Digital Transformation in Acquisition: Using Modeling and Simulation to Advance the State of Practice

WRT-1043

Nicole Hutchison (Stevens) & David Pearson (DAU)

Paper 204 – **Hutchison, Wach**, See Tao, Clifford, Burley, Arndt, Beling, Sherburne, McDermott, Long, Blackburn, Verma

STEVENS INSTITUTE OF TECHNOLOGY 1870

VT

GT

ANNUAL RESEARCH REVIEW 2022

Outline

Meeting the Team

Digital Engineering Context

DE at DAU

Project Overview

Case Studies

Digital Artifacts

WRT-1043 Team

STEVENS

VIRGINIA TECH
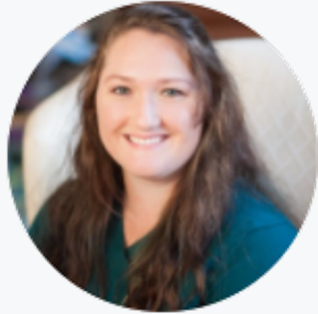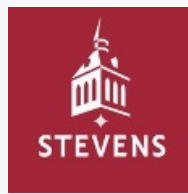
Co-PI: Dr. Peter Beling
Mr. Tim Sherburne
Mr. Paul Wach
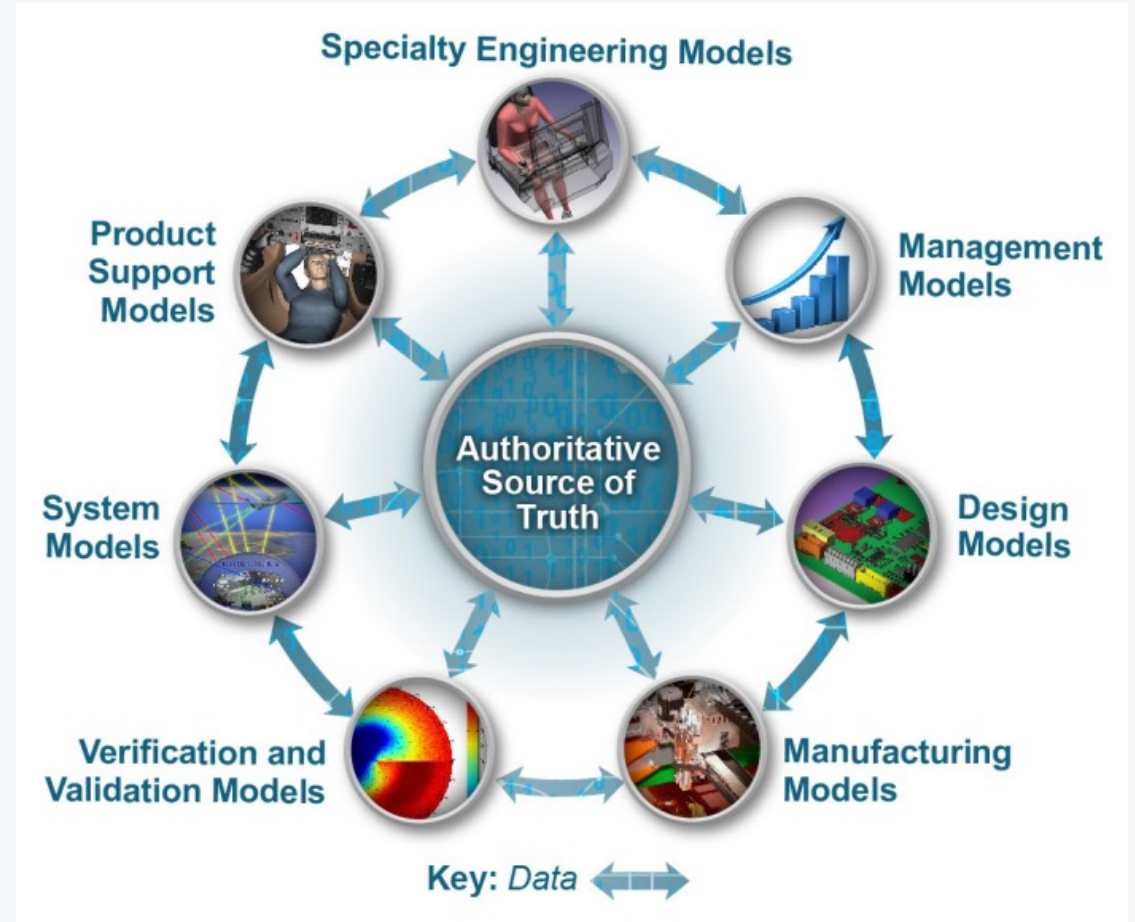Mr. Geoff Kerr
Ms. Alexis Flick

DAU

Mr. David Pearson
Dr. Robert Raygan
Dr. Jim Roche
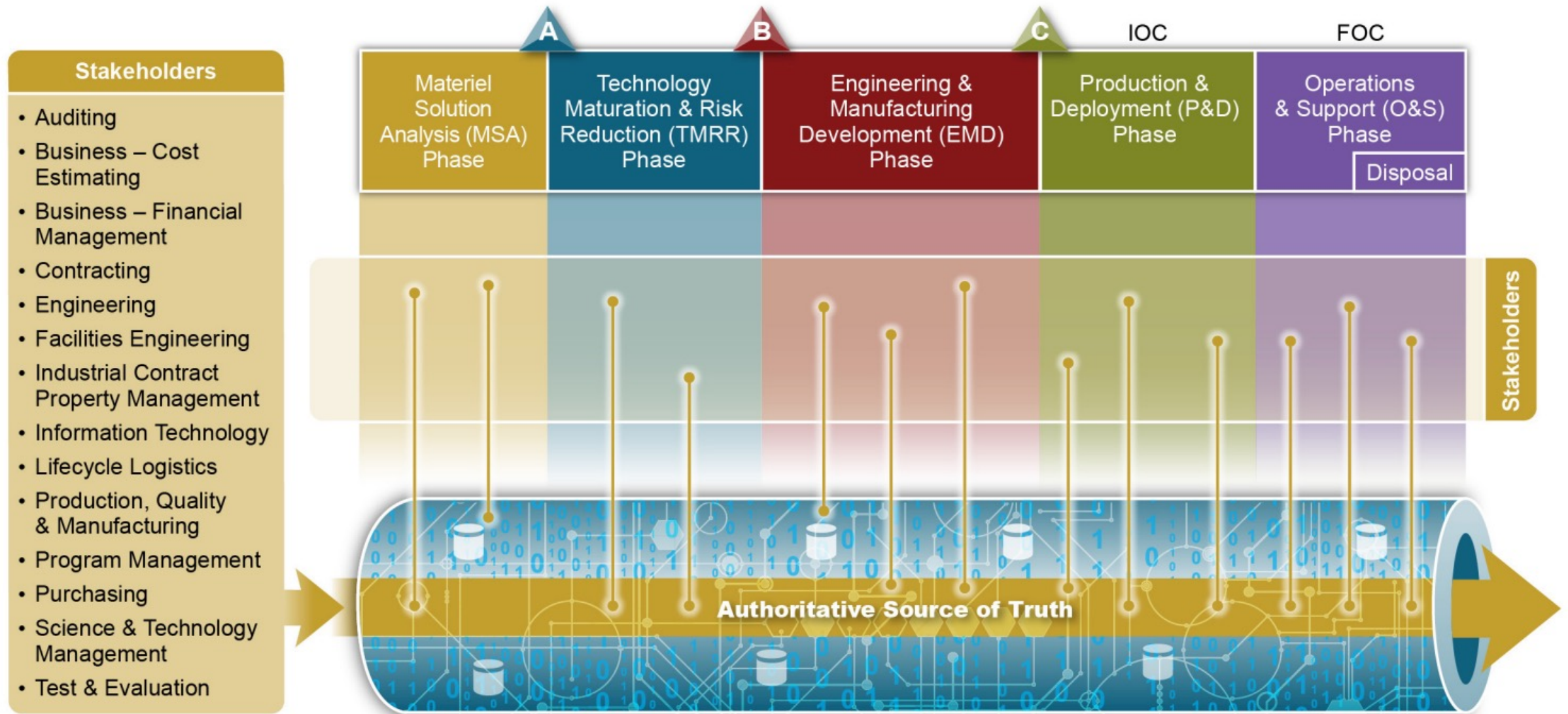Dr. John Snoderly
Mr. Troy Snow
Mr. John Quintana

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

Georgia Tech Research Institute

Dr. Craig Arndt
Mr. Dalton Clark

Big Data & Analytics

Cognitive Technologies

Human-Machine Interface

Data Visualization

Computing Technologies

Physics-Based Models

Digital Manufacturing
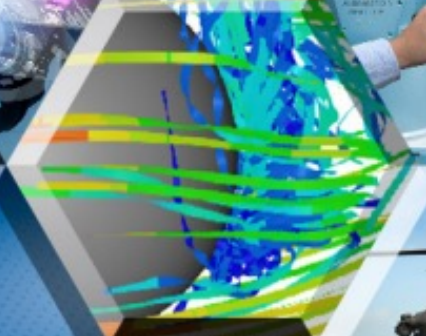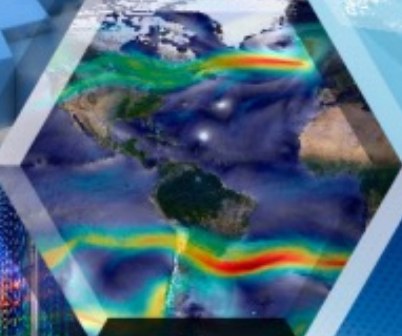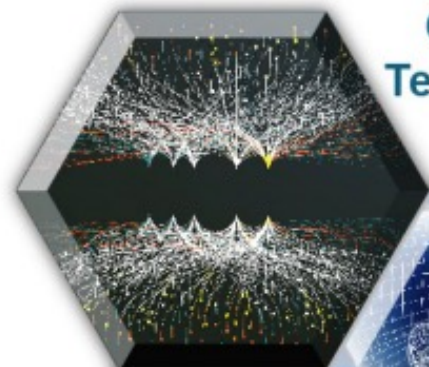
Virtual Reality

Augmented Reality

Commercial Cloud

Artificial Intelligence

New Emerging Technologies

3D Printing

Digital Twin

DAU Digital Engineering Training

- Certification training
  - ➢ Digital Literacy Fundamentals
  - ➢ Digital Literacy for Practitioners
- Credentials:
  - ➢ Intermediate Digital Engineering
  - ➢ Advanced Digital Engineering

Digital Engineering Credentials

Cyber Resilient Engineering Credentials

Mission Engineering Credentials

Systems Engineering Credentials

Digital Training Ecosystem
Skyzer Model
Silverfish Model
Model Dev't tools
Etc

Program Management

Test and Evaluation Training

Cost Estimating Training

Logistics Training

Paradigm Shift

Digitization

Transitioning existing documents and processes as they are into a digital environment.

