Conference
Presenter: Paul Wach
3 November 2022





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A collaboration platform for engaging stakeholders within the extended DoD Acquisition and Engineering Enterprise, thought leaders from across the nation, and researchers across academia.



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PI: Dr. Nicole Hutchison
Co-PI: Dr. Dinesh Verma
Mr. Tom McDermott
Dr. Yan See Tao
Ms. Megan Clifford
Mr. David Long
Mr. Shubham Dekatey



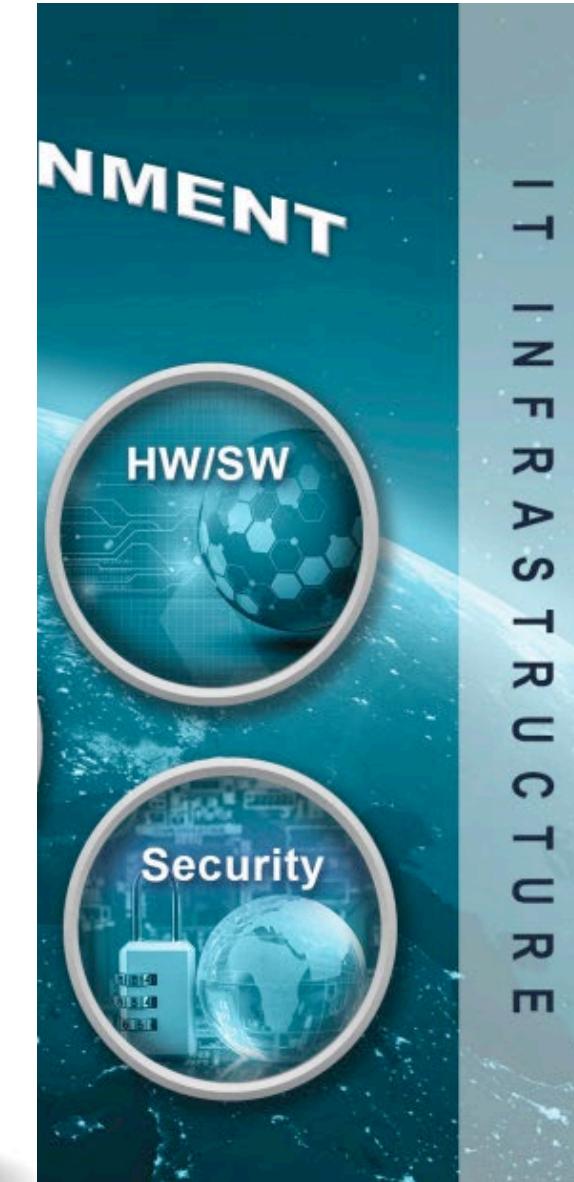
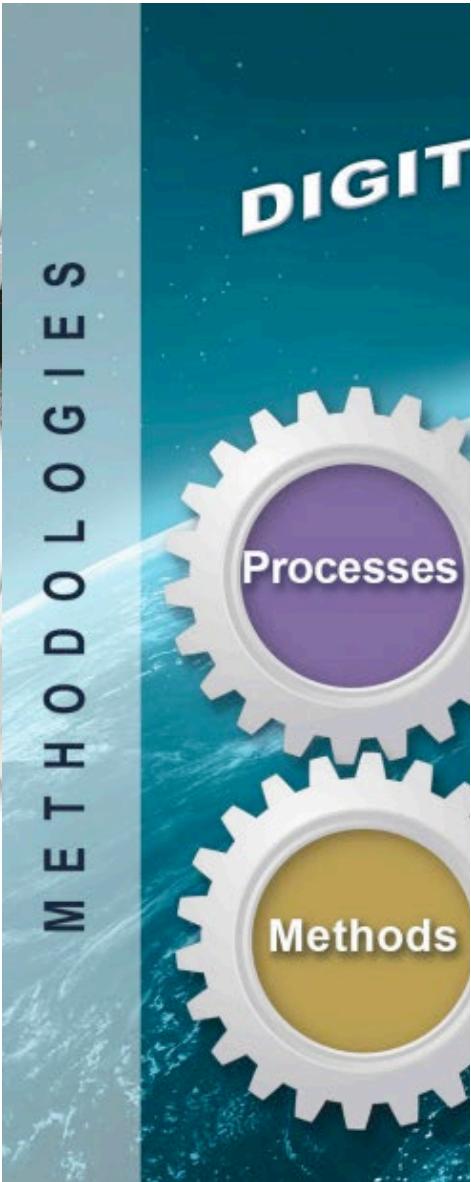
Dr. Craig Arndt



