Uniting LLMs and MBSE

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About the Presenter

TONY SUKHWANI

Introduction

- Lives in Huntsville, AL
- BS and MS in Systems Engineering (GMU and UAH)
- Principal Systems Engineer at Belcan
- 15+ Years of SE experience in A&D
- Loves smoking various meats, the beach, and animals

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Agenda

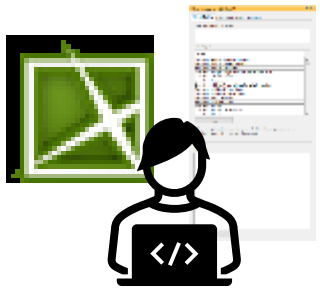
- LLM and MBSE Integration Motivation and Overview
- Tool Usage Examples
- MBSE-LLM Application Example
- Conclusion and Questions

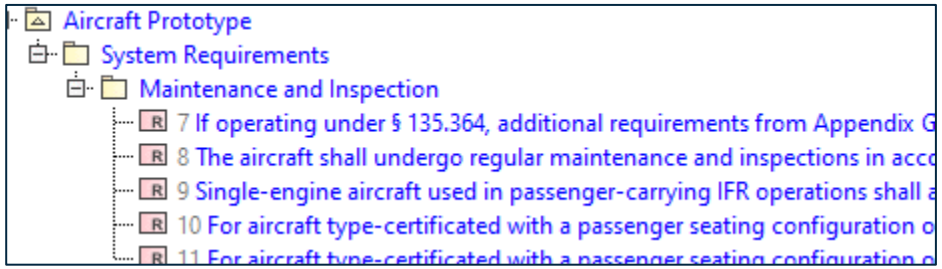
LLM AND MBSE INTEGRATION MOTIVATION AND OVERVIEW

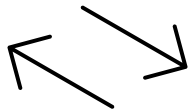
LLM-MBSE Integration

- **Purpose: Generate MBSE models, Review models, General MBSE assistant**
- **Method: Cameo Plugin, interacts with a LLM to automatically**

Magic Systems of Systems



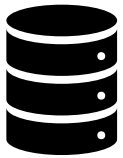


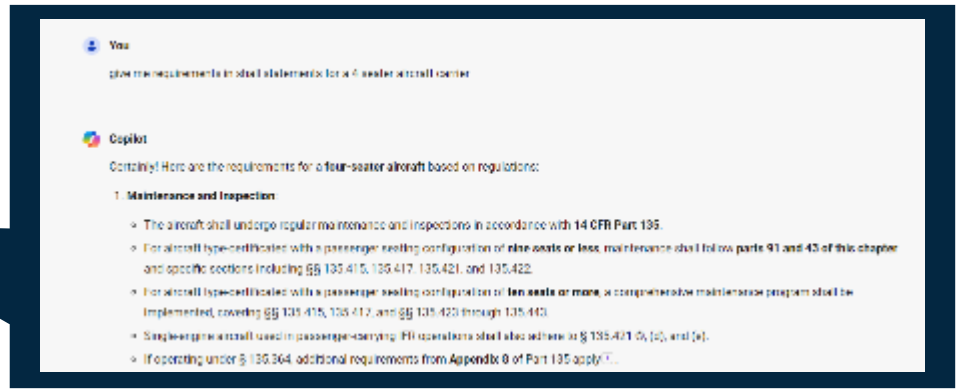


LLM

Search/RAG

Data



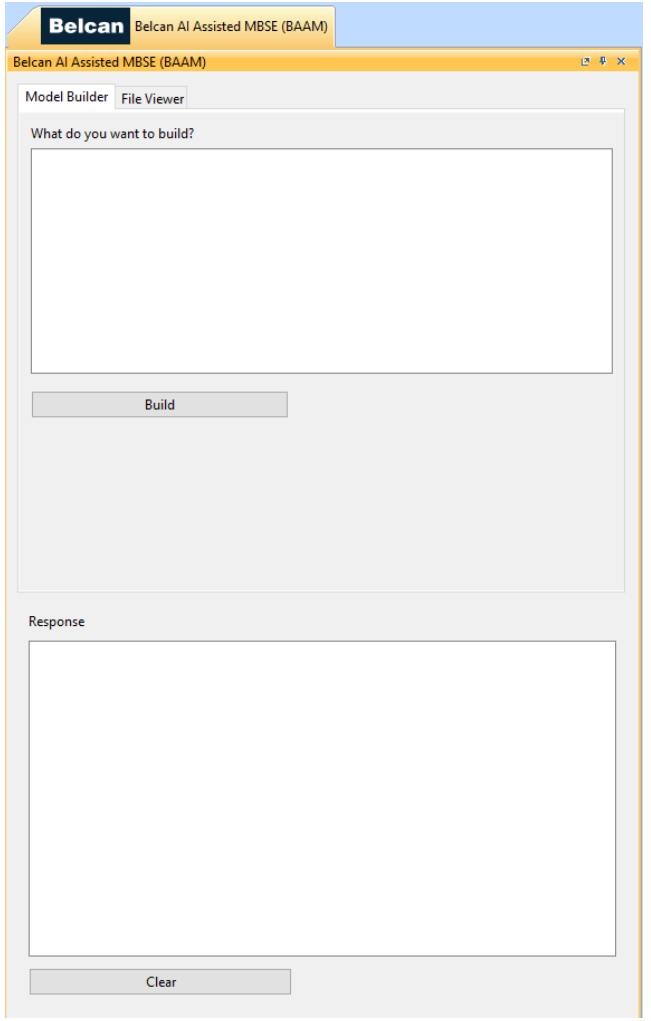


LLM Integrated + related model elements:

1) Generate Requirements
2) Rewrite requirements
3) Use Cases/Behaviors
4) Activities/Sequences/State Machines
5) Model Structure
6) Model Analysis

Belcan AI-Assisted MBSE (BAAM) Overview

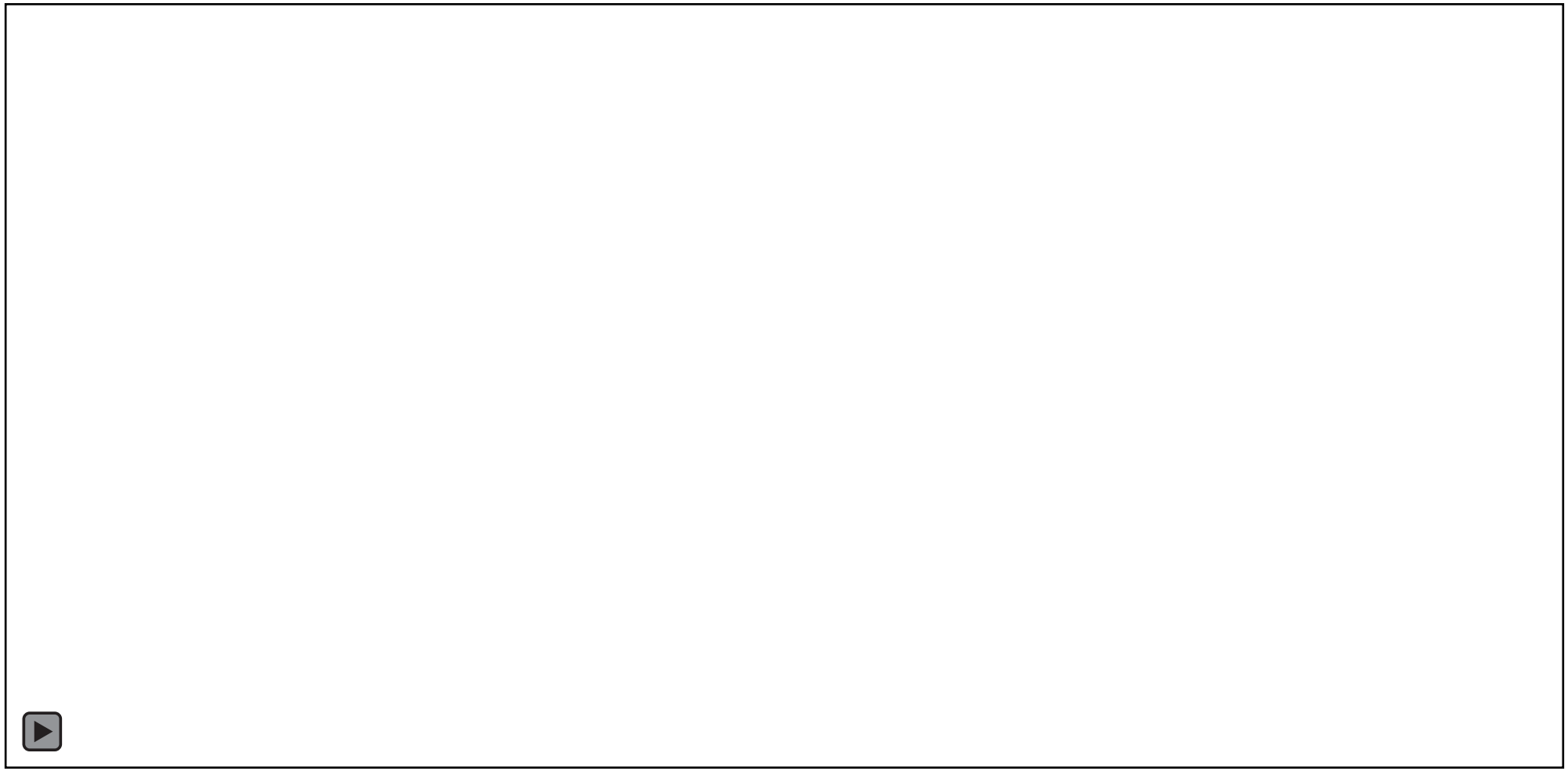
- LLM holds specific SysML instructions – Trained in certain aspects of SE
- Can upload files for Retrieval Augmented Generation (RAG)
- Can input existing Elements to create new Elements and Relationships
- LLM returns formatted information – Elements, Relationships
- Plugin translates information via MagicDraw OpenAPI



TOOLS USAGE EXAMPLES

Building Requirements