Digitalization

Transforming existing approaches and artifacts to optimize for a digital environment.

Digital Transformation
True transition from document-based acquisition to digital acquisition and engineering.

DIGITAL
TRANSFORMATION

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

Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System
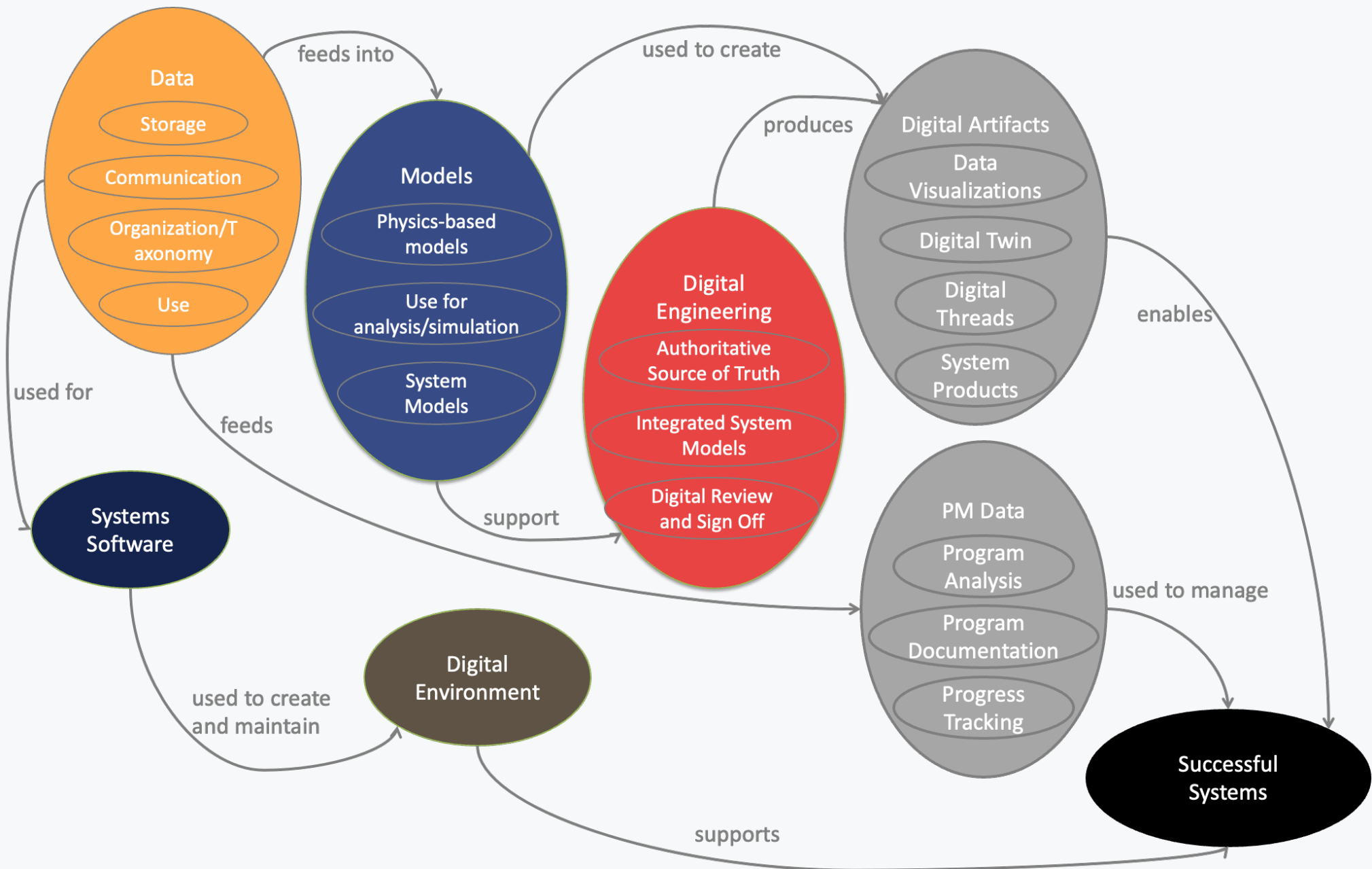
Adaptive Acquisition Framework
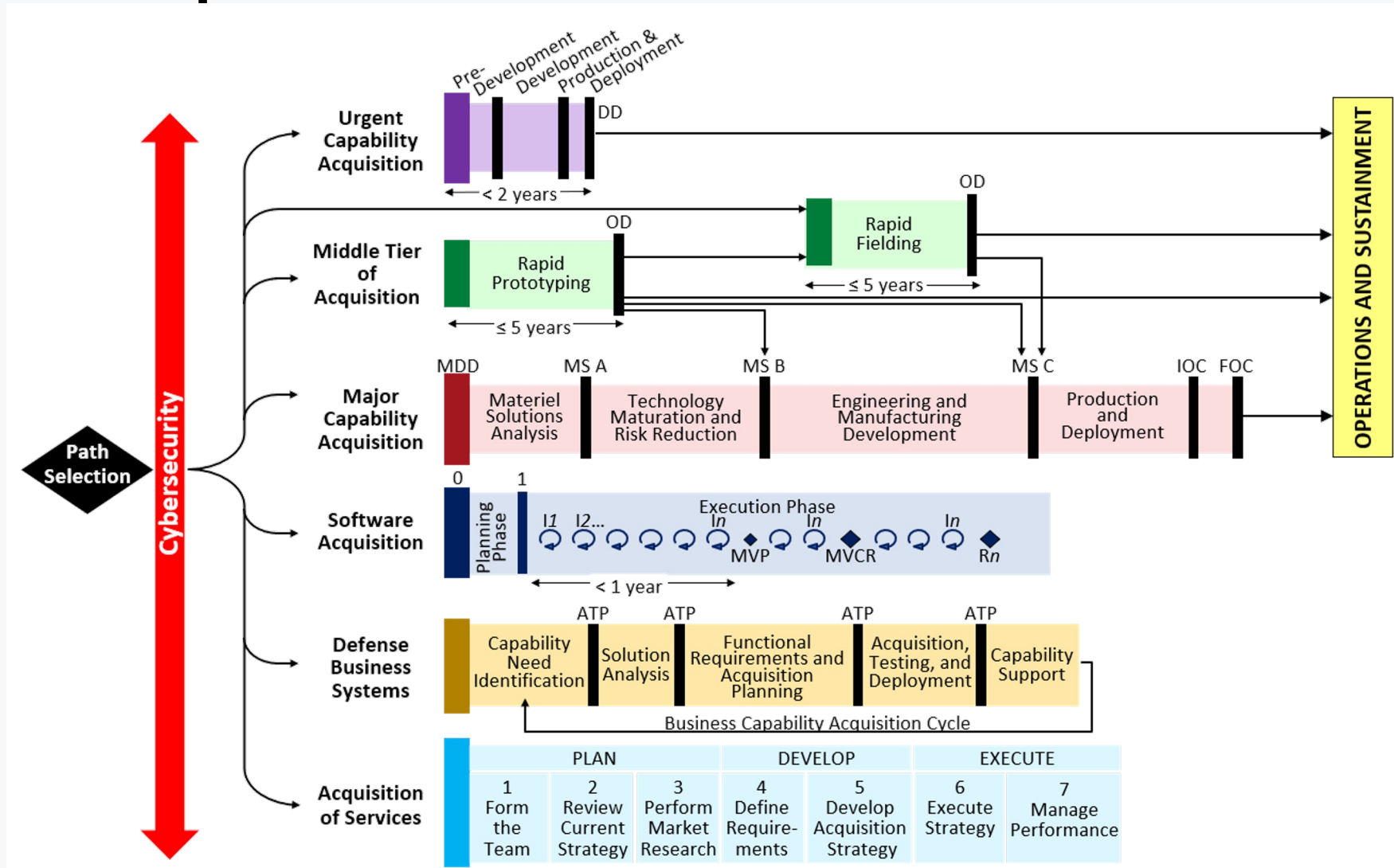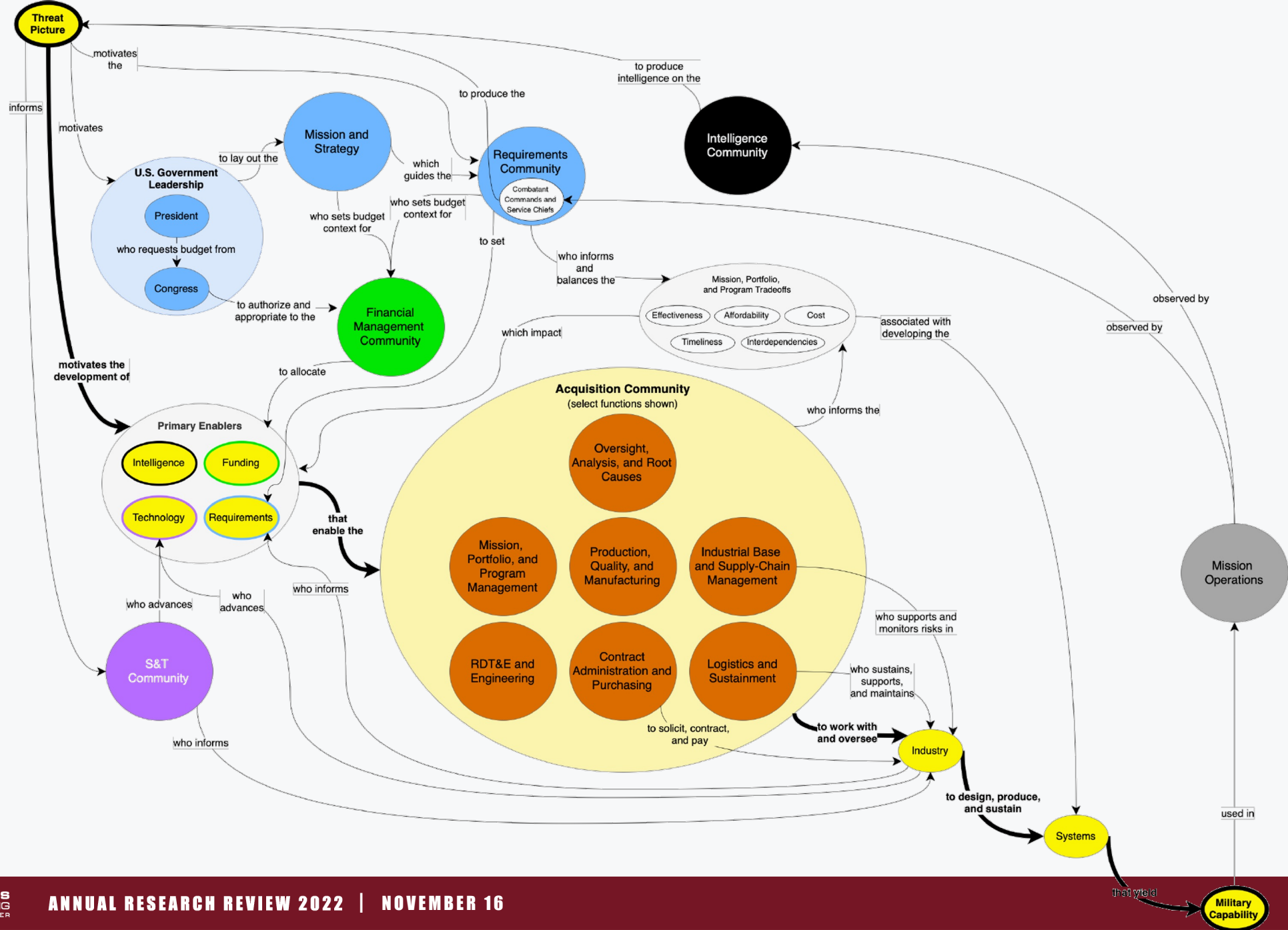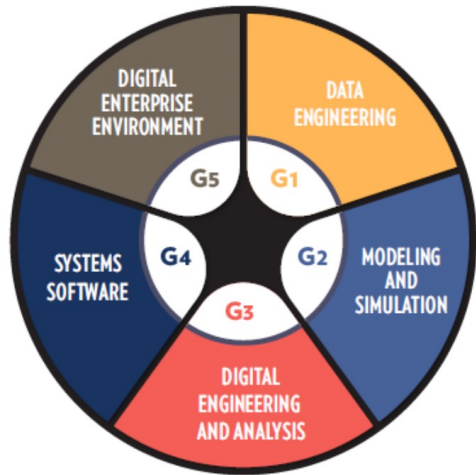
STEDE Overview
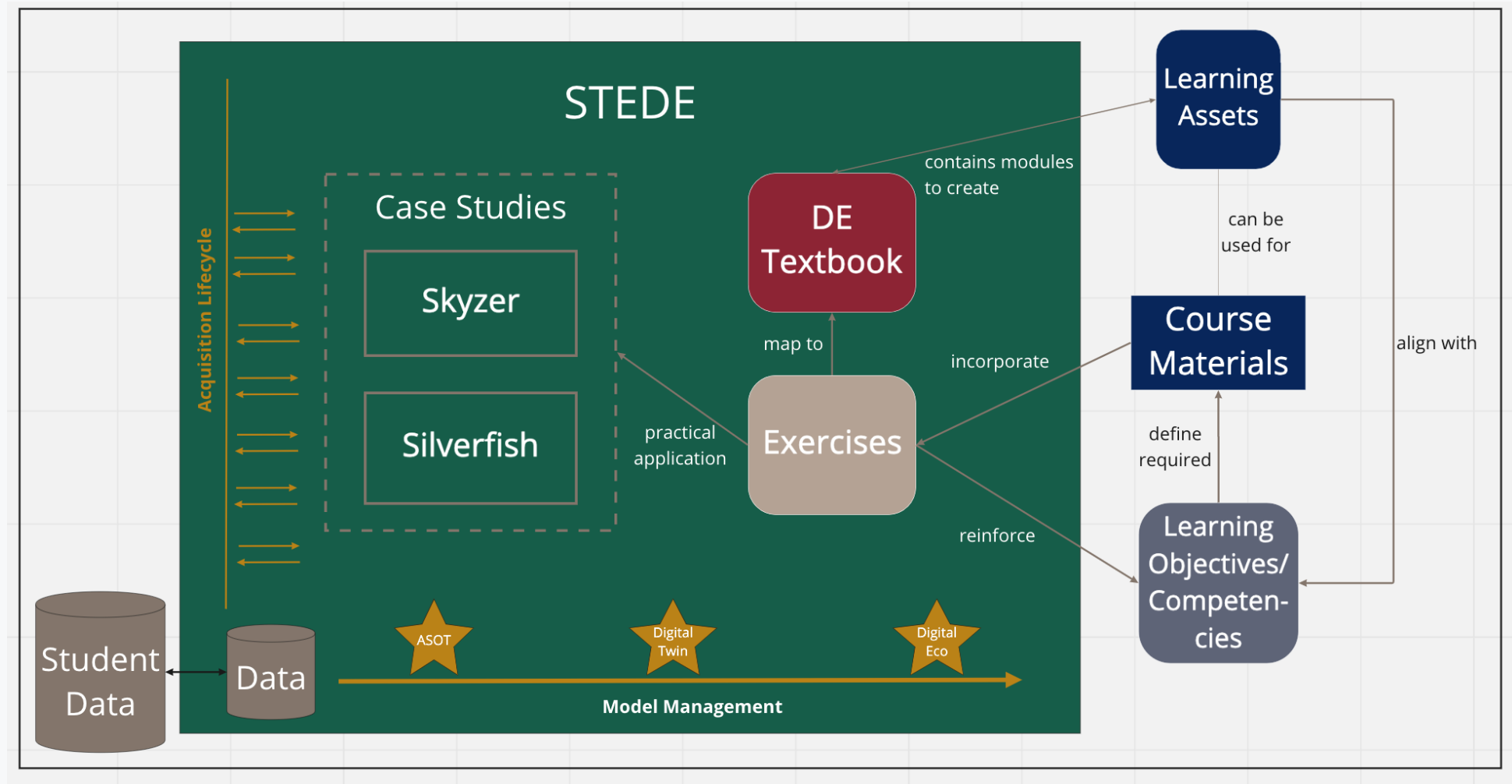
Simulation Training Environment for Digital Engineering (STEDE)