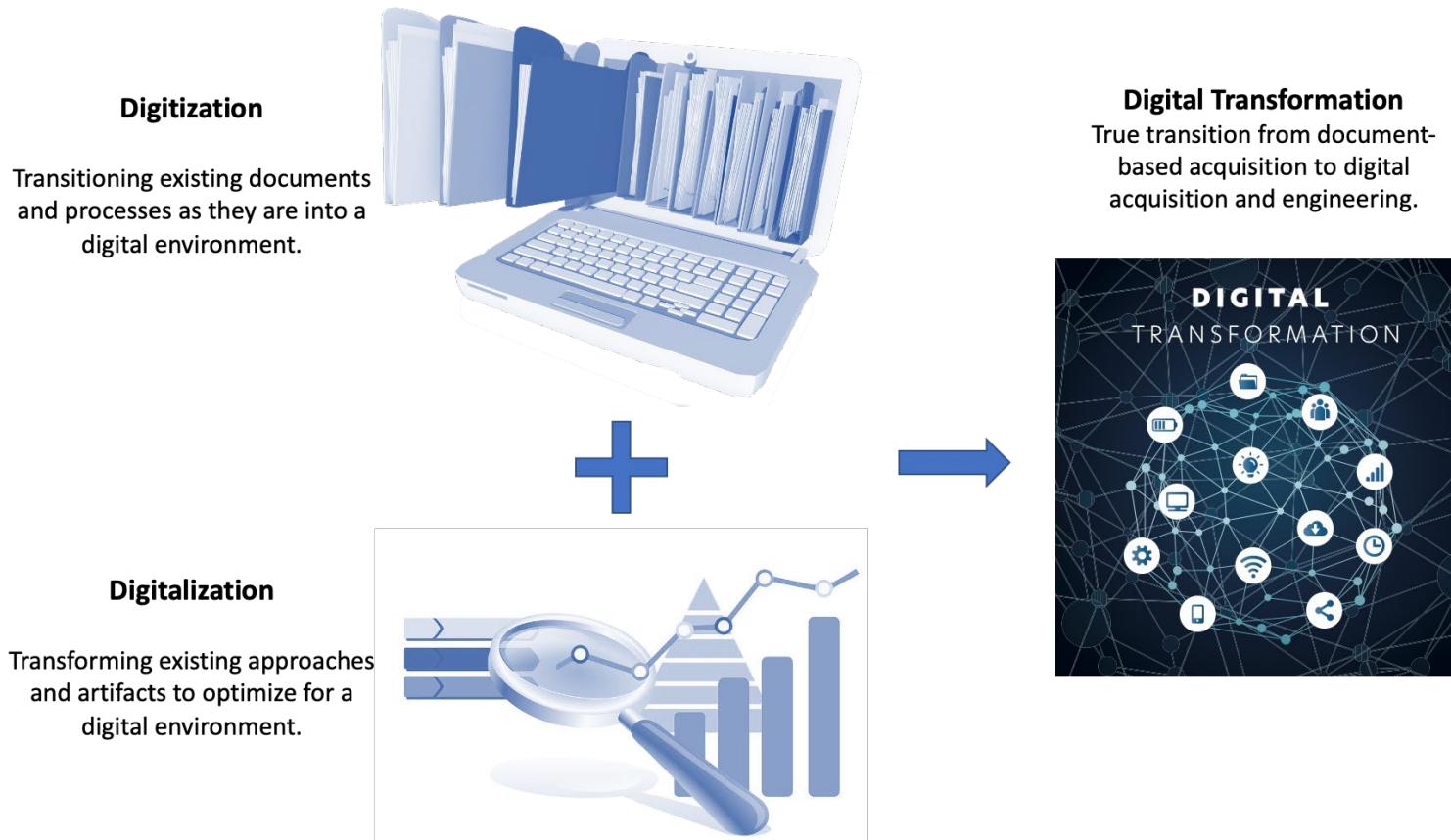
Mr. David Pearson

Dr. Robert Raygan

Dr. Jim Roche



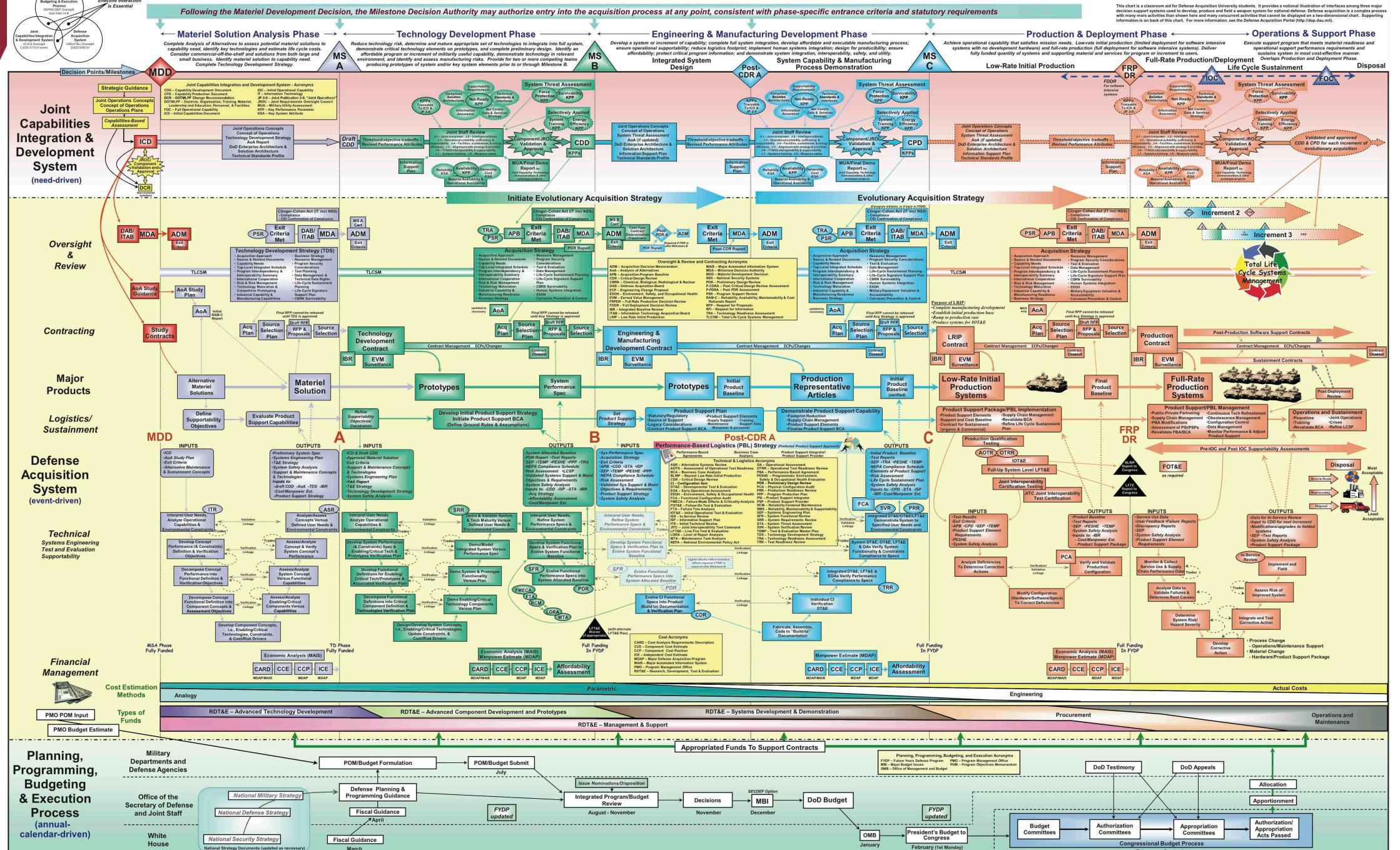
Paradigm Shift

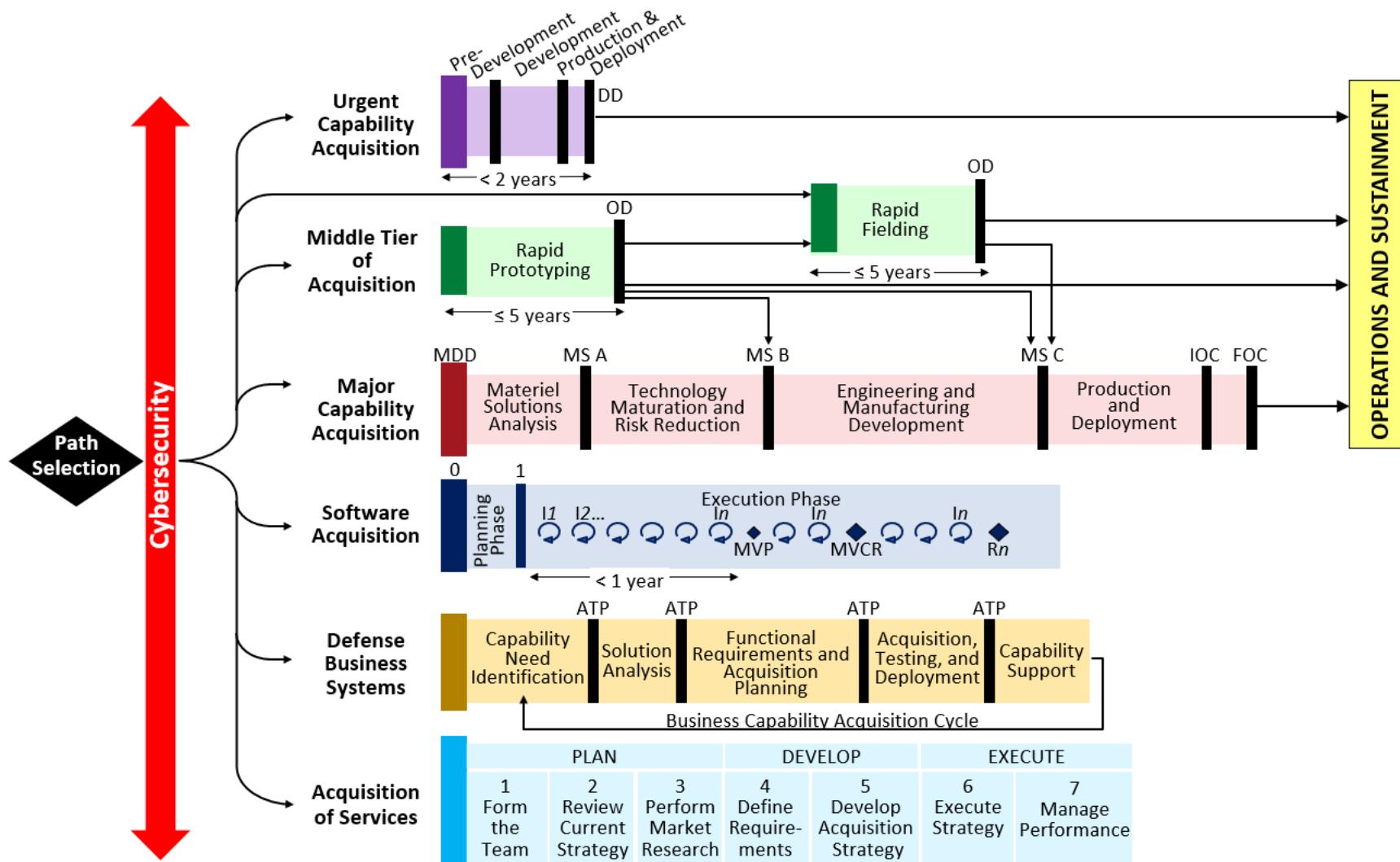


- Challenge:
 - Provide training that addresses individuals at all different stages of the transition

Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System

Defense Acquisition University students. It provides a national illustration of interfaces among three major areas: develop, produce and field a weapon system for national defense. Defense acquisition is a complex process shown here and many concurrent activities that cannot be displayed on a two-dimensional chart. Supporting art. For more information, see the Defense Acquisition Portal (<http://dap.dau.mil>).





DIGITAL ENGINEERING (DE)

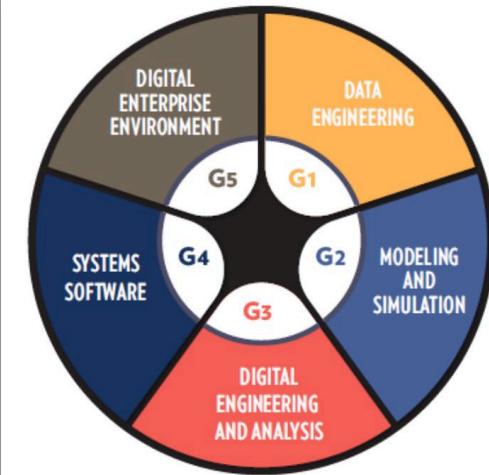
1. Using the Systems Modeling Language (SysML)
2. Model-Based Systems Engineering (MBSE)
3. Digital Engineering Environment
4. Digital Engineering Technical Processes
5. Digital Engineering Acquisition Management Processes
6. Digital Engineering Intermediate Credential Capstone

SECURE CYBER RESILIENCE ENGINEERING (SCRE)

1. Foundational - CYB 5610
2. Introduction – CYB 5620
3. Practitioner – CYB56XX

*Tiered approach

**Main focus of this presentation is on the DE credentials



FOUNDATIONAL DIGITAL COMPETENCIES	
F1	Digital Literacy
F2	Digital Engineering Value Proposition
F3	DoD Policy/Guidance
F4	Coaching and Mentoring
F5	Decision Making
F6	Software Literacy

LEGEND:
 C# - Competency Title
 F# - Foundational Competency Title
 G# - Competency Group
 S# - Competency Subgroup

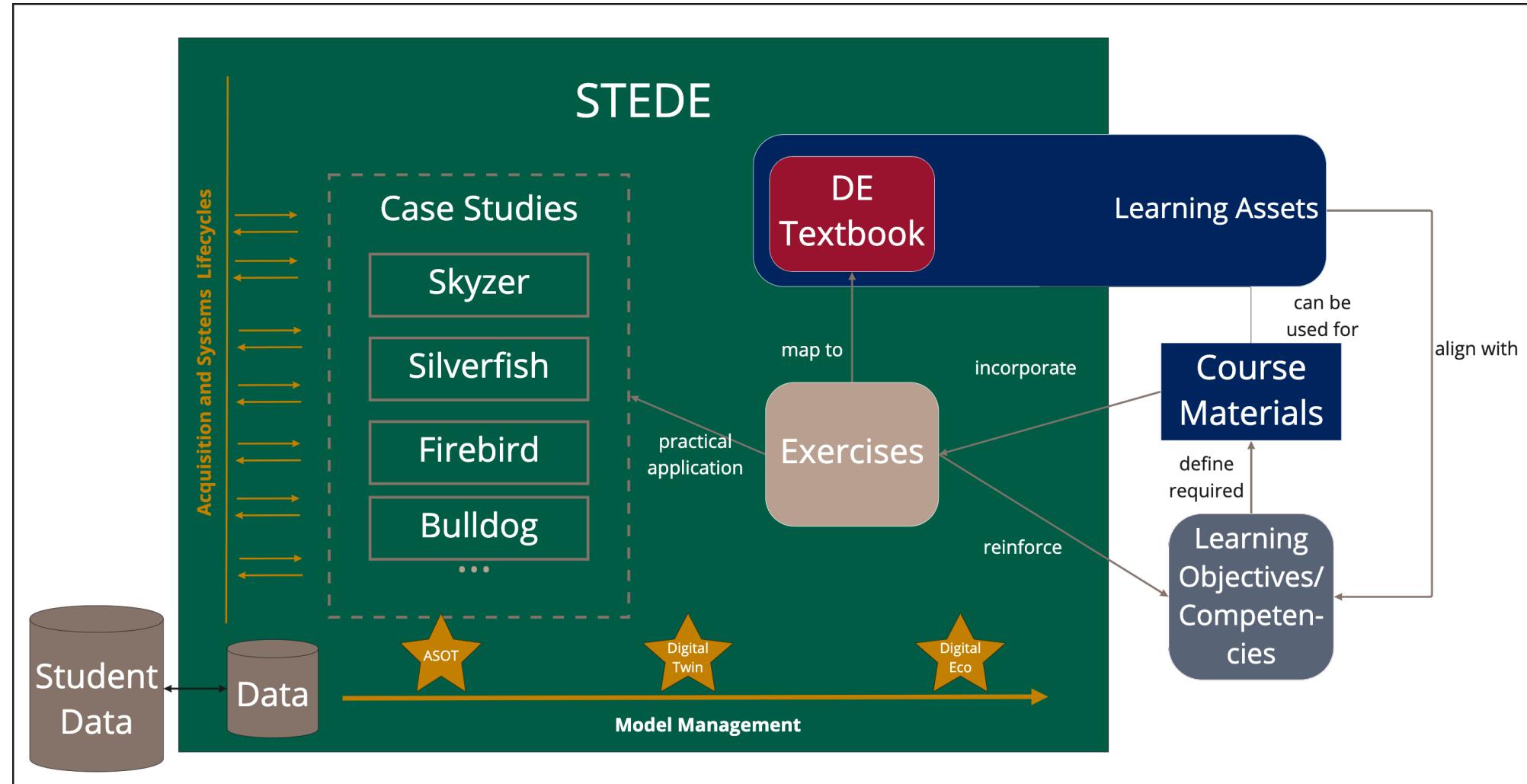
G1 DATA ENGINEERING		
S1	Data Engineering	C1 Data Governance
		C2 Data Management
G2 MODELING AND SIMULATION		
S2	Modeling and Simulation	C3 Modeling
		C4 Simulation
		C5 Artificial Intelligence/Machine Learning
		C6 Data Visualization
		C7 Data Analytics
G3 DIGITAL ENGINEERING AND ANALYSIS		
S3	Digital Systems Engineering	C8 Digital Architecting
		C9 Digital Requirements Modeling
		C10 Digital Validation and Verification
		C11 Model-Based Systems Engineering Processes
S4	Engineering Management	C12 Digital Model-Based Reviews
		C13 Project and Program Management
		C14 Organizational Development
		C15 Digital Engineering Policy and Guidance
		C16 Configuration Management
G4 SYSTEMS SOFTWARE		
S5	Systems Software	C17 Software Construction
		C18 Software Engineering
G5 DIGITAL ENTERPRISE ENVIRONMENT		
S6	Digital Enterprise Environment Development	C19 Digital Environment Development
S7	Digital Enterprise Environment Management	C20 Management
		C21 Communications
		C22 Planning
S8	Digital Enterprise Environment Operations and Support	C23 Digital Environment Operations
		C24 Digital Environment Support
S9	Digital Enterprise Environment Security	C25 Digital Environment Security

The DECF is mapped to the DE textbook use cases in the table below.

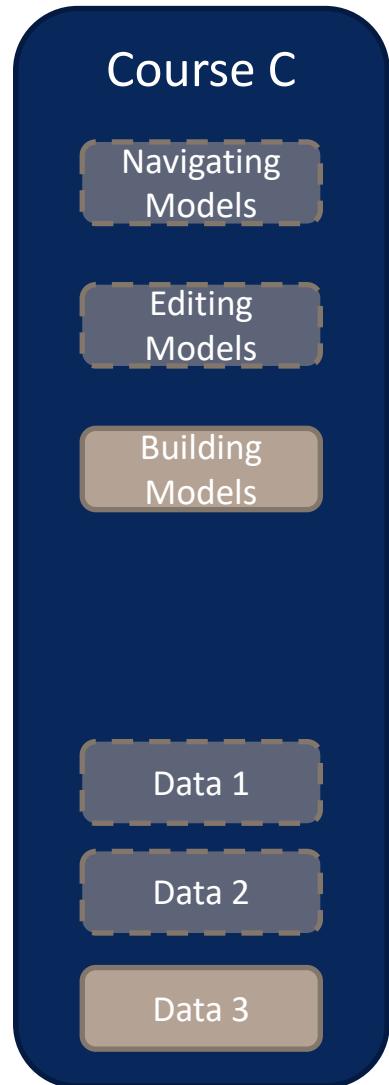
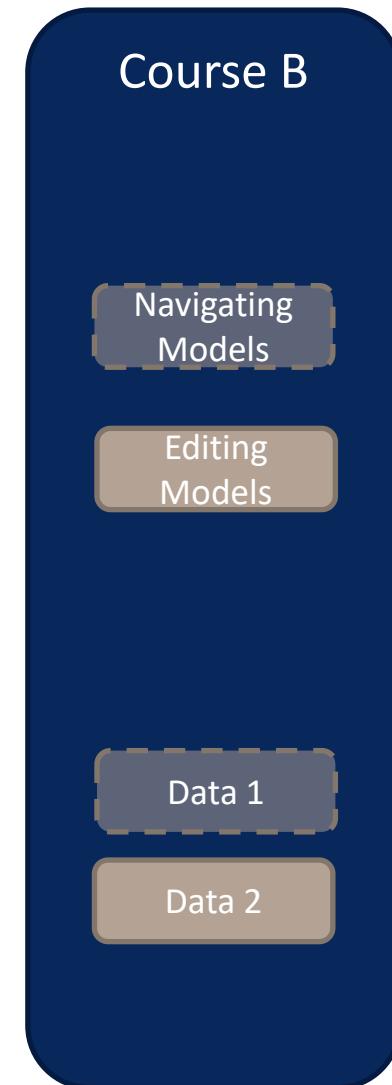
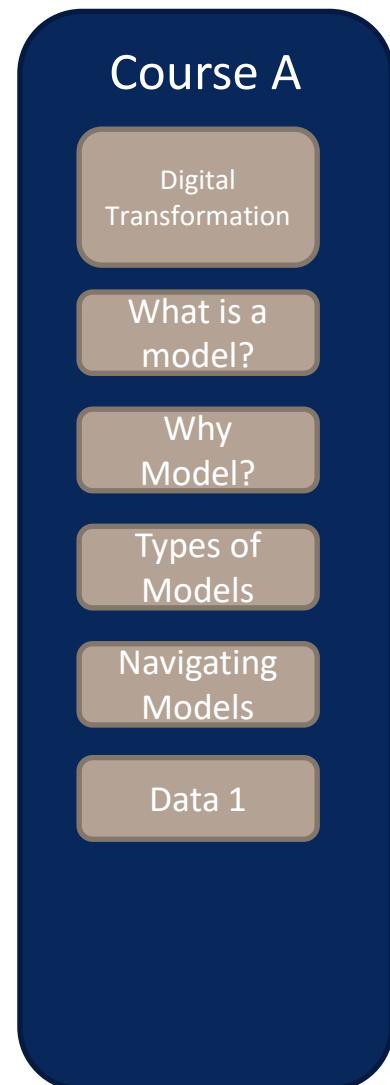
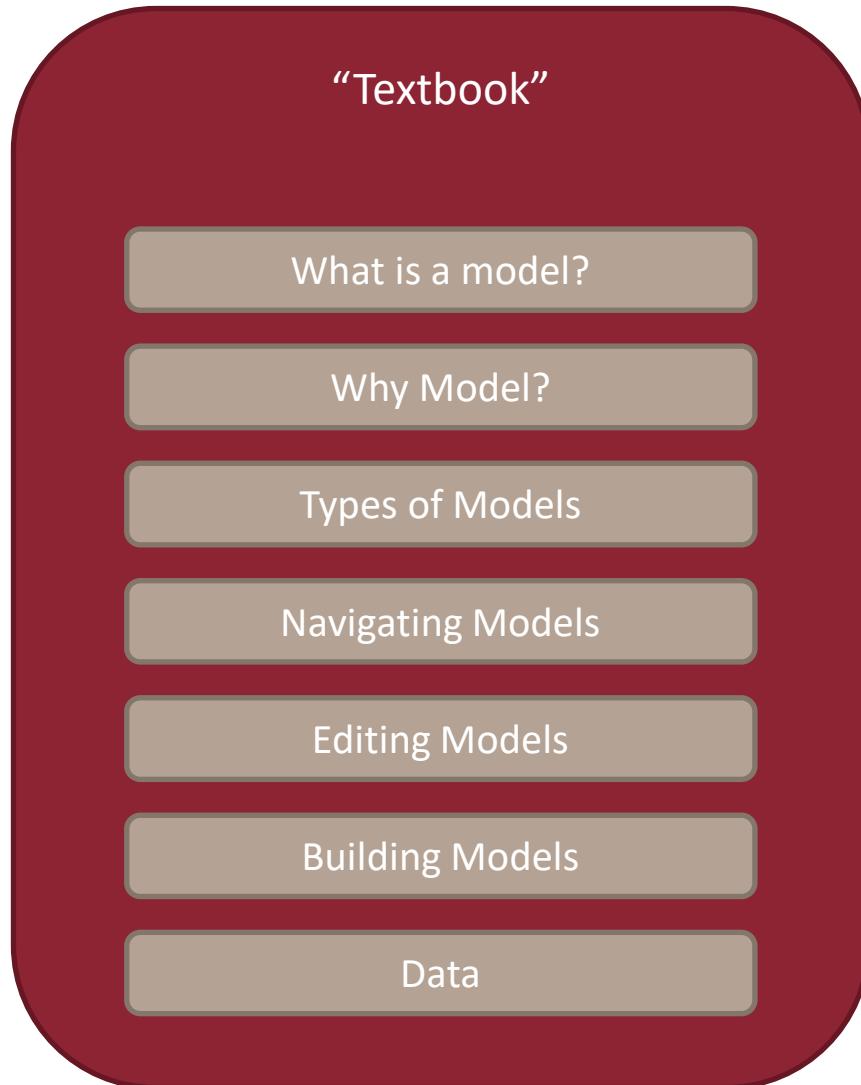
The mapping primarily aligns with the G2: Modeling and Simulation & G3: Digital Engineering and Analysis Competency Groups.