Digital Engineering Competency Framework (DECF) Mapping

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

The mapping primary aligns with the G2: Modeling and Simulation & G23: 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
			MA: Vulnerability Assesment	3.3.1
		C4: Simulation	Behavior Simulation Module	3.3.2
			Parametrics and Physics-based Model Integration	3.4.2
		C5: AI/ML	SE4AI & AI4SE Module	3.8
		C6: Data Visualization	Reports and Presentations Module	3.7
			DoDAF View Module	3.7.1
		C7: Data Analytics	Reports and Presentations Module	3.7
G3: Digital Engineering and Analysis	S3: Digital Systems Engineering	C8: Digital Architecting	System Architecture Module	3.4
			MA: Resilience Architecture Module	3.4.1
		C9: Digital Requirments Modeling	Mission Engineering Module	3.1
			MA: Operational Risk Assesment Module	3.1.1
			DoDAF Operational Domain Module	3.1.2
			Requirments Managemet Module	3.2
		C10: Digital Validation and Verification	Verification and Validation Module	3.5
		C11: Model-based SE	Perform Capstone Group Project	4
	S4: Engineering Management	C12: Digital Model-based Reviews	Model Review and Signoff Module	3.6.3
		C13: Project and Program Management	Project Management Module	3.6
			Cost Simulation Module	3.6.1
		C14: Organizational Development	Setup Student Environment	1
			Select Student Type Module Navigation	2
			Execute Training Module	3
		C15: Digital Engineering Policy and Guidance		
		C16: Configuration Management	Lifecycle Simulation Module	3.6.2

Digital "Textbook": User Experience

Digital Engineering Textbook

"Textbook"

- What is a model?
- Why Model?
- Types of Models
- Navigating Models
- Editing Models
- Building Models
- Data

Course A

- Digital Transform
- What is a model?
- Why Model?
- Types of Models
- Navigating Models
- Data 1

Course B

- Navigating Models
- Editing Models
- Data 1
- Data 2

Course C

- Navigating Models
- Editing Models
- Building Models
- Data 1
- Data 2
- Data 3
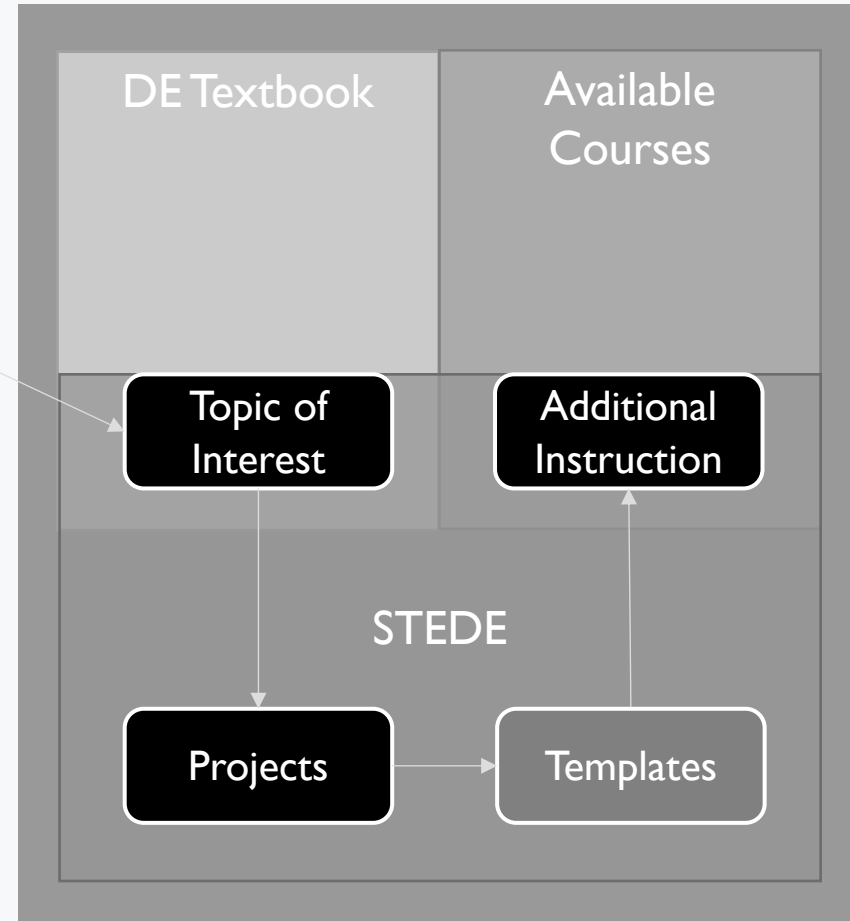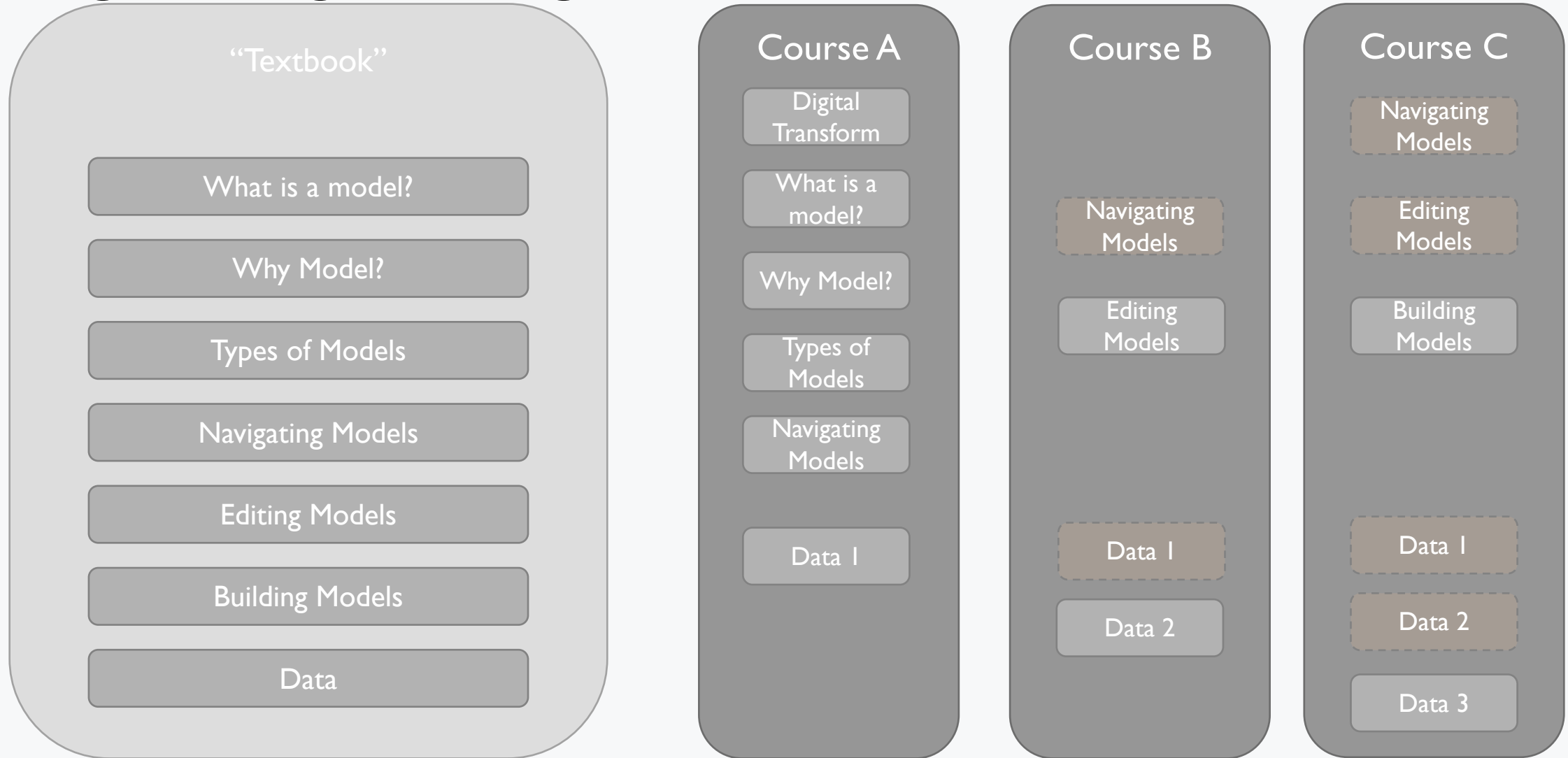
Digital Engineering Textbook
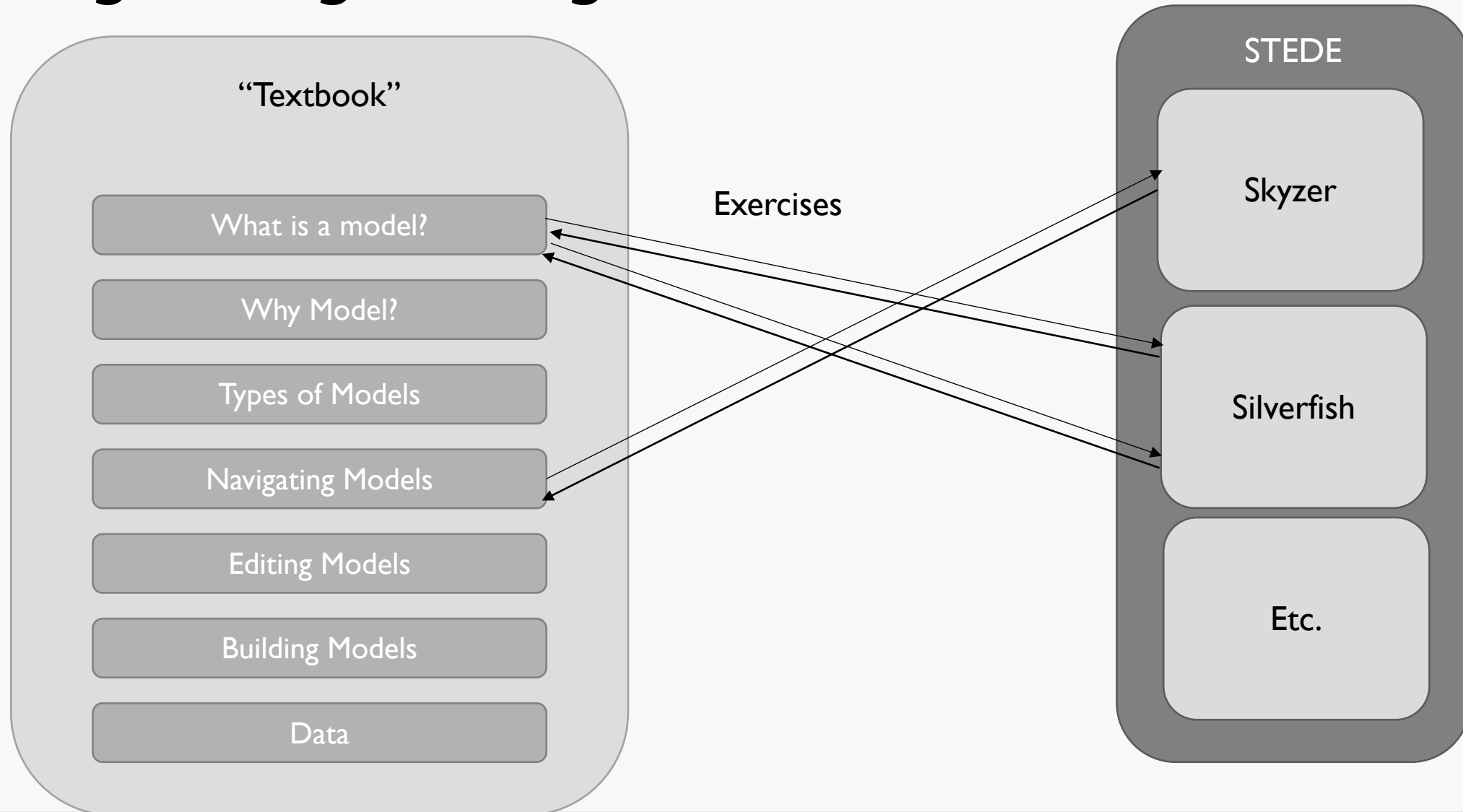
Draft Module Network
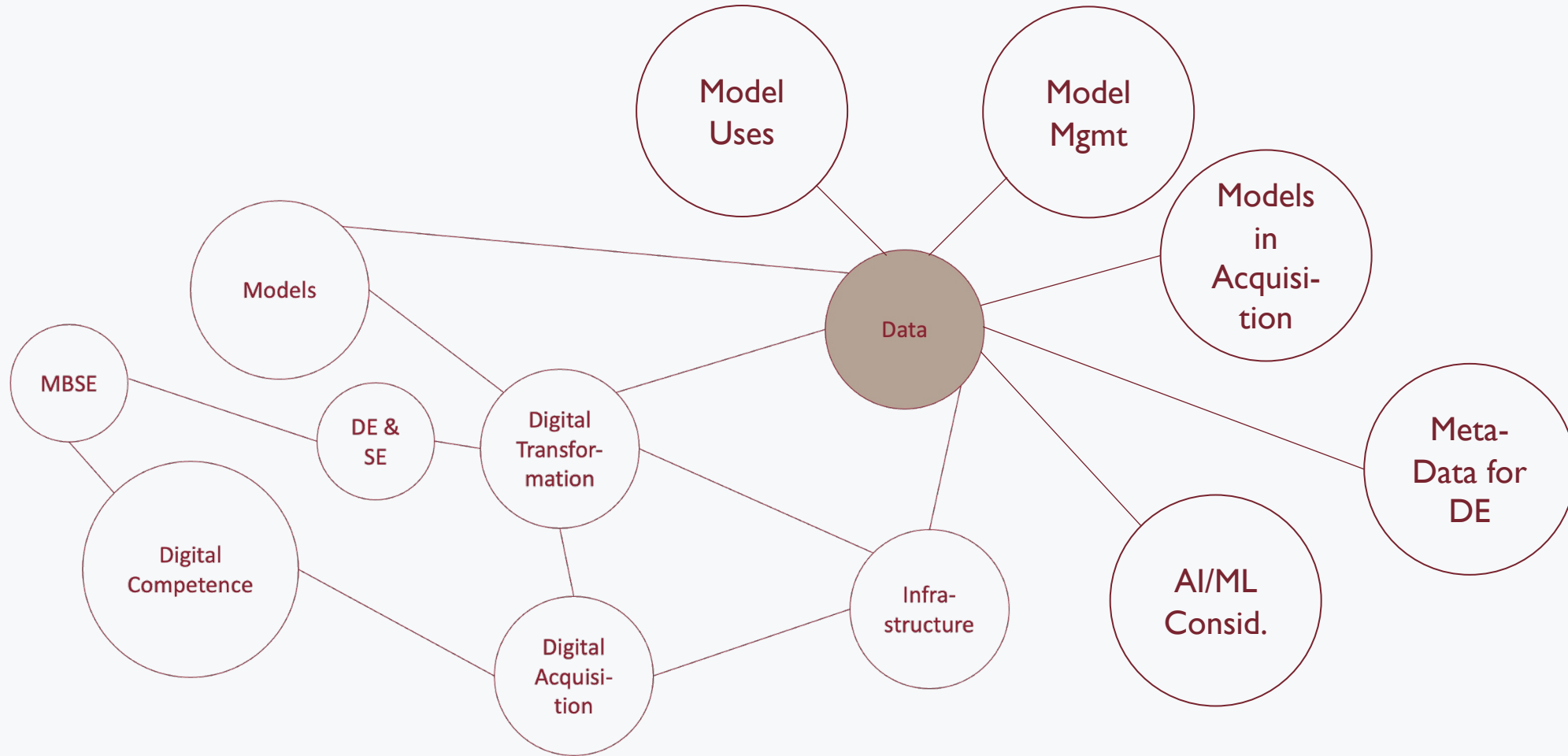
DE Architecture Context
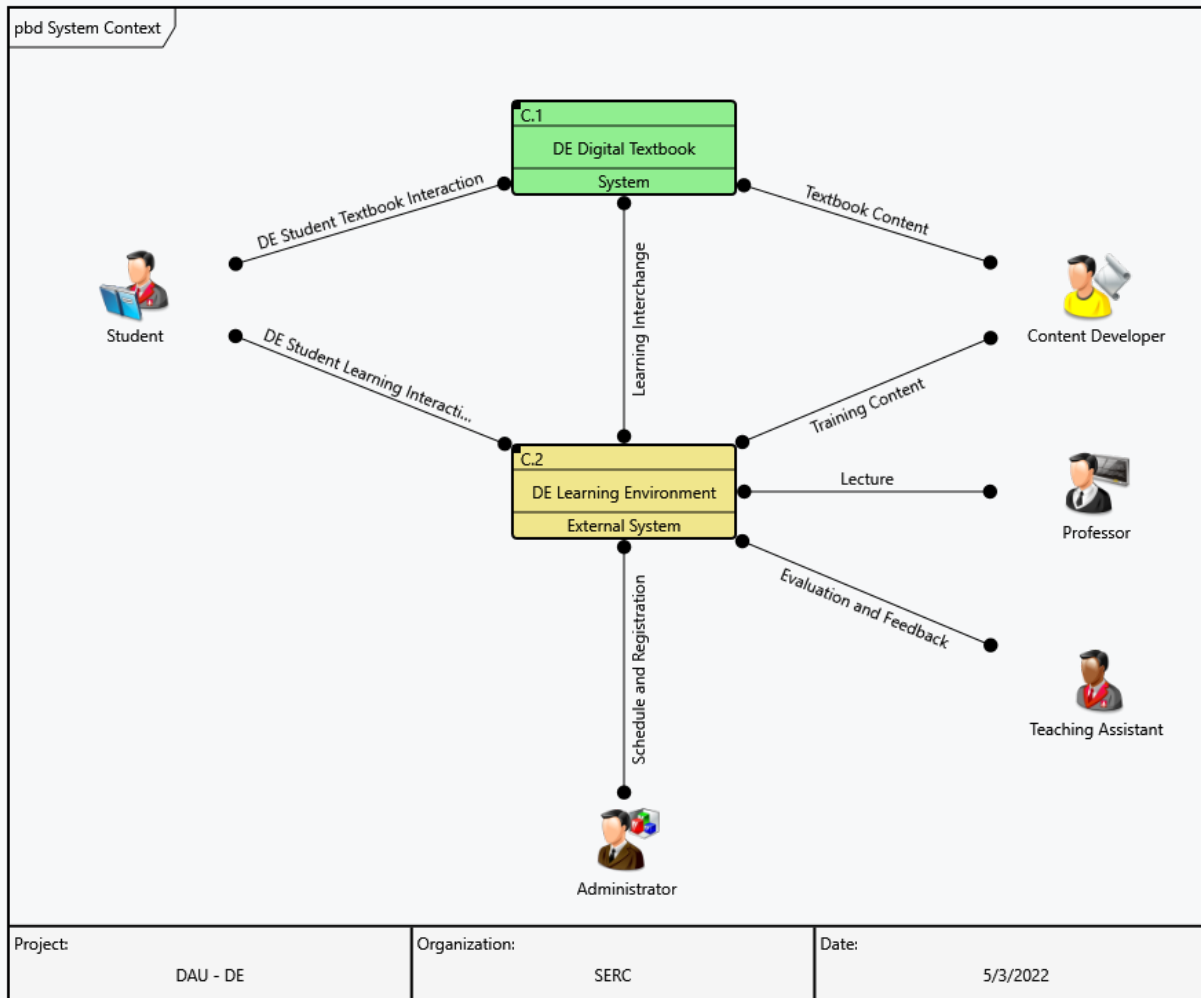
- The DE architecture context defines independence between the DE textbook and DE Learning environment