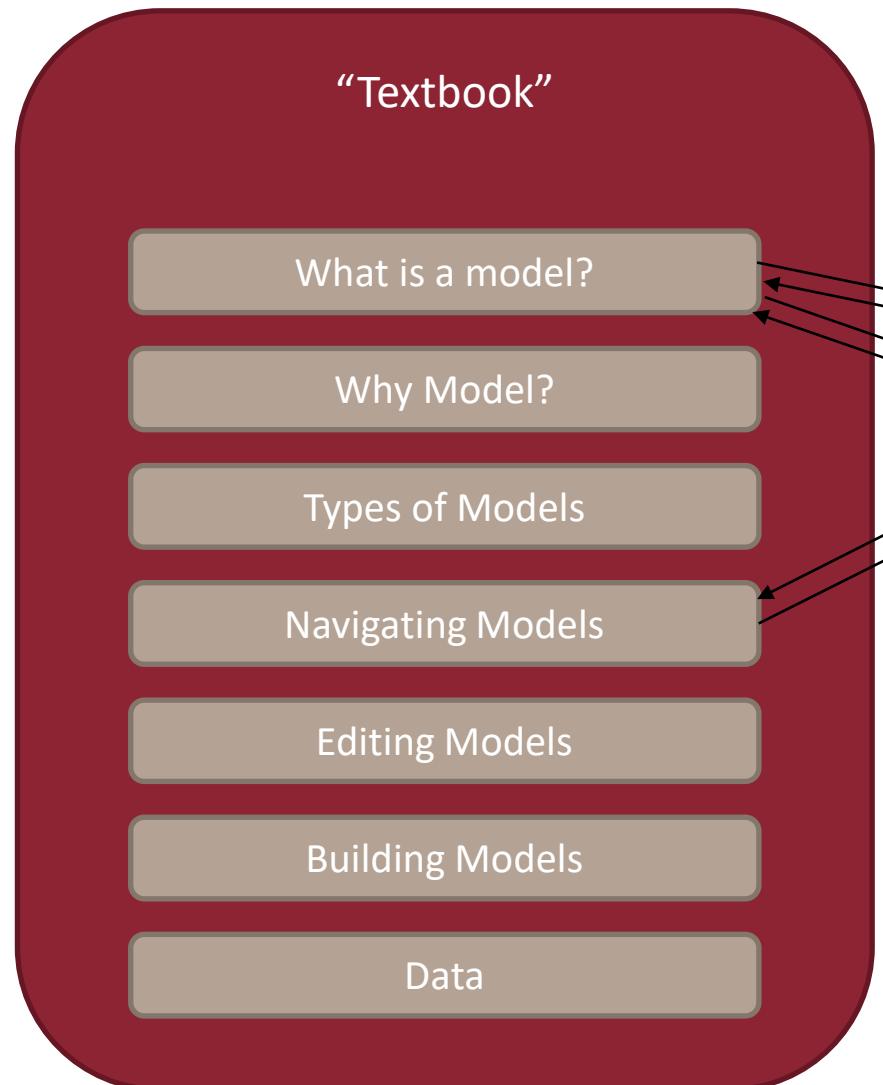
Competency Group	Competency Sub-Group	Competency	Use Case: Training Module	Order
G2: Modeling and Simulation	S2: Modeling and Simulation	C3: Modeling	Behavior Analysis Module	3.3
		C4: Simulation	MA: Vulnerability Assessment	3.3.1
		C5: AI/ML	Behavior Simulation Module	3.3.2
		C6: Data Visualization	Parametrics and Physics-based Model Integration	3.4.2
		C7: Data Analytics	SE4AI & AI4SE Module	3.8
			Reports and Presentations Module	3.7
			DoDAF View Module	3.7.1
			Reports and Presentations Module	3.7
G3: Digital Engineering and Analysis	S3: Digital Systems Engineering	C8: Digital Architecting	System Architecture Module	3.4
		C9: Digital Requirements Modeling	MA: Resilience Architecture Module	3.4.1
		C10: Digital Validation and Verification	Mission Engineering Module	3.1
		C11: Model-based SE	MA: Operational Risk Assesment Module	3.1.1
			DoDAF Operational Domain Module	3.1.2
			Requirements Managemet Module	3.2
			Verification and Validation Module	3.5
			Perform Capstone Group Project	4
			C12: Digital Model-based Reviews	3.6.3
			Model Review and Signoff Module	3.6
			C13: Project and Program Management	3.6
			Project Management Module	3.6.1
			Cost Simulation Module	3.6.1
			C14: Organizational Development	1
			Setup Student Environment	
			Select Student Type Module Navigation	2
			Execute Training Module	3
			Lifecycle Simulation Module	3.6.2

[Link to WRT-1006 Technical Report](#)

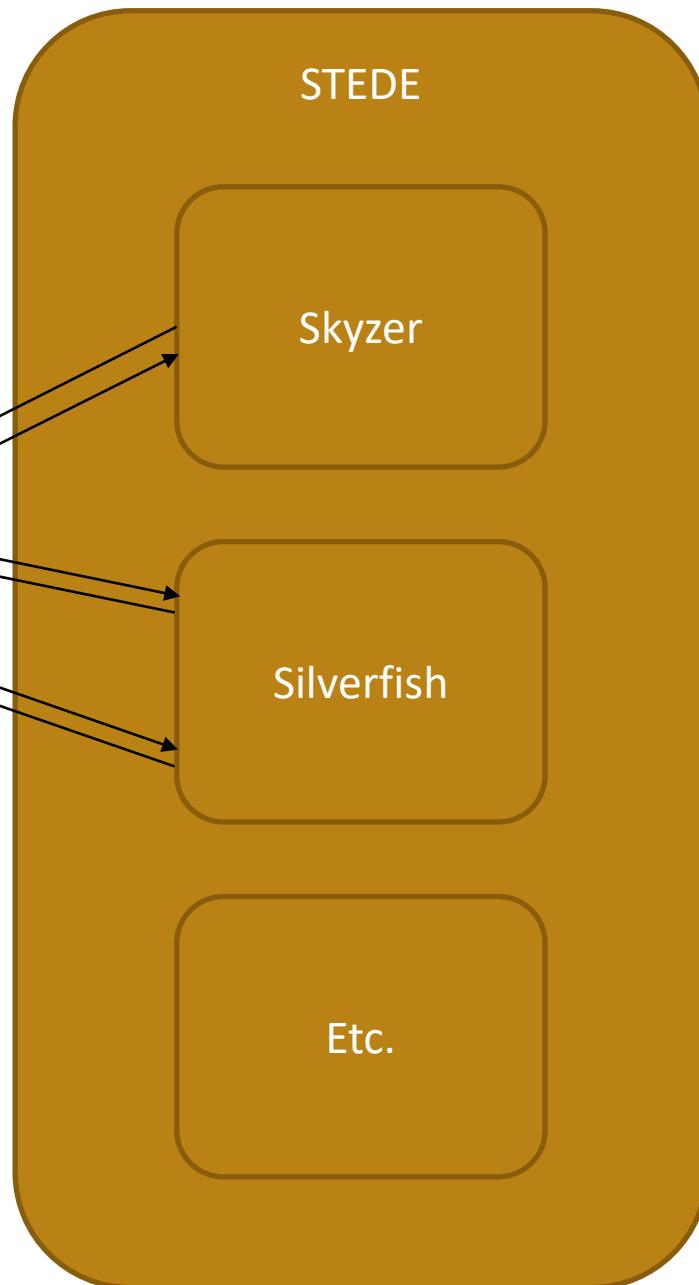


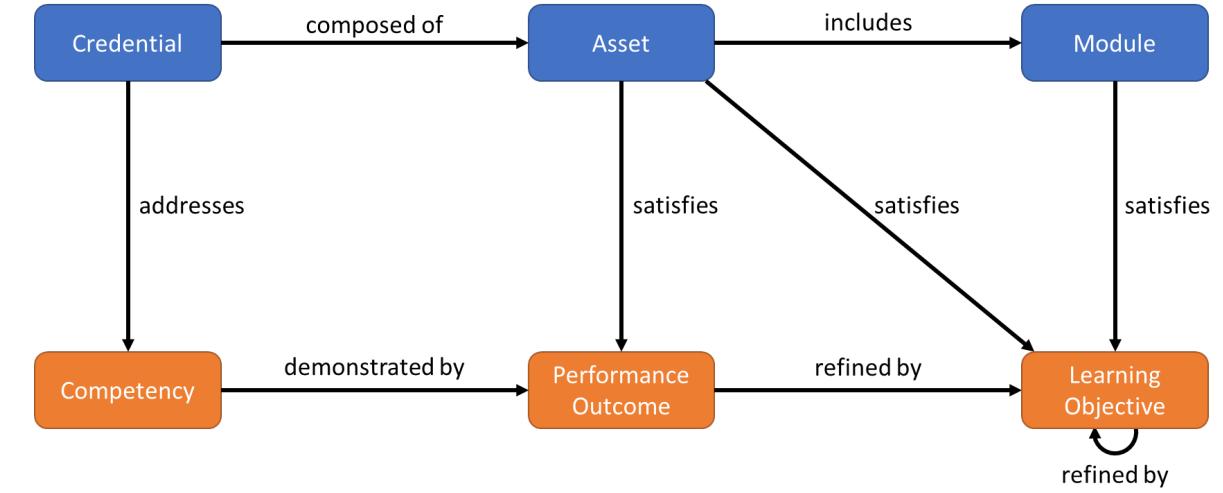
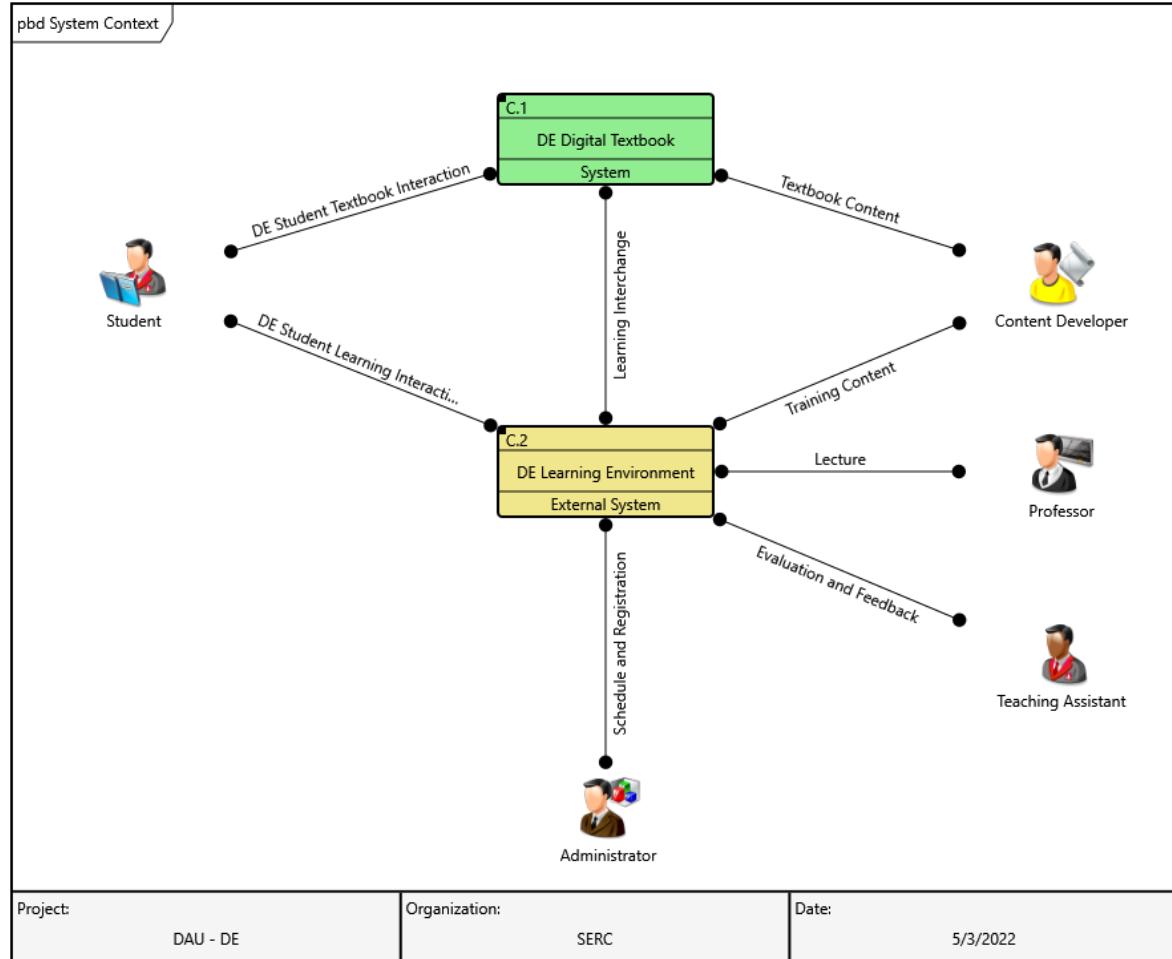
Simulation Training Environment for Digital Engineering (STEDE)