- The DE Learning environment leverages the DE Textbook, but the Textbook is intended for independent asynchronous usage as well
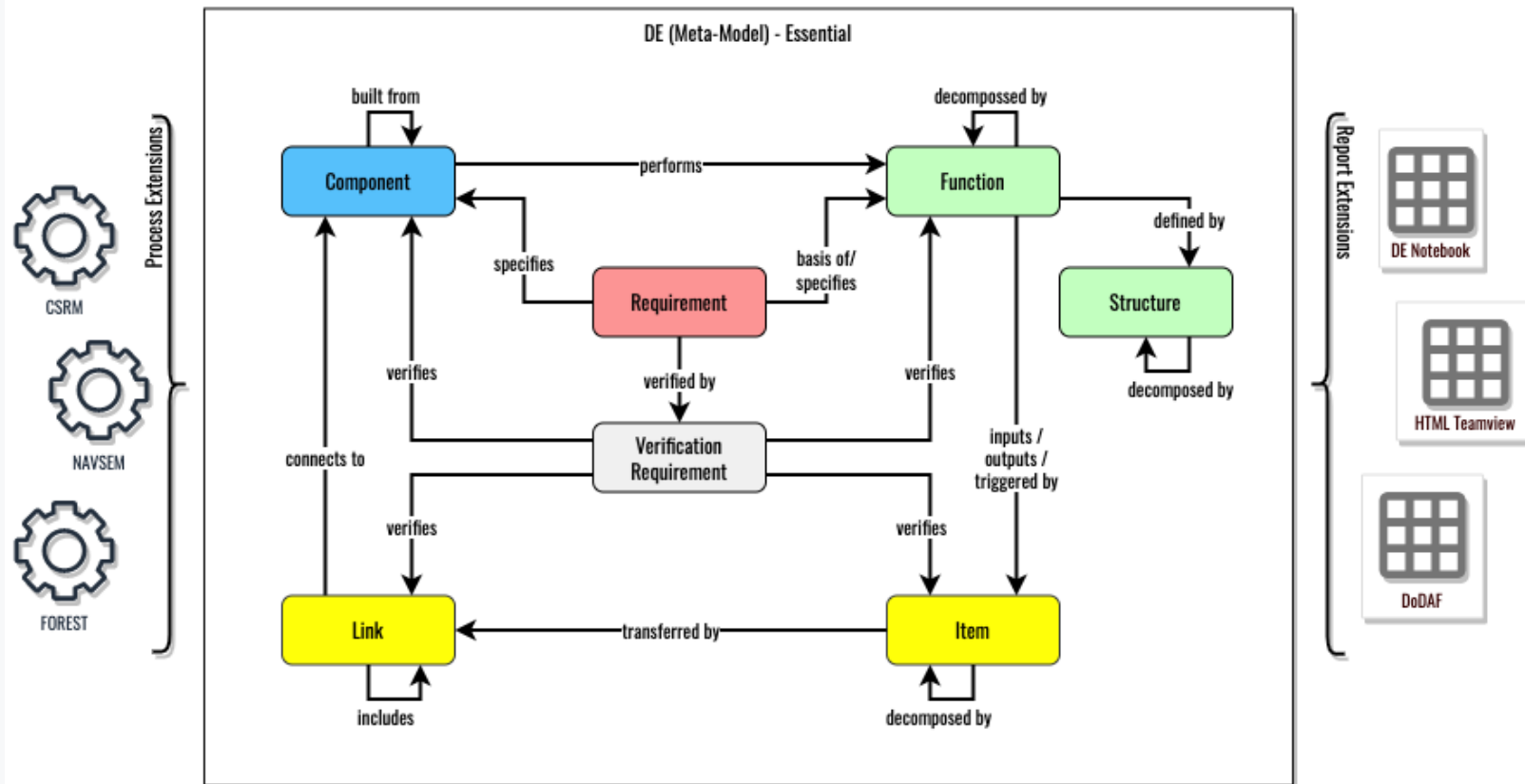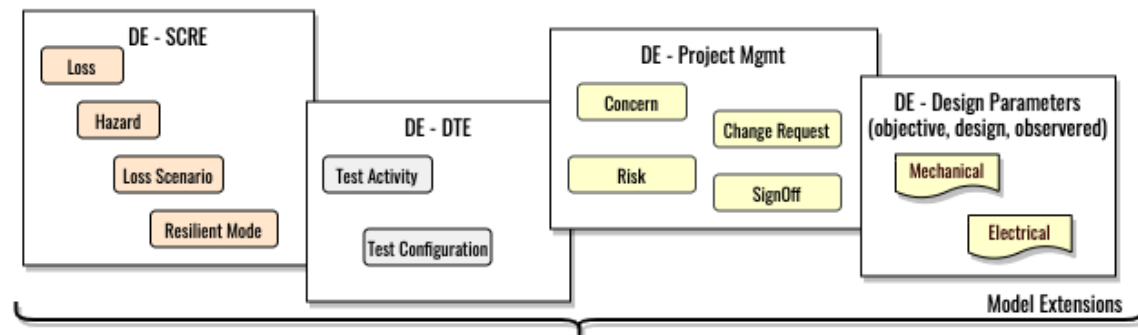
STEDE Overview
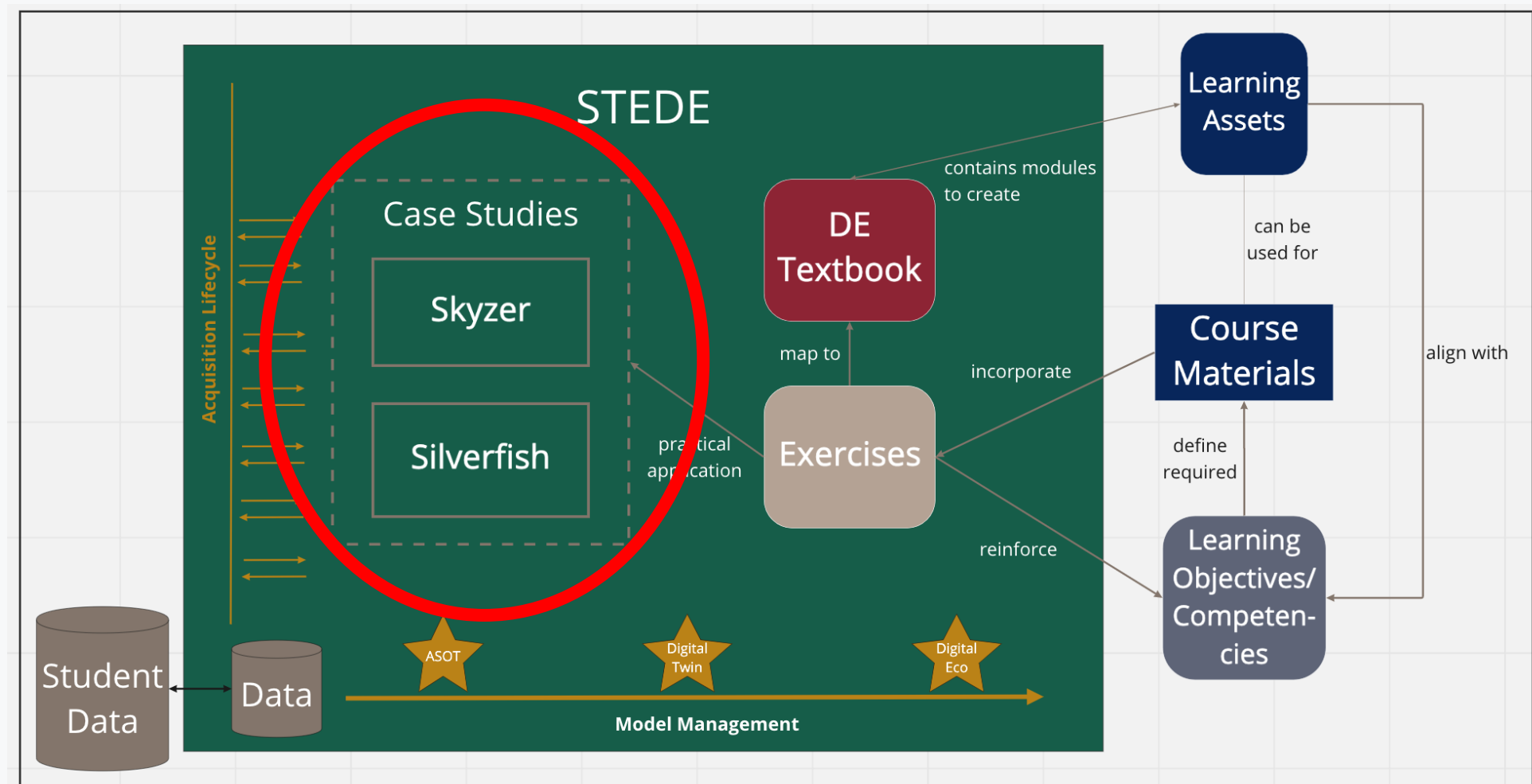
Simulation Training Environment for Digital Engineering (STEDE)

Skyzer (Search and Rescue UAV) Case Study Overview

Deep Dives by Phases

P1: Multi-physics
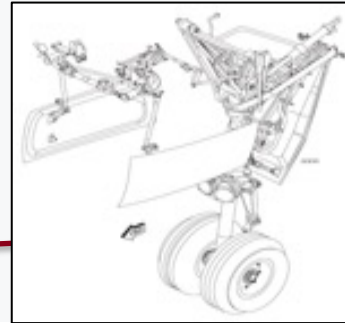
P2: Airworthiness

P3: Cost Modeling

Graphical CONOPS Scenario: Search & Rescue

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

NAVAIR Public Release 2019-443. Distribution Statement A – "Approved for public release; distribution is unlimited"

13 décembre 2022

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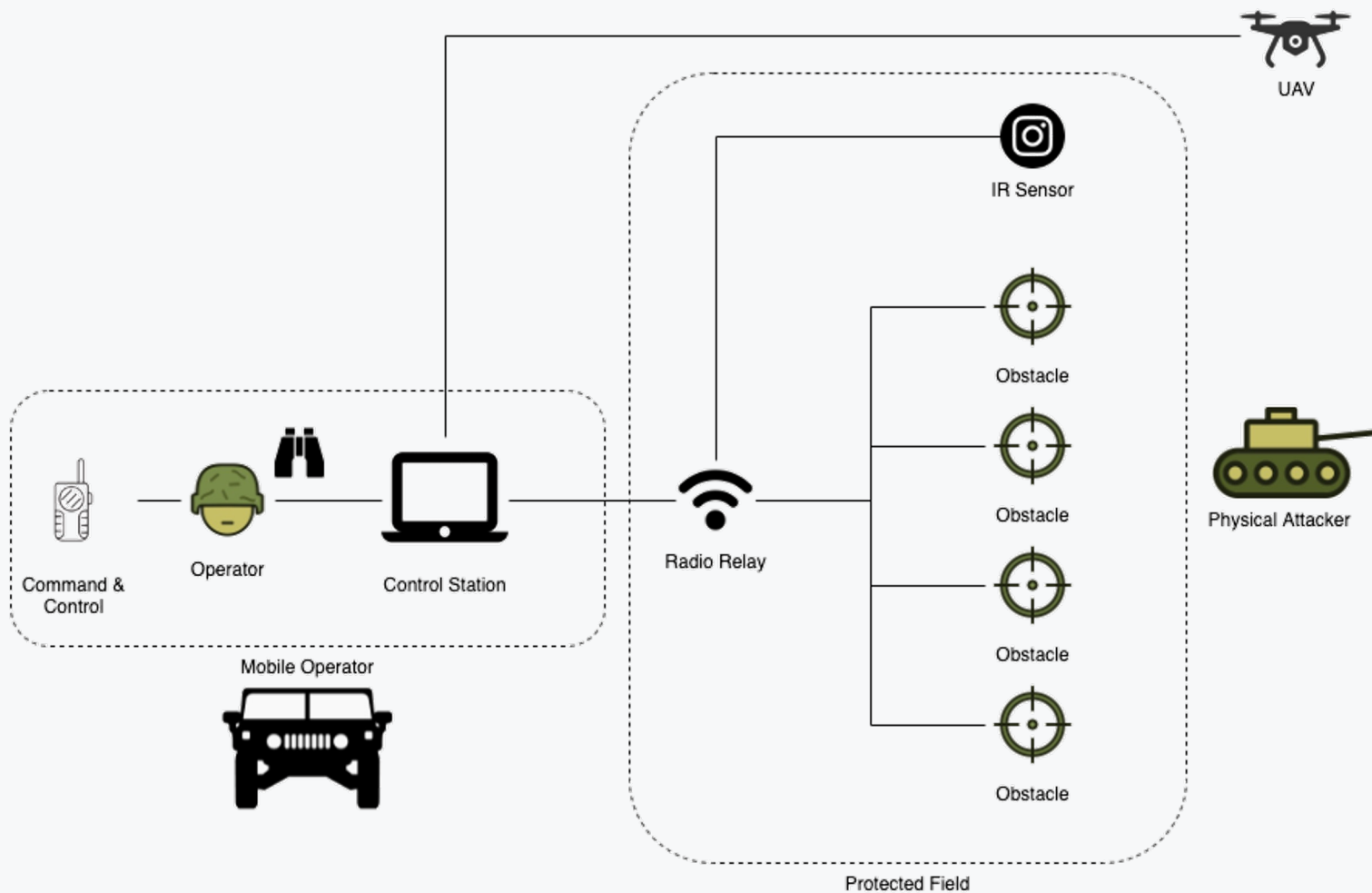
- Silverfish is a rapidly deployable set of fifty (50) individual ground-based weapon platforms (obstacles)
- The purpose of the system is to deter and prevent adversaries from trespassing into a geographic area
- The system includes a variety of sensors to locate and classify potential trespassers as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

STEDE Overview
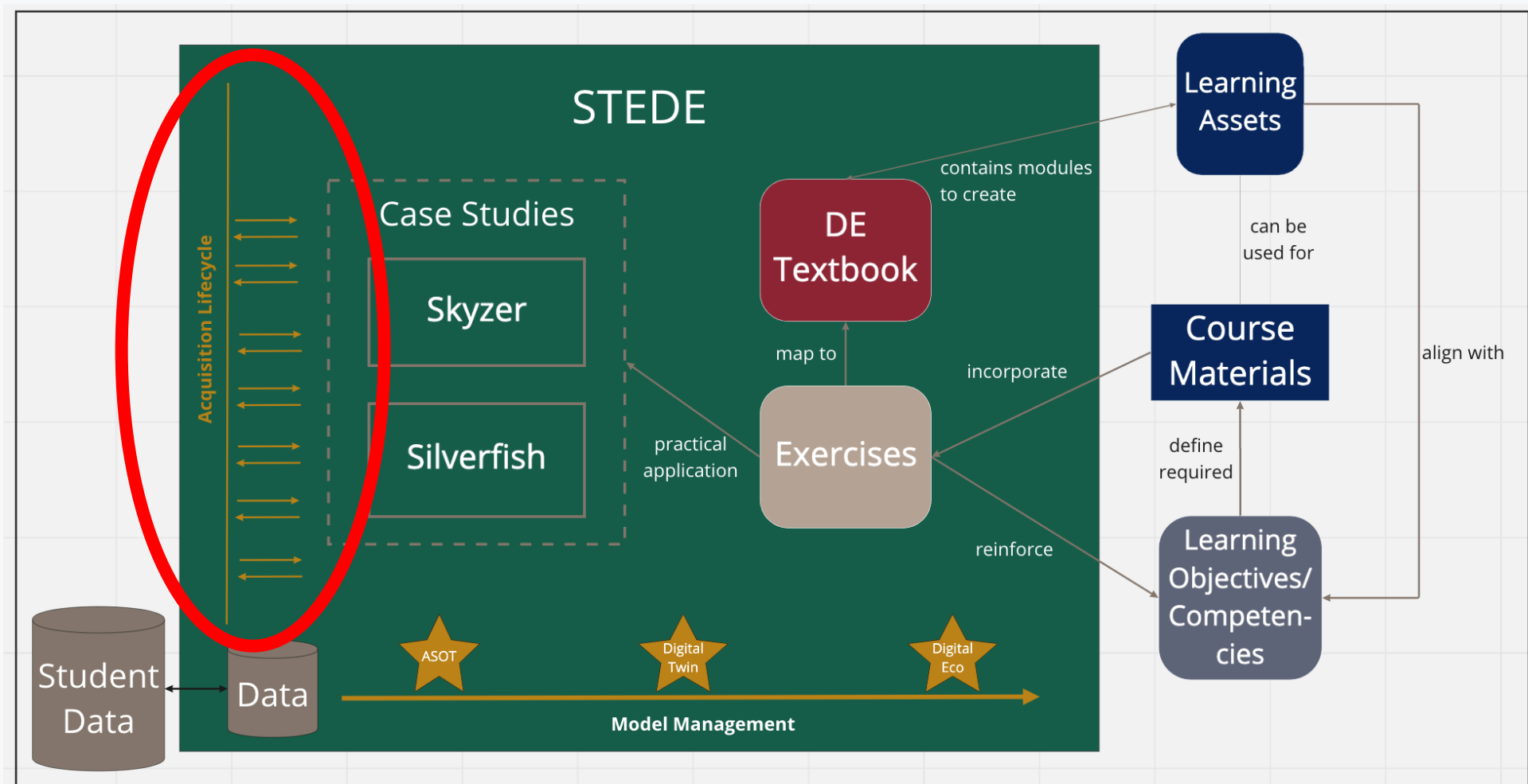
Simulation Training Environment for Digital Engineering (STEDE)