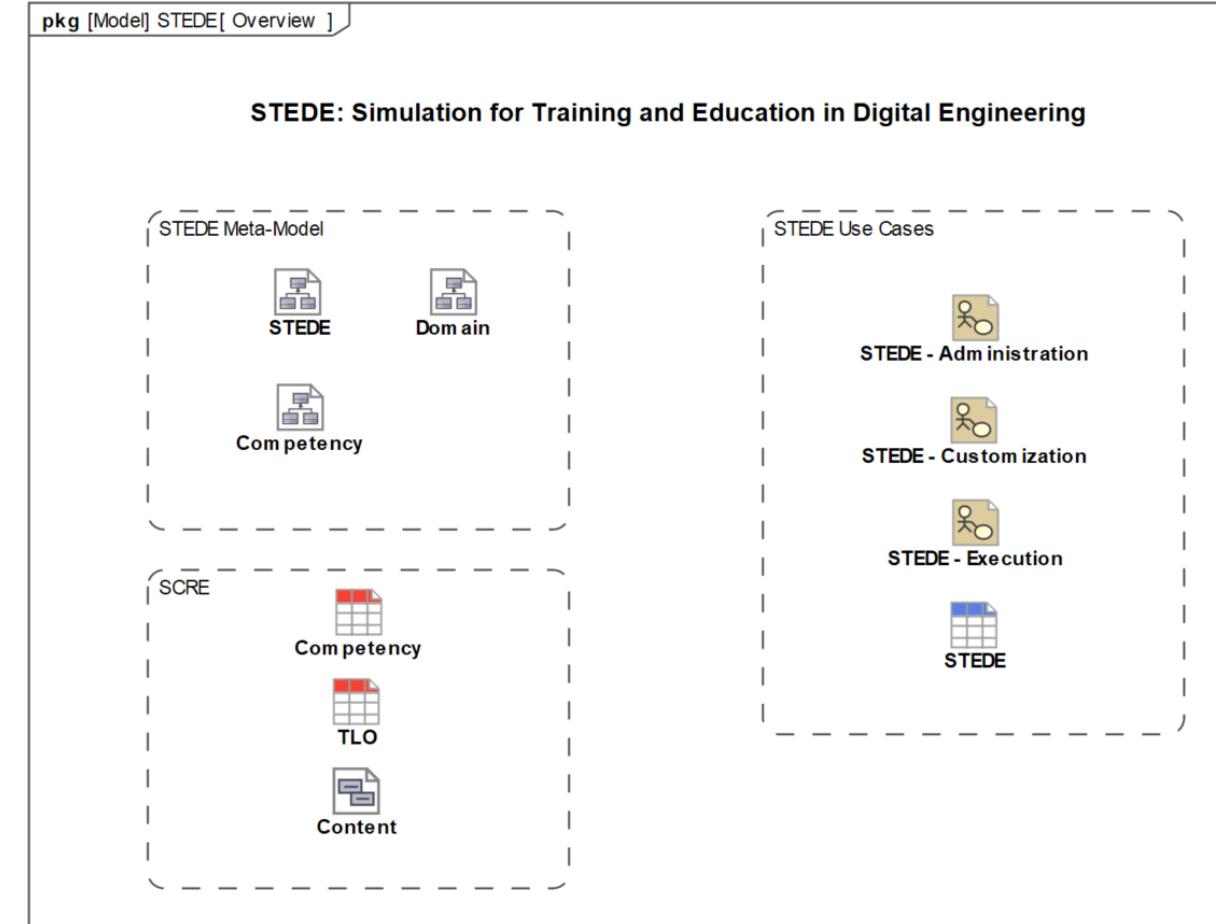
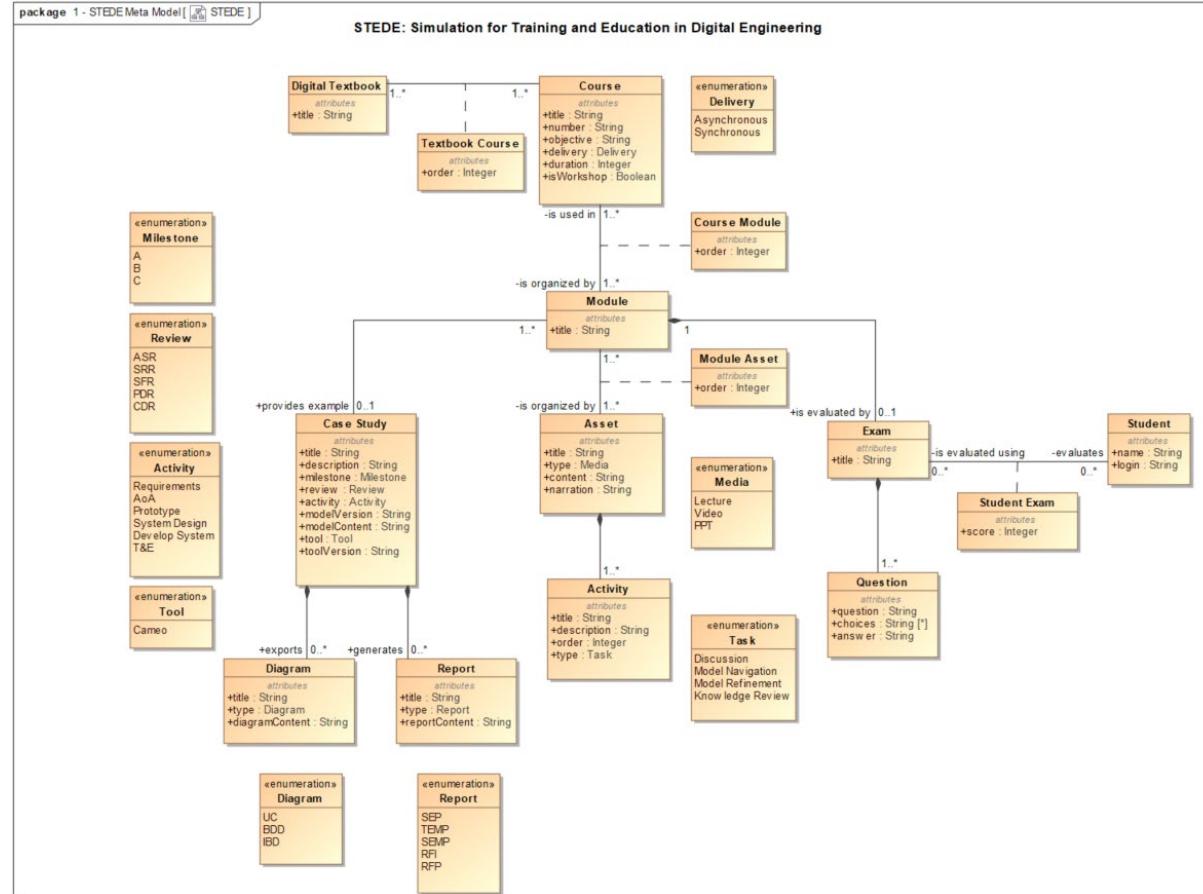


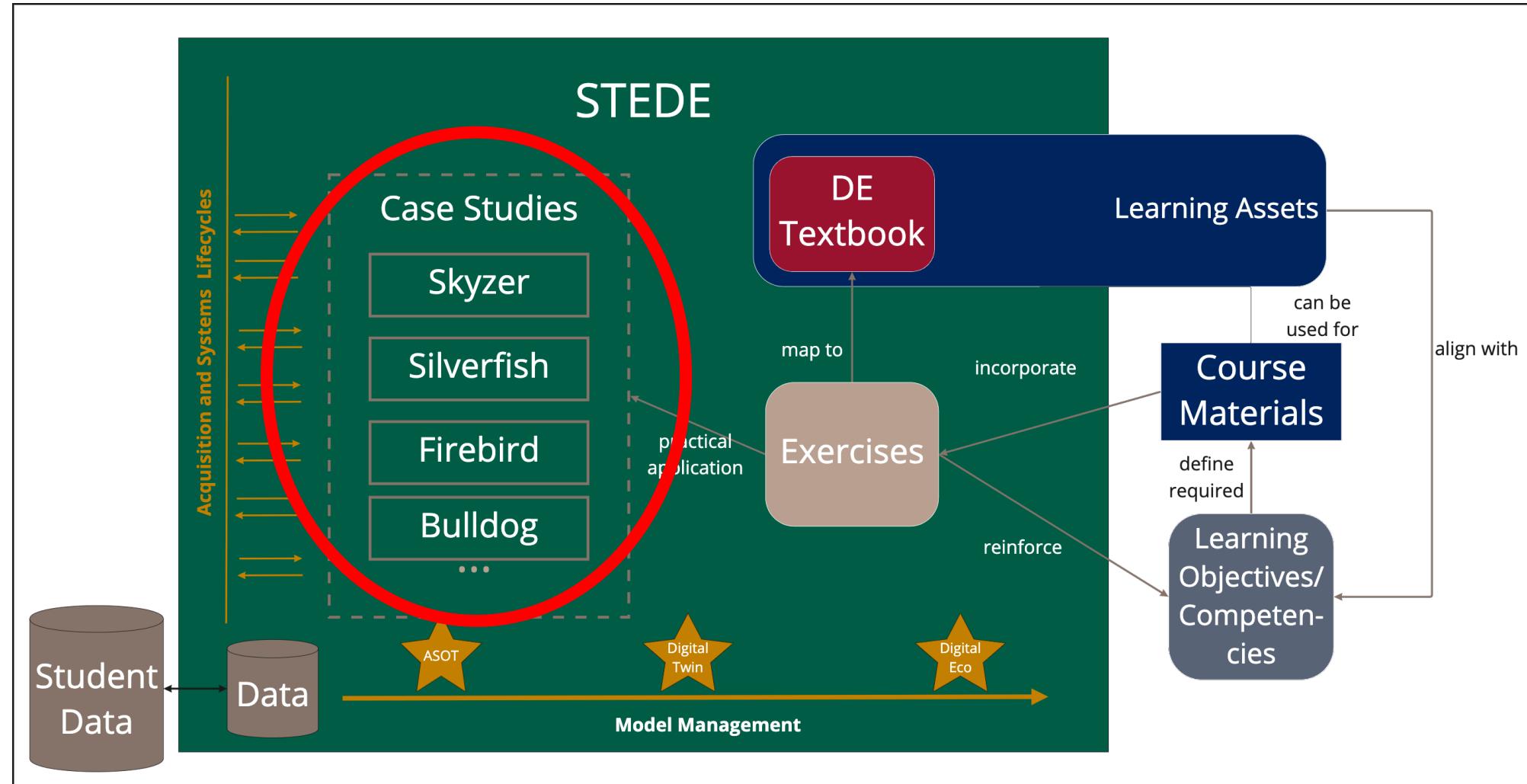


Exercises









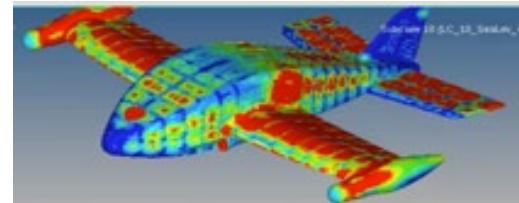
Simulation Training Environment for Digital Engineering (STEDE)