Digital Acquisition Artifacts

Links to the SEP

Systems Models

Requirements Model

Design Model

Program

Engineering Management / Analysis

Program Management

Document-Based SEP Template

1. Introduction
2. Program Technical Requirements
2.1. Architectures and Interface Control
2.2. Technical Certifications
3. Engineering Resources and Management
3.1. Technical Schedule and Schedule Risk Analysis
3.1.1. Relationships with External Technical Organizations
3.1.2. Schedule Management
3.1.3. System of Systems Schedule
3.1.4. Schedule Risk Analysis
3.2. Technical Risk, Issue, and Opportunity Management
3.3. Technical Structure and Organization
3.3.1. Work Breakdown Structure
3.3.2. Government Program Office Organization
3.3.3. Program Office Technical Staffing Levels
3.3.4. Engineering Team Organization and Staffing
3.4. Technical Performance Measures and Metrics
4. Technical Activities and Products
4.1. Planned SE Activities for the Next Phase
4.2. Requirements Development and Change Process
4.3. Configuration and Change Management
4.4.Design Considerations
Appendix A – Acronyms
Appendix B – Item Unique Identification Implementation Plan
References

Digital Acquisition Artifacts

Vender Contract

Concept of Operations

Acquisition Strategy

SEP Template

Integrated Master Schedule

	Notional Mode	MIL-STD-881	MIL-STD-XYZ	Skyzer Facets	Cameo	OpenMBEE	TeamWorkClo	Cost Model	Evaluation Mo	Mission Model	NAVSEM	Performance	RFI	SET Surrogate	SOW	System Descri
SEP v4		1			1	1	1		1	3	3	1		12		2
01 Introduction	1							1	↗							
02 Program Technical Definition	1							1	↗							
02-1 Requirements Development	1							1	↗							
02-2 Architectures and Interface Control	1							1								↗
02-3 Specialty Engineering																
02-4 Modeling Strategy	2							2		↗				↗		
02-5 Design Considerations	3							3	↗	↗		↗				↗
02-6 Technical Certifications	1							1	↗							
03 Program Technical Management																
03-1 Technical Planning	1							1						↗		
03-1-1 Technical Schedule	1							1						↗		
03-1-1-1 Schedule Management																
03-1-1-2 Family of Systems and System of Systems Management																
03-1-2 Maturity Assessment Planning																
03-1-3 Technical Structure and Organization	1							1						↗		
03-1-3-1 Work Breakdown Structure	1	1	↗													
03-1-3-2 Government Program Office Organization	1							1						↗		
03-1-3-3 Program Office Technical Staffing Levels	1							1						↗		
03-1-3-4 Engineering Team Organization and Staffing	1							1						↗		
03-2 Technical Tracking	1							1						↗		
03-2-1 Technical Risk Issue and Opportunity Management	1							1						↗		

Legend

↗ Trace

Reference Models

Skyzer Models

D-TEMP Links

TEMP

PART I – INTRODUCTION
1.1 PURPOSE
1.2 MISSION DESCRIPTION
1.3 SYSTEM DESCRIPTION
PART II – TEST PROGRAM MANAGEMENT AND SCHEDULE
2.1 T&E MANAGEMENT
2.2 COMMON T&E DATA BASE REQUIREMENTS
2.3 DEFICIENCY REPORTING
2.4 TEMP UPDATES
2.5 INTEGRATED TEST PROGRAM SCHEDULE
PART III – TEST AND EVALUATION STRATEGY
3.1 T&E STRATEGY
3.2 EVALUATION FRAMEWORK
3.3 DEVELOPMENTAL EVALUATION APPROACH
3.4 LIVE FIRE EVALUATION APPROACH
3.5 CERTIFICATION FOR IOT&E
3.6 OPERATIONAL EVALUATION APPROACH
3.7 OTHER CERTIFICATIONS
3.8 DESIGN OF EXPERIMENTS
3.9 FUTURE TEST AND EVALUATION
PART IV – RESOURCE SUMMARY
4.1 INTRODUCTION
4.2 FEDERAL, STATE, LOCAL REQUIREMENTS
4.3 MANPOWER/PERSONNEL TRAINING
4.4 TEST FUNDING SUMMARY
APPENDIX A – BIBLIOGRAPHY
APPENDIX B – ACRONYMS
APPENDIX C – POINTS OF CONTACT
APPENDIX D – DESIGN OF EXPERIMENTS

Systems Models

Requirements Model

Design Model

Range Capability Model

Digital Acquisition Artifacts

Test Policy

Concept of Operations

Acquisition Strategy

M&S Strategy

IMS

SEMP

Exercise Progression

Case Study

Simple
Models

Complicated
Complicated

Complex
Models

- Simple Models
  - ➢ Versions with only partial information/few connections
  - ➢ May be demonstrated in videos or lite interactions
- Complicated Examples
  - ➢ Increased data in models or number of models
  - ➢ Student interactions with the models
    - ▪ Seek and find
    - ▪ Data entry/simulations
    - ▪ Decisions from data
- Complex Examples
  - ➢ Full model "ecosystem"
  - ➢ Digital Sign off
  - ➢ Creation of new models