SKYZER CASE STUDY

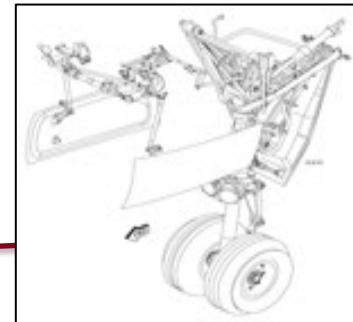
**Graphical CONOPS
Scenario: Search &
Rescue**



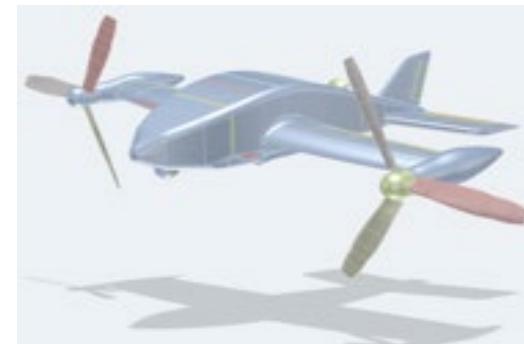
Deep Dives by Phases



P1: Multi-physics



P2: Airworthiness

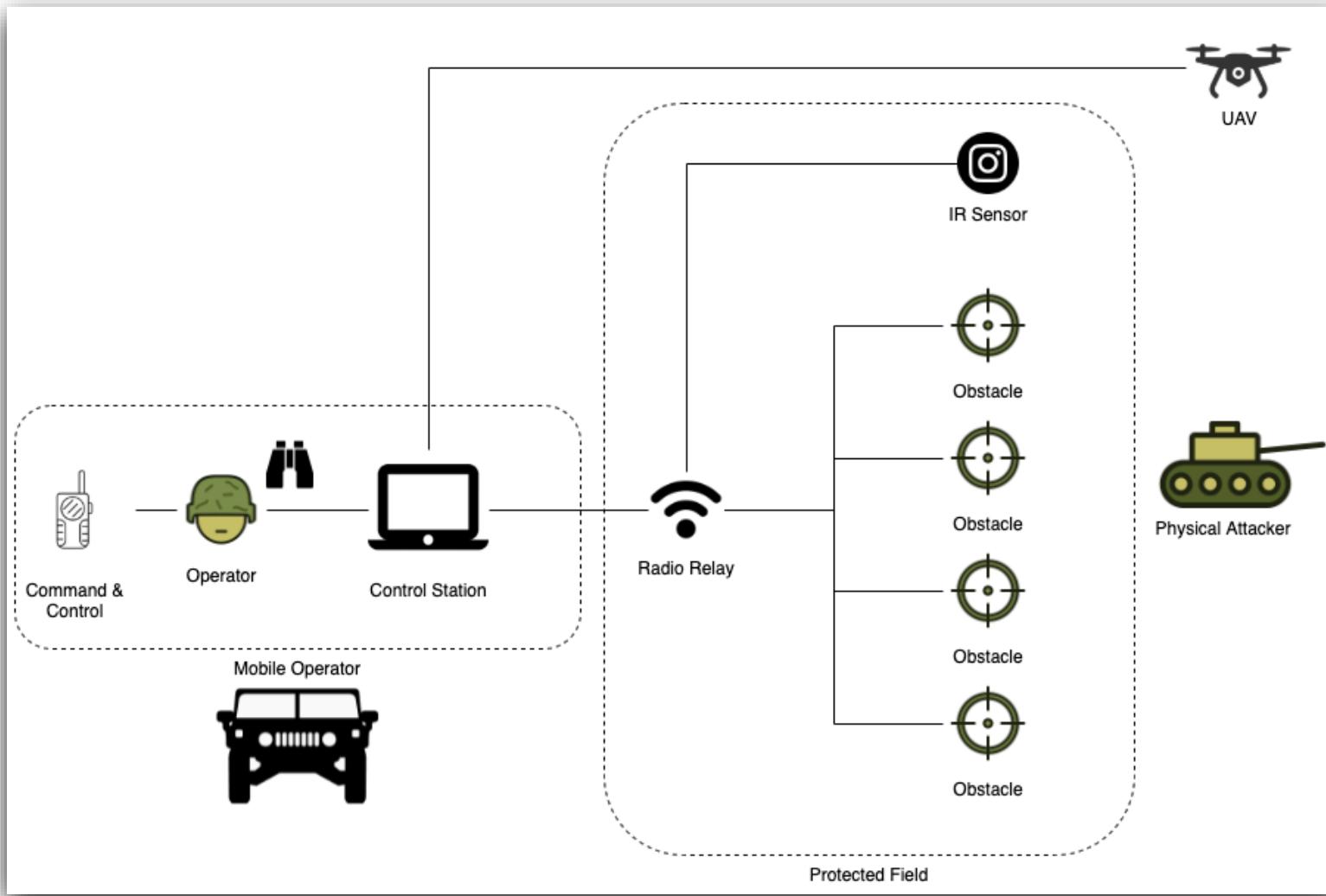


P3: Cost Modeling

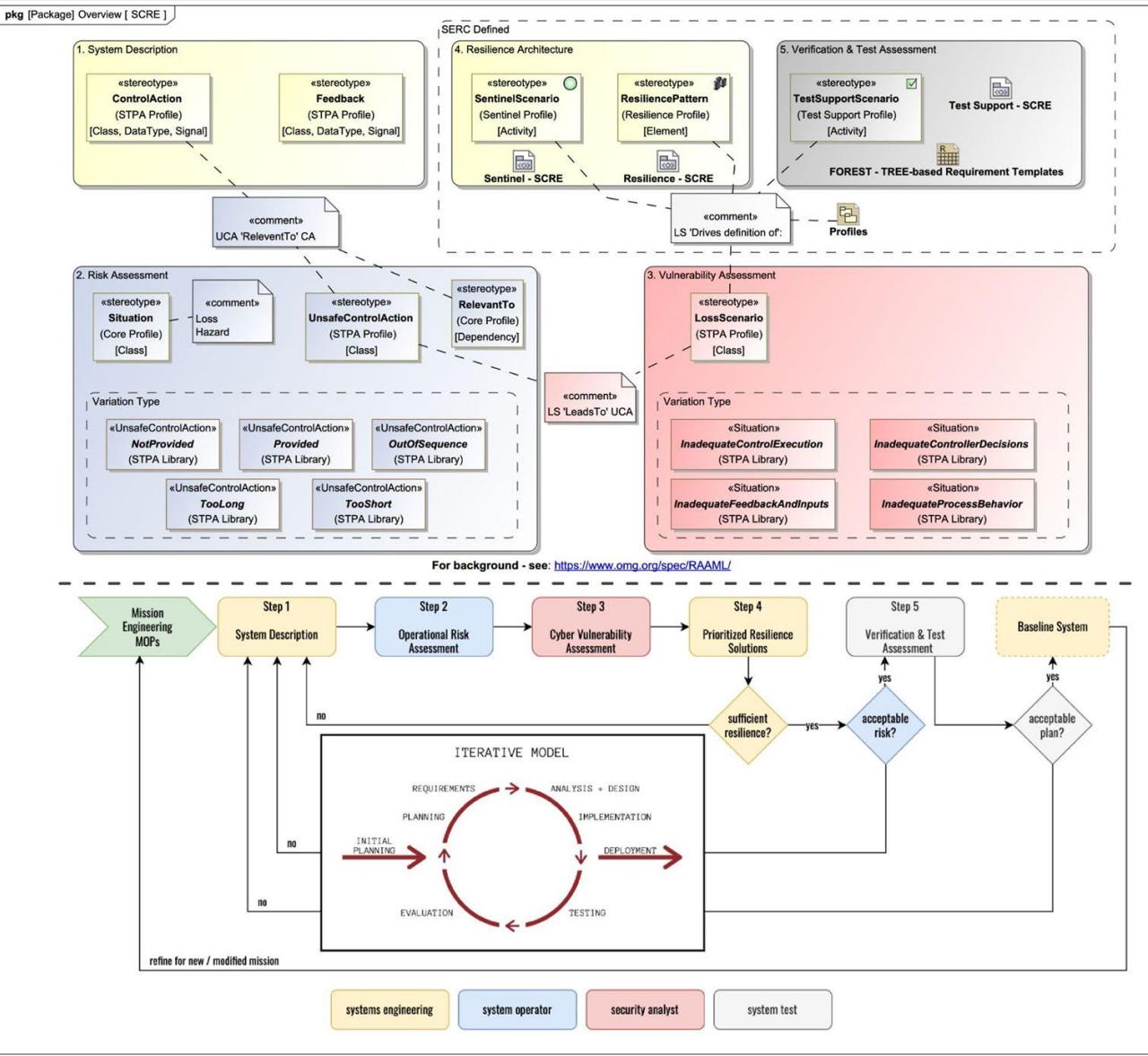
**Performance constraints force
Multi-physics Design
considerations –
similar to Bell Eagle Eye**



Doing Everything in Models to Demonstrate Art-of-the-Possible



- Silverfish is a rapidly deployable set of fifty (50) individual ground-based weapon platforms (obstacles)
- The purpose of the system is to deter and prevent adversaries from trespassing into a geographic area
- The system includes a variety of sensors to locate and classify potential trespassers as either personnel or vehicles
- The operator is located in a vehicle and operates within visual range of the protected area



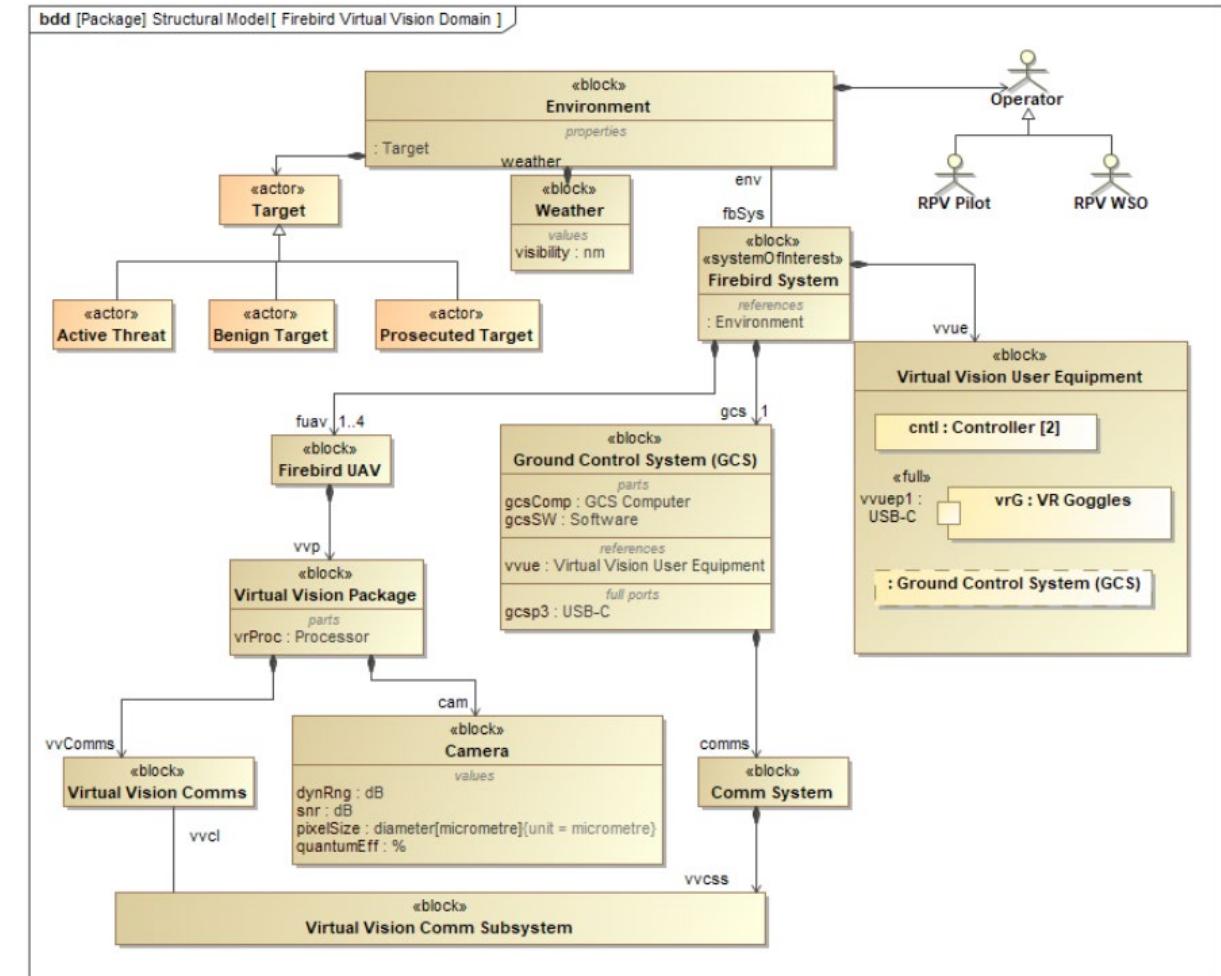
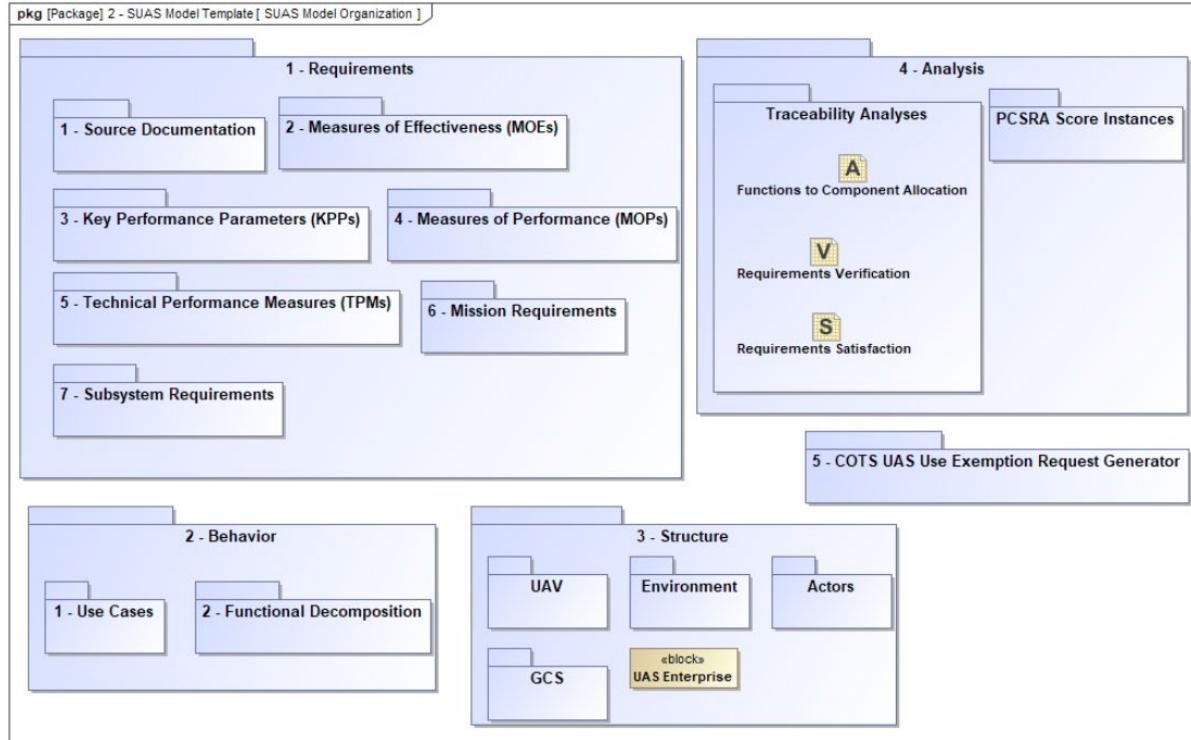
MBSE Lifecycle

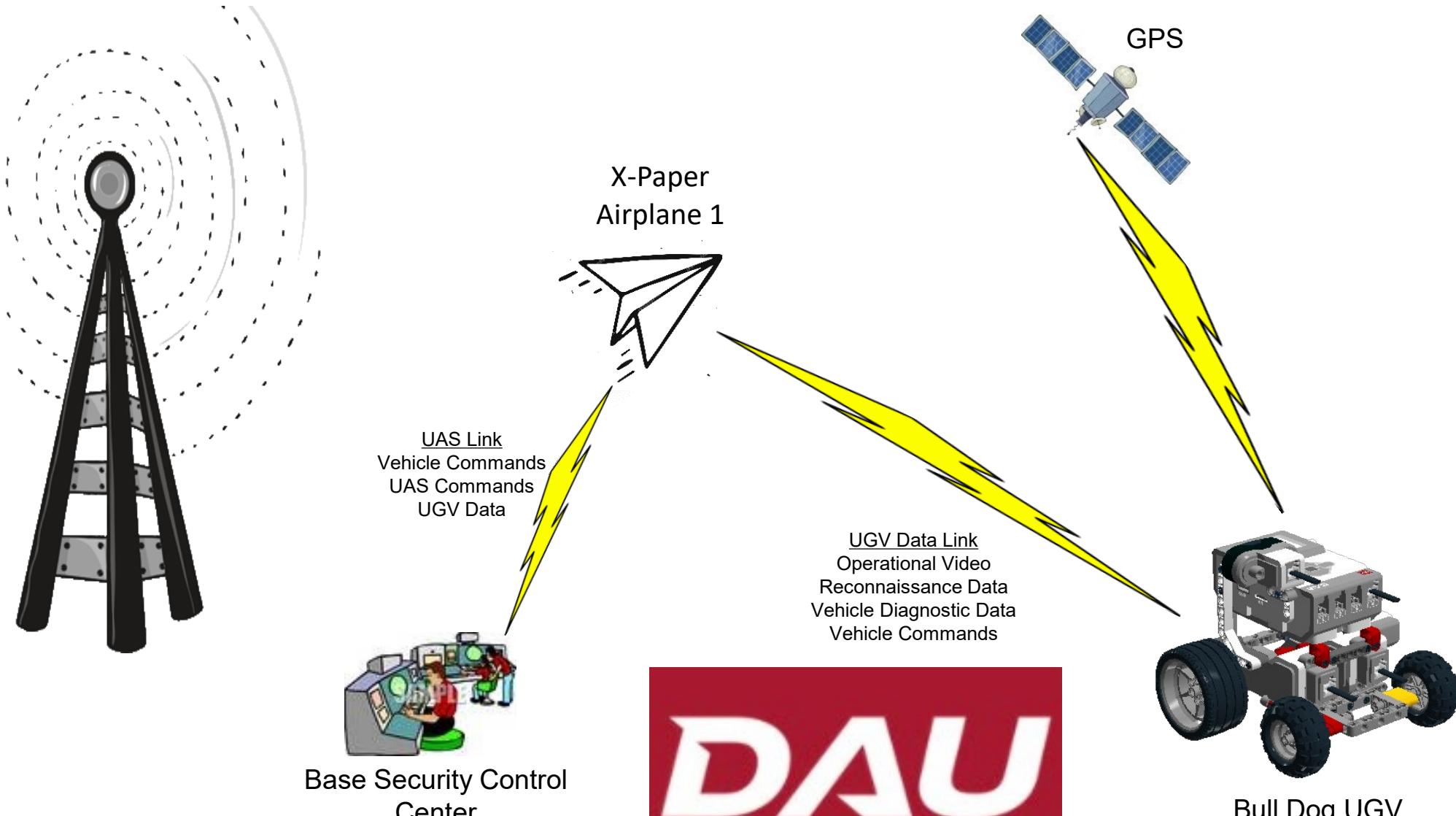
- RAAML for STPA:
 - Control Structure
 - Control Actions / Feedback
 - Risk Assessment
 - Losses / Hazards / Hazardous Control Actions
 - Vulnerability Assessments
 - Loss Scenarios
- FOREST for:
 - Sentinel
 - Resilience
 - Test Support System
 - Requirements Elicitation

SCRE – Secure Cyber Resilience Engineering

FOREST – Framework for Operational Resilience in Engineering & System Test

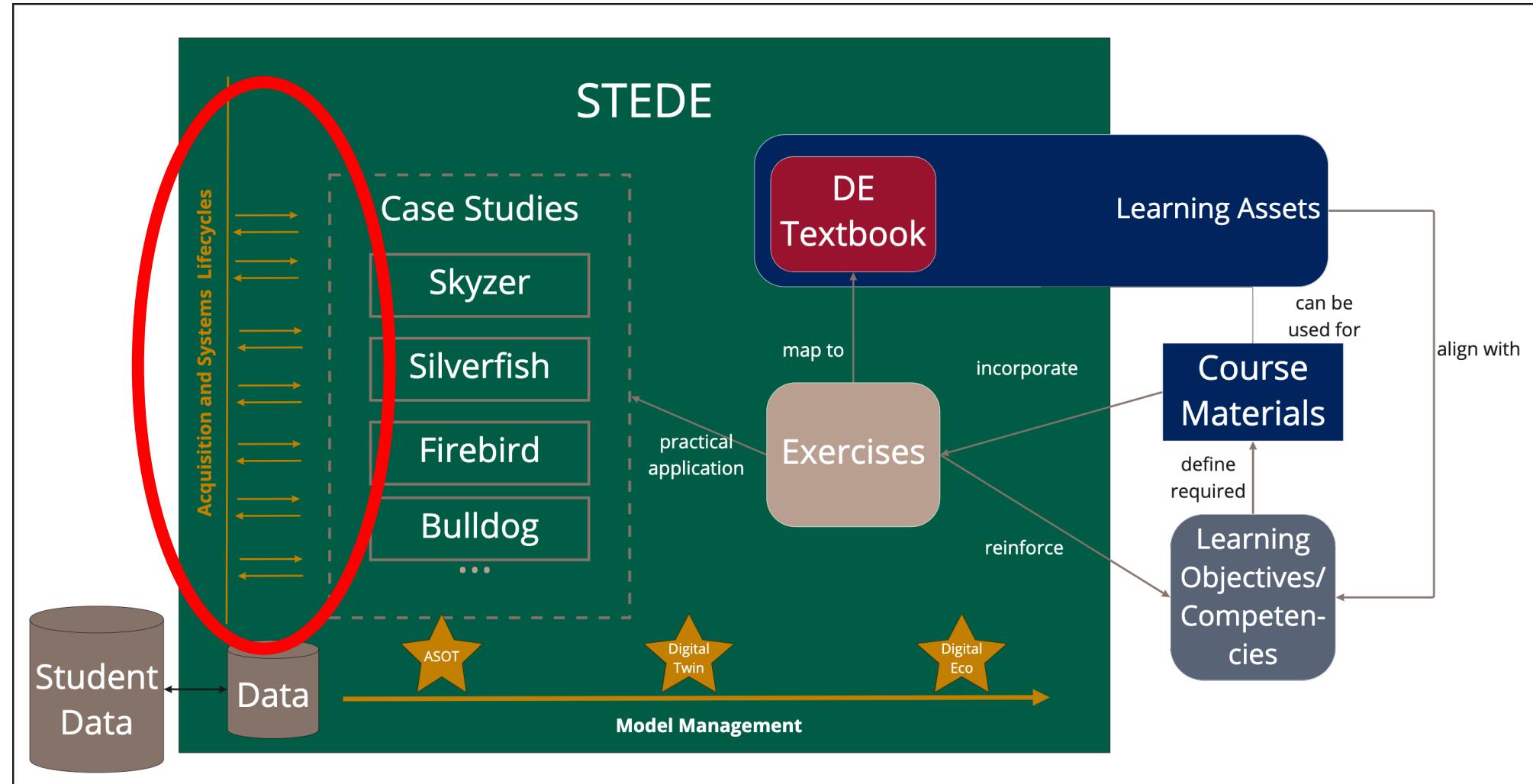
RAAML – Risk Analysis and Assessment Modeling Language





DAU

DIGITAL ACQUISITION ARTIFACTS



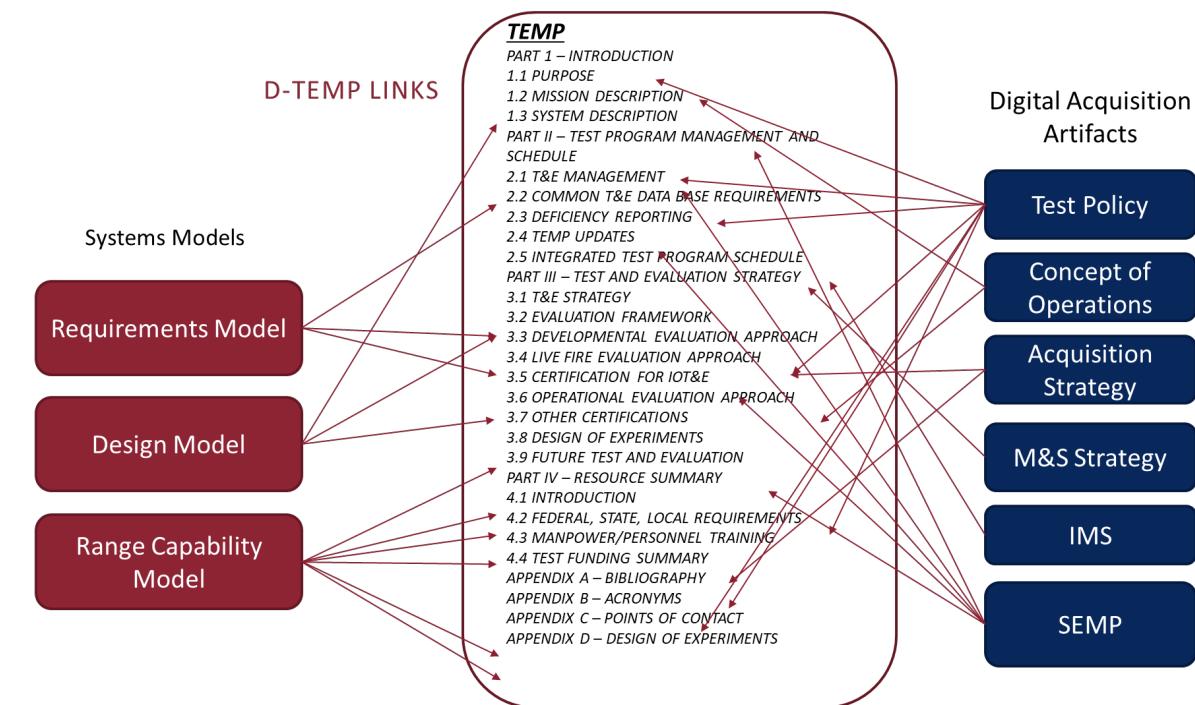
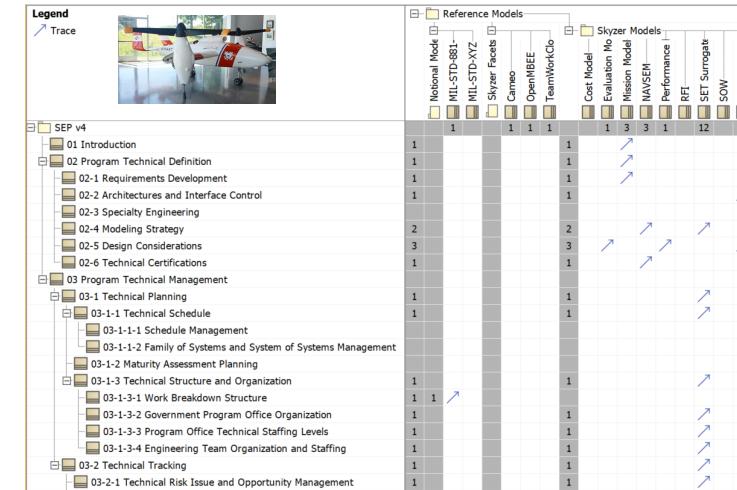
Simulation Training Environment for Digital Engineering (STEDE)