Exercise Threads
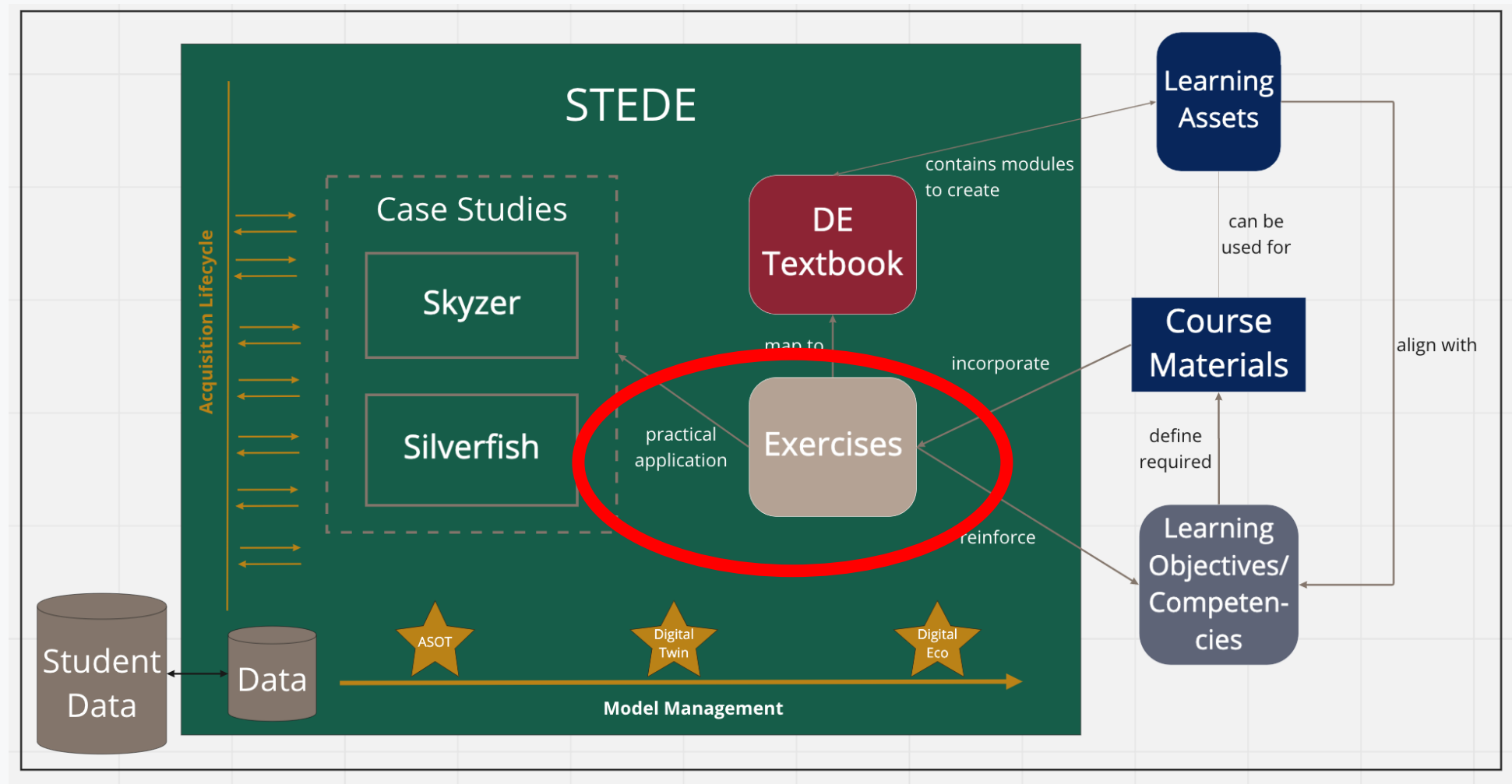
Exercises

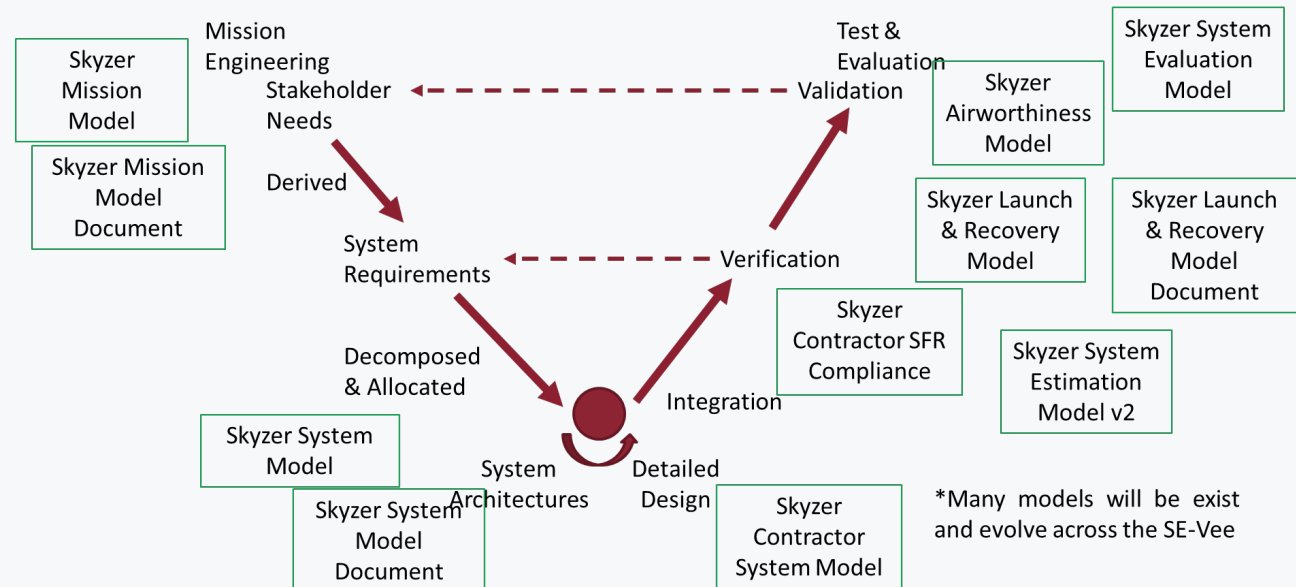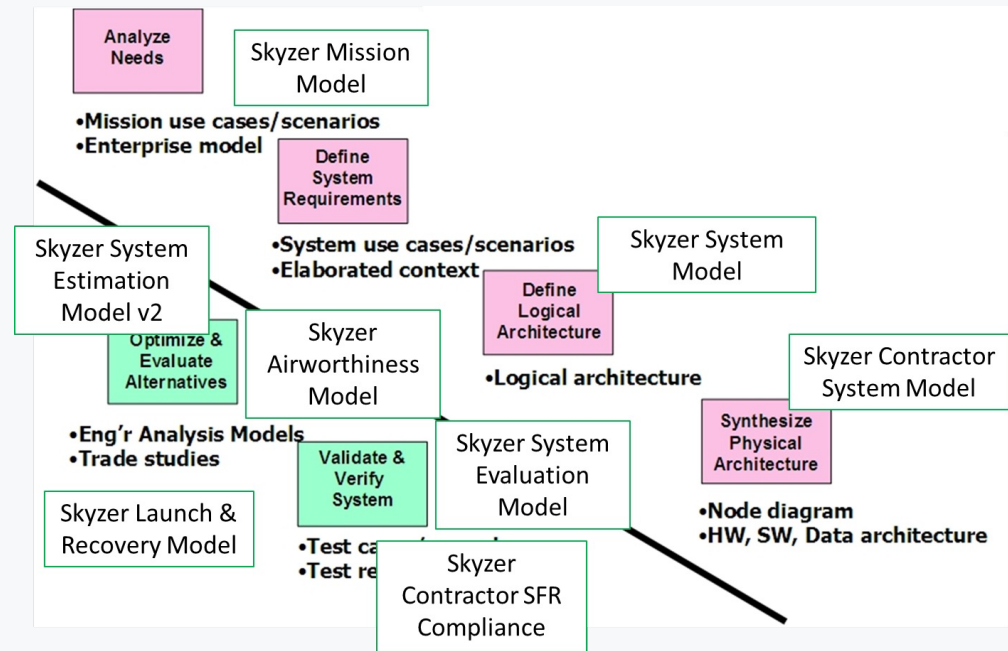1. **Mapping Skyzer to the Vee**
   1. **SE-Vee**
   2. **OOSEM**

2. Mapping Skyzer to the Acq. Lifecycle

3. Digital-sign-off

4. Go find me:
   1. In Cameo
   2. In OpenMBEE ViewEditor

Skyzer-Based Exercises
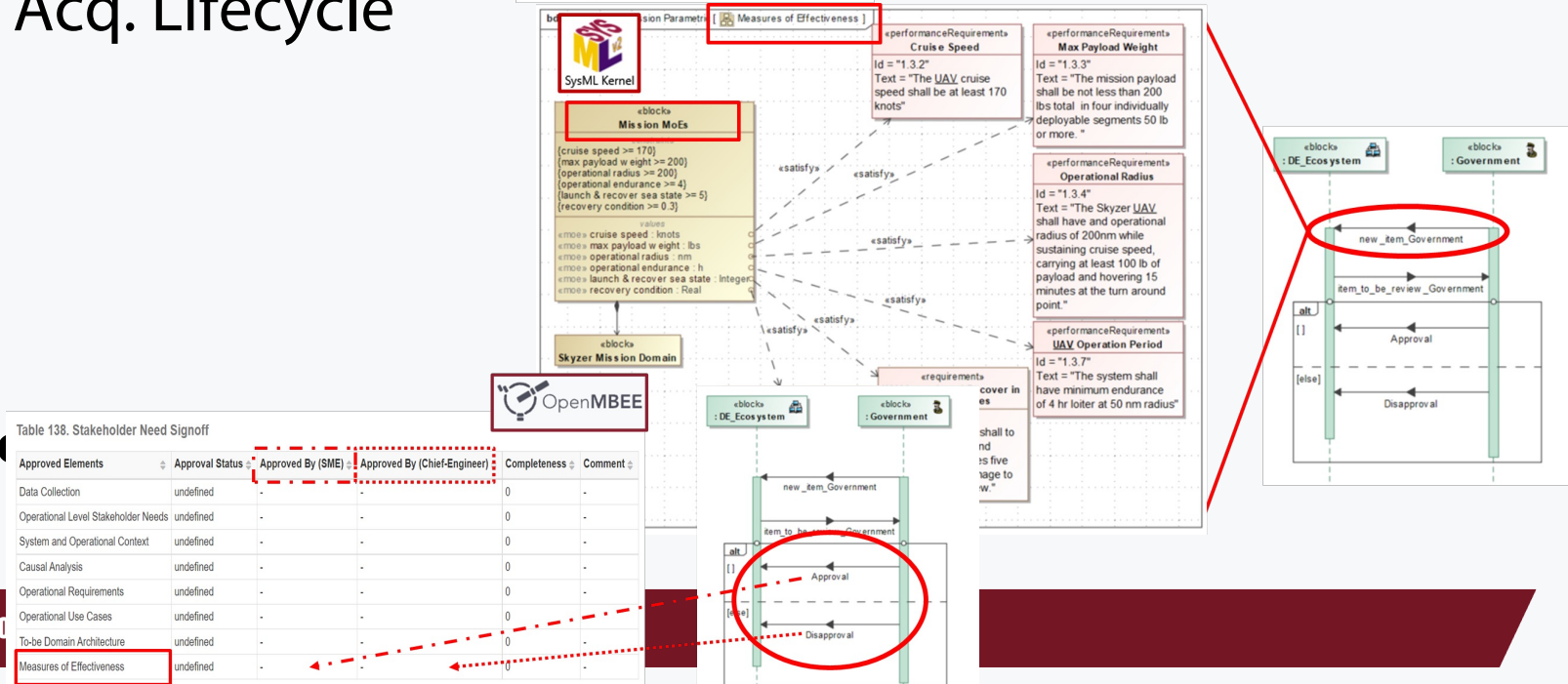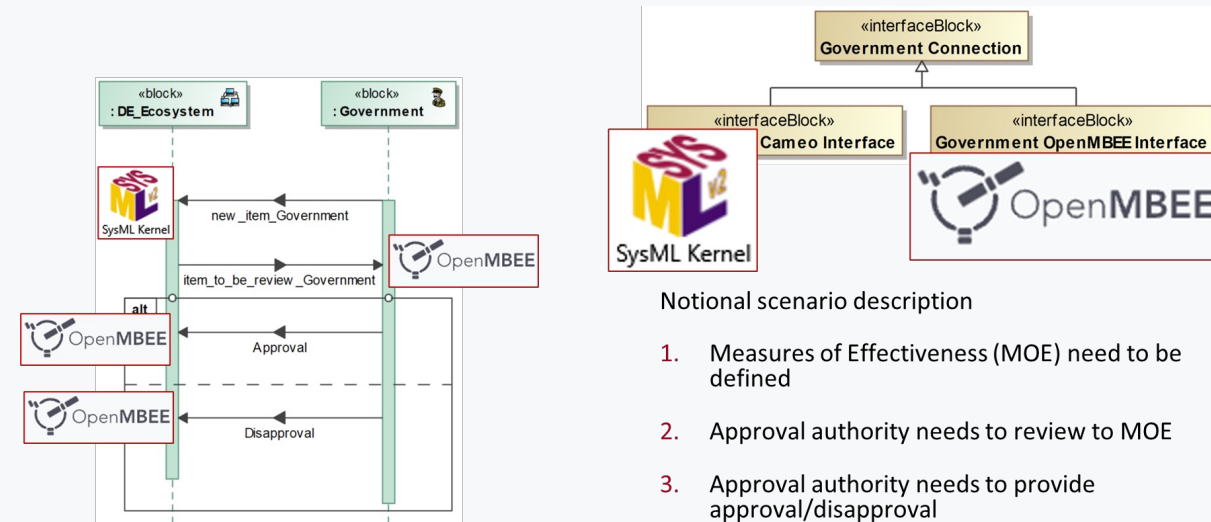
1. Mapping Skyzer to the Vee
   1. SE-Vee
   2. OOSEM-Vee

2. Mapping Skyzer to the Acq. Lifecycle

3. **Digital-sign-off**

4. **Go find me:**
   1. **In Cameo**
   2. **In OpenMBEE ViewEditor**

Notional scenario description

1. Measures of Effectiveness (MOE) need to be defined
2. Approval authority needs to review to MOE
3. Approval authority needs to provide approval/disapproval

Table 138. Stakeholder Need Signoff

Approved Elements	Approval Status	Approved By (SME)	Approved By (Chief-Engineer)	Completeness	Comment
Data Collection	undefined	-	-	0	-
Operational Level Stakeholder Needs	undefined	-	-	0	-
System and Operational Context	undefined	-	-	0	-
Causal Analysis	undefined	-	-	0	-
Operational Requirements	undefined	-	-	0	-
Operational Use Cases	undefined	-	-	0	-
To-be Domain Architecture	undefined	-	-	0	-
Measures of Effectiveness	undefined	-	-	0	-

SYSTEMS ENGINEERING RESEARCH CENTER