- Leverage existing case studies for d-Artifact content

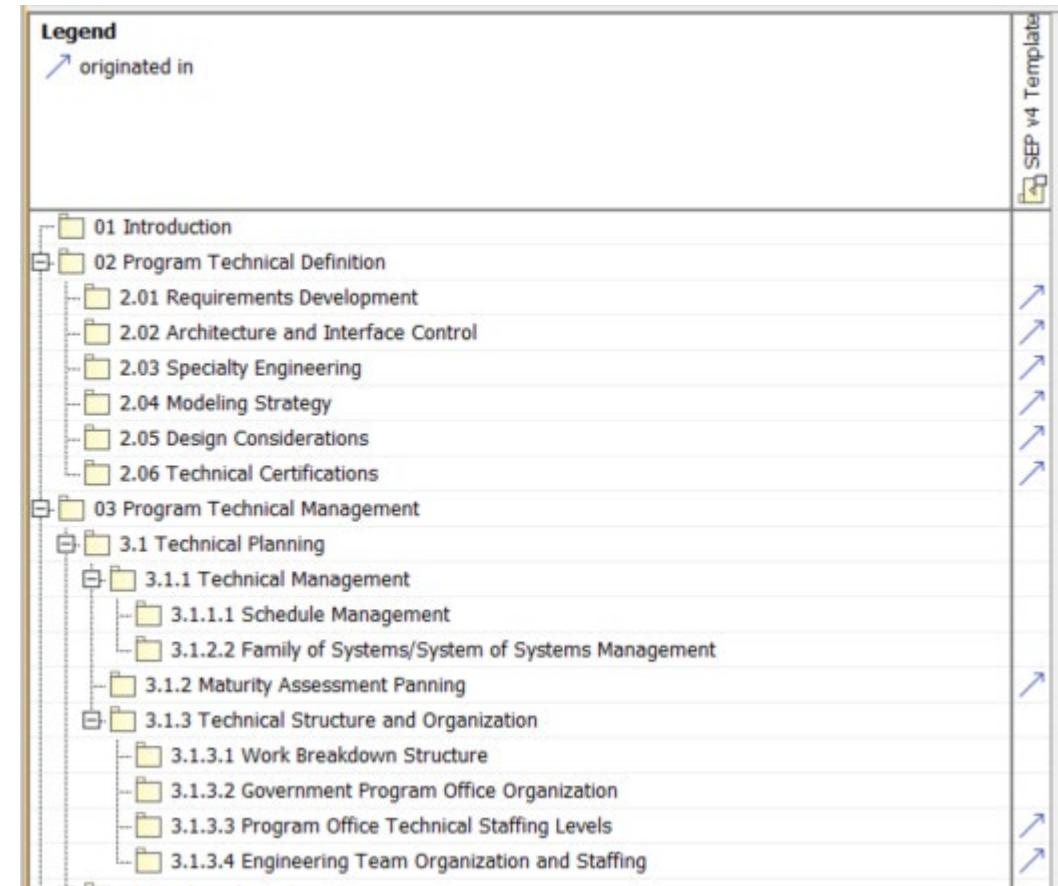
1. Silverfish
2. Skyzer
3. Firebird
4. Bulldog

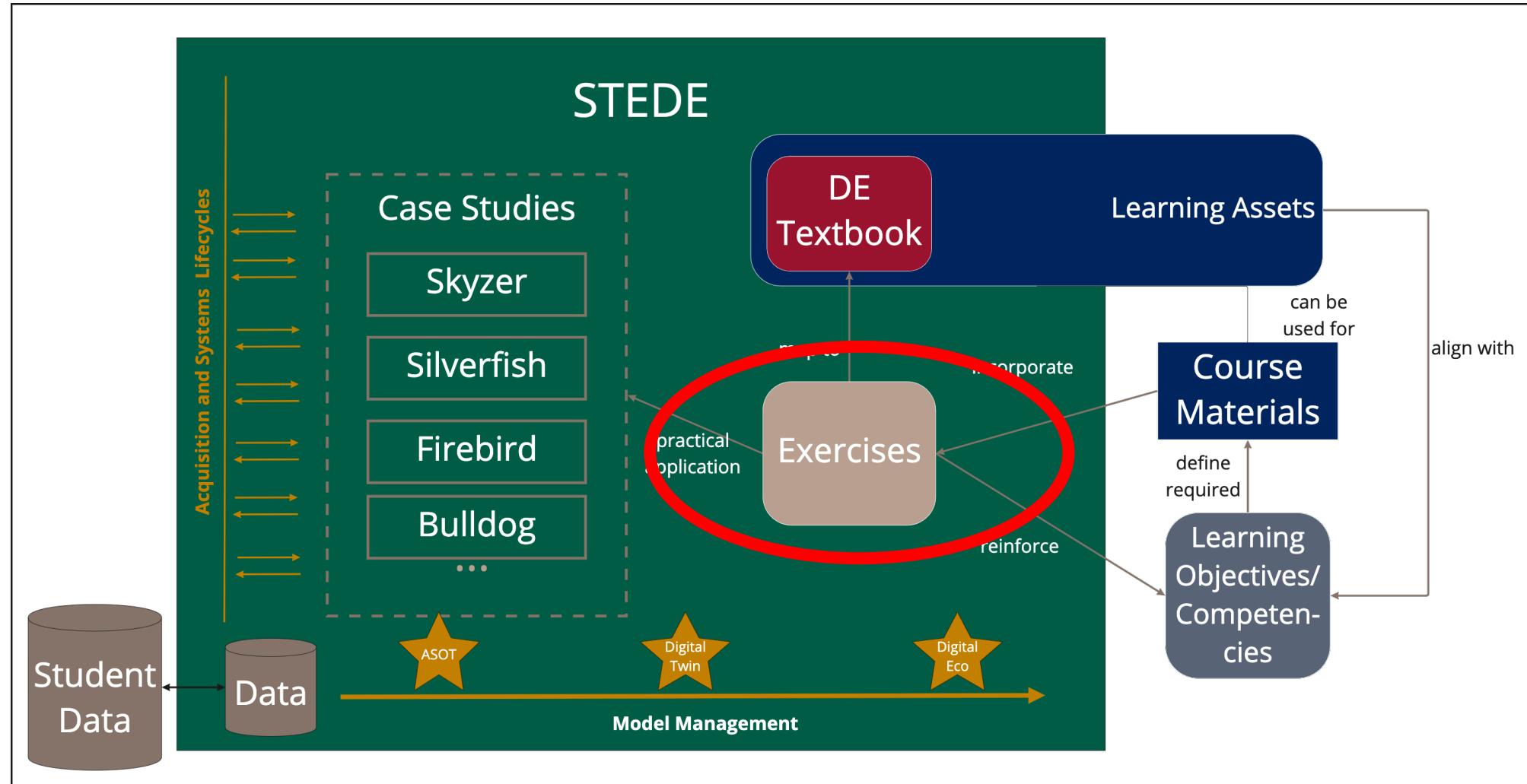
- d-Artifacts in progress

1. RFP – Request for Proposal
2. TEMP – Test & Evaluation Master Plan
3. SEP – Systems Engineering Plan
 - DEIP – DE Implementation Plan



- Create d-SEP framework
 - Template based on SEPv4
 - Process flow
- Identifying content origination
 - What originates in the SEP versus other artifact?
 - E.g., mapping of content originating in the SEP **shown to the left**
- Identifying responsible content creators?
 - What organization or job function creates content for specific SEP sections?
- Overall, applying SE to engineer d-Artifacts
 - Using Cameo





1. Mapping Skyzer to the Vee

1. SE-Vee

2. OOSEM-Vee

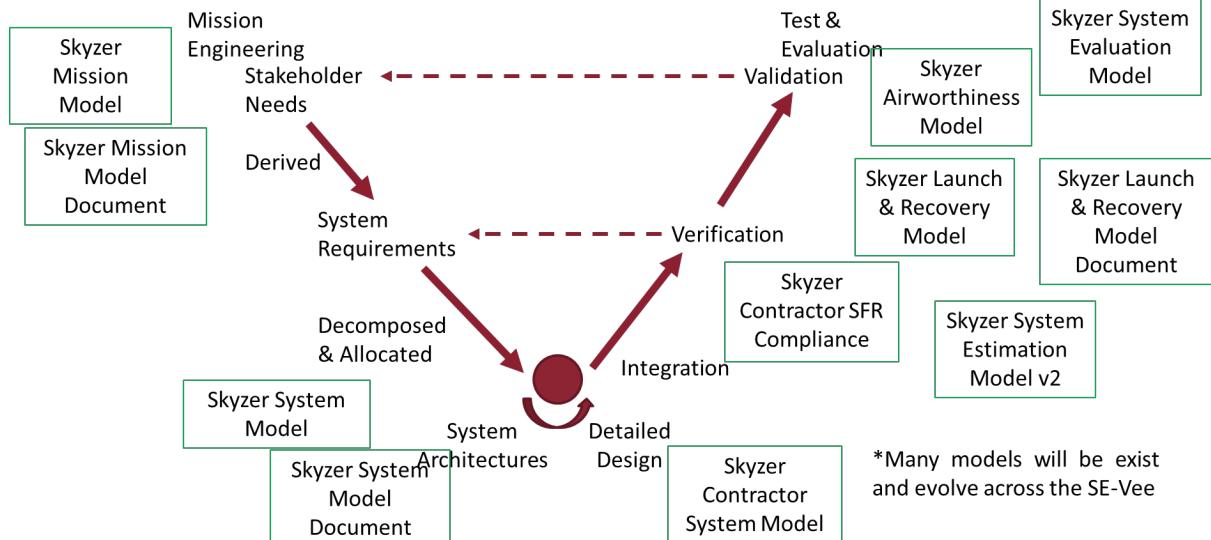
2. Mapping Skyzer to the Acquisition Lifecycle

3. Digital-sign-off

4. Go find me:

1. In Cameo

2. In OpenMBEE ViewEditor



*Many models will be exist and evolve across the SE-Vee

SKYZER MODELS	SKYZER MODELS													
	516C-TACC-Airworthiness	Skyzer Mission Model (NAVSEM 1 & 2)	Skyzer Mission Model Document	Skyzer Mission Model (NAVSEM 3 & 4)	Skyzer System Model (NAVSEM 3 & 4)	Skyzer System Model Document	Skyzer Statement of Work (SOW) Model	Skyzer Surrogate Contractor Model (NAVSEM 5)	Skyzer System Evaluation Model	Skyzer System Estimation Model	Skyzer MBSE Cost Model	Skyzer MBTD	Skyzer Airworthiness Model	Viewpoint Library
516C-TACC-Airworthiness														x
Skyzer Mission Model Document		x												
Skyzer System Model Document			x											
Skyzer Statement of Work (SOW) Model				x										
Skyzer Surrogate Contractor Model (NAVSEM 5)	x	x					x							
Skyzer System Evaluation Model	x	x						x						
Skyzer System Estimation Model	x	x							x					
Skyzer MBSE Cost Model	x	x	x						x			x		
Skyzer MBTD	x	x	x							x		x		
Skyzer Airworthiness Model	x	x	x							x		x		
Viewpoint Library														x
Skyzer Profile	x	x	x											x

SKYZER MODELS	SKYZER MODELS													
	516C-TACC-Airworthiness	Skyzer Mission Model (NAVSEM 1 & 2)	Skyzer Mission Model Document	Skyzer Mission Model (NAVSEM 3 & 4)	Skyzer System Model (NAVSEM 3 & 4)	Skyzer System Model Document	Skyzer Statement of Work (SOW) Model	Skyzer Surrogate Contractor Model (NAVSEM 5)	Skyzer System Evaluation Model	Skyzer System Estimation Model	Skyzer MBSE Cost Model	Skyzer MBTD	Skyzer Airworthiness Model	Viewpoint Library
516C-TACC-Airworthiness														
Skyzer Mission Model Document		x												
Skyzer System Model Document			x											
Skyzer Statement of Work (SOW) Model				x										
Skyzer Surrogate Contractor Model (NAVSEM 5)	x	x	x				x							
Skyzer System Evaluation Model	x	x	x					x						
Skyzer System Estimation Model	x	x	x						x					
Skyzer MBSE Cost Model	x	x	x						x			x		
Skyzer MBTD	x	x	x							x		x		
Skyzer Airworthiness Model	x	x	x							x		x		
Viewpoint Library														
Skyzer Profile	x	x	x											x

SKYZER MODELS		
Model 1	Model 3	Model 4
		x
x		
Read as:		
Model 1 uses Model 4		
Model 2 uses Model 3		

1. Mapping Skyzer to the Vee

1. SE-Vee
2. OOSEM-Vee

*Python-based
Digital textbook
exercise

2. Mapping Skyzer to the Acquisition Lifecycle

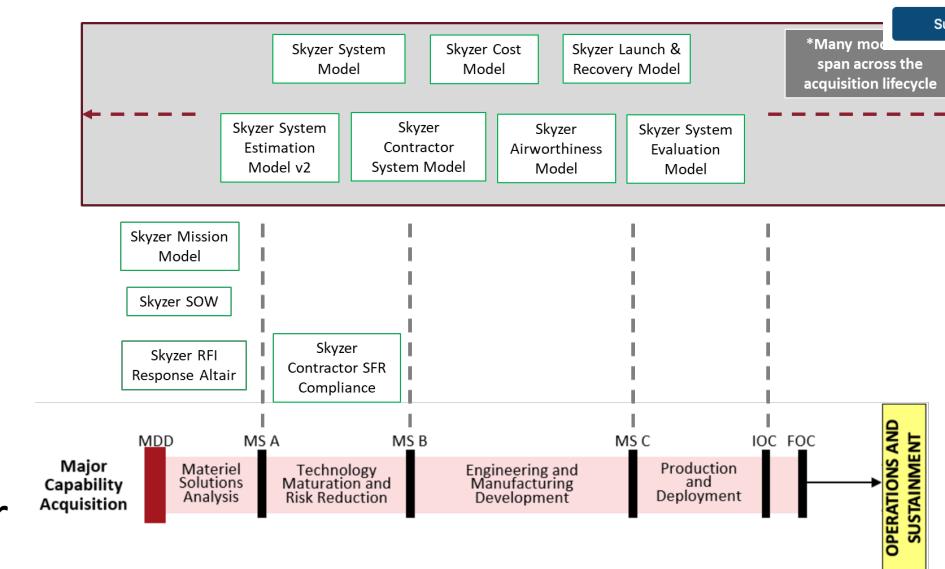
3. Digital-sign-off

4. Go find me:

1. In Cameo
2. In OpenMBEE ViewEditor

Based on your understanding please select the phases in which the models will be used. A model can be used in multiple phases, please select all correct phases, if required.*

	Material Solutions Analysis	Technology Maturation and Risk Reduction	Engineering and Manufacturing Development	Production and Development
Skyzer Mission Model	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skyzer SOW	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skyzer System Model	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skyzer Cost Model	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Skyzer launch & Recovery Model	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Skyzer Contractor System Model	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skyzer Airworthiness Model	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Skyzer Estimation Model V2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Skyzer Contractor SFR Compliance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Skyzer RFI Response Altair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skyzer System Evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



1. Mapping Skyzer to the Vee

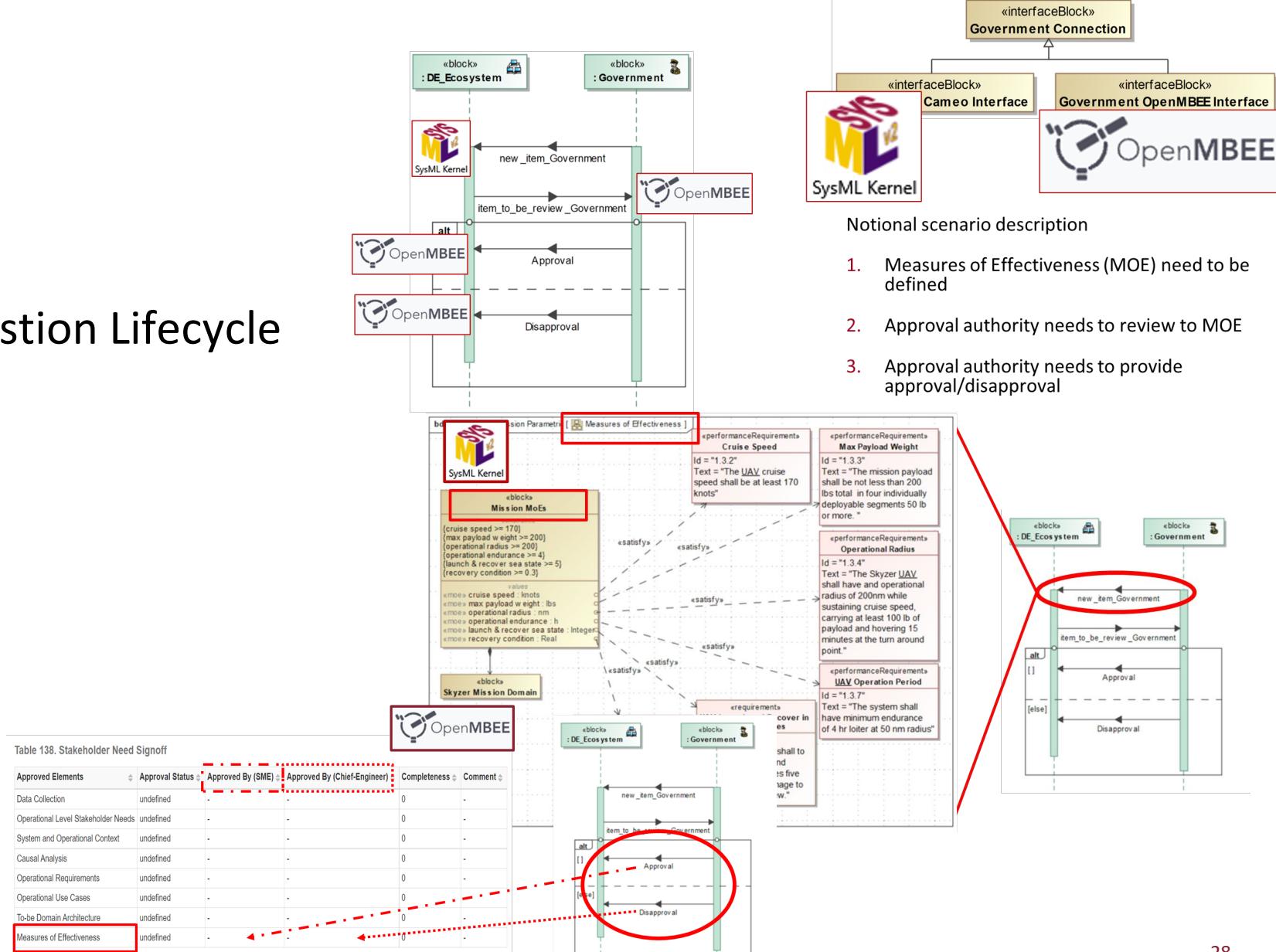
1. SE-Vee
2. OOSEM-Vee

2. Mapping Skyzer to the Acquisition Lifecycle

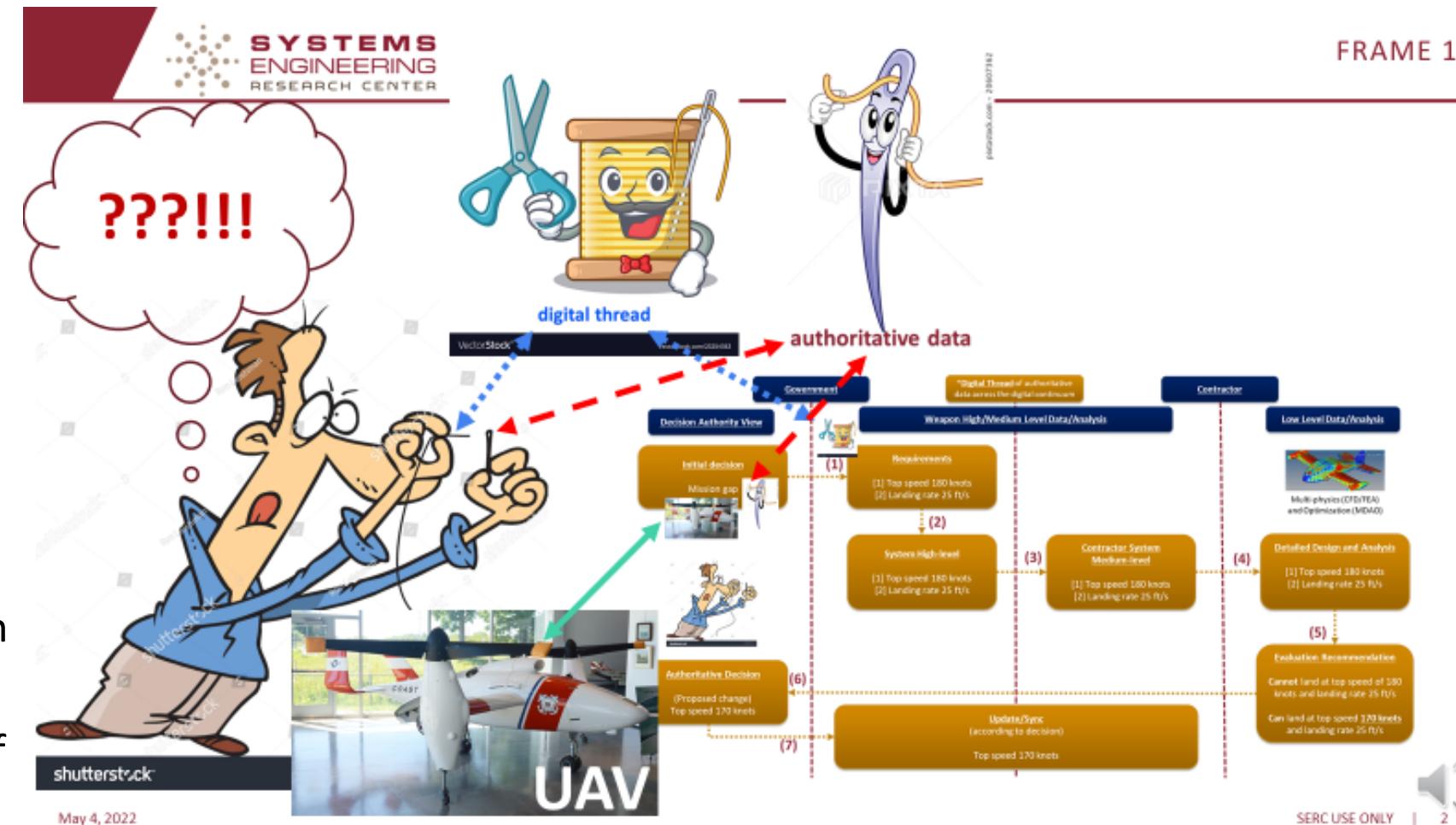
3. Digital-sign-off

4. Go find me:

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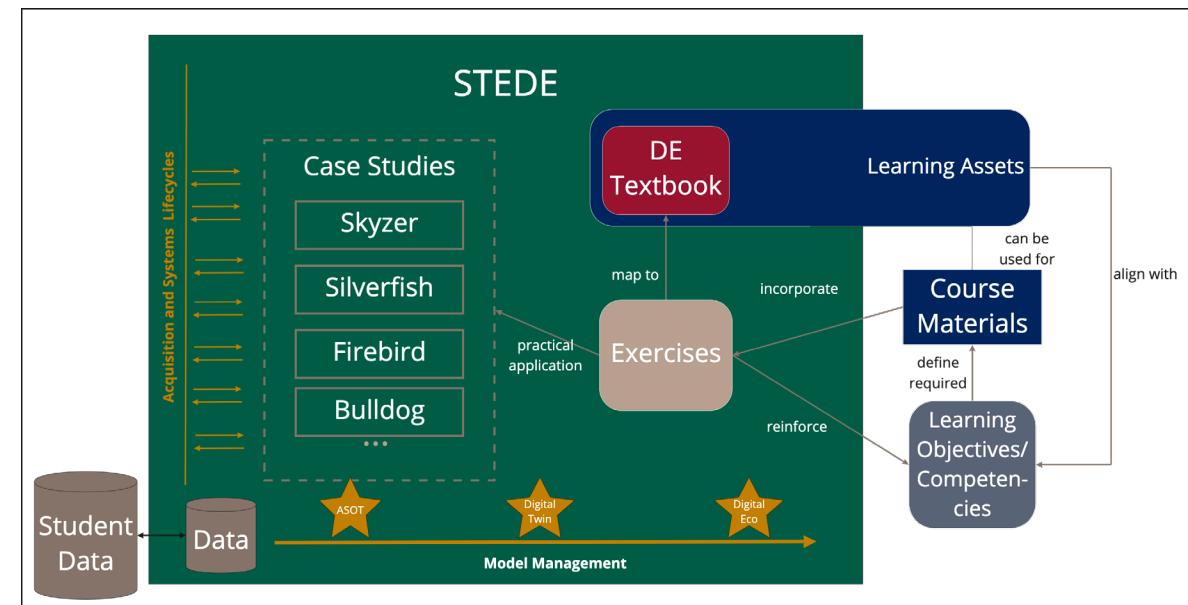
- Follows a digital thread for Skyzer
- The thread exposes conflicting mission requirements
- The thread extends:
 - from mission requirements at the Government level
 - to detailed analysis and design at the contractor level
 - To Government digital sign-off
- Script, visuals are available

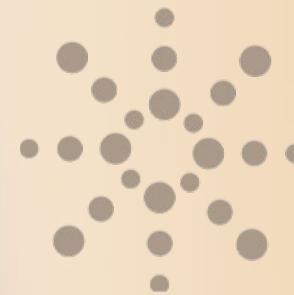


Thank you for attending!

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paulw86@vt.edu

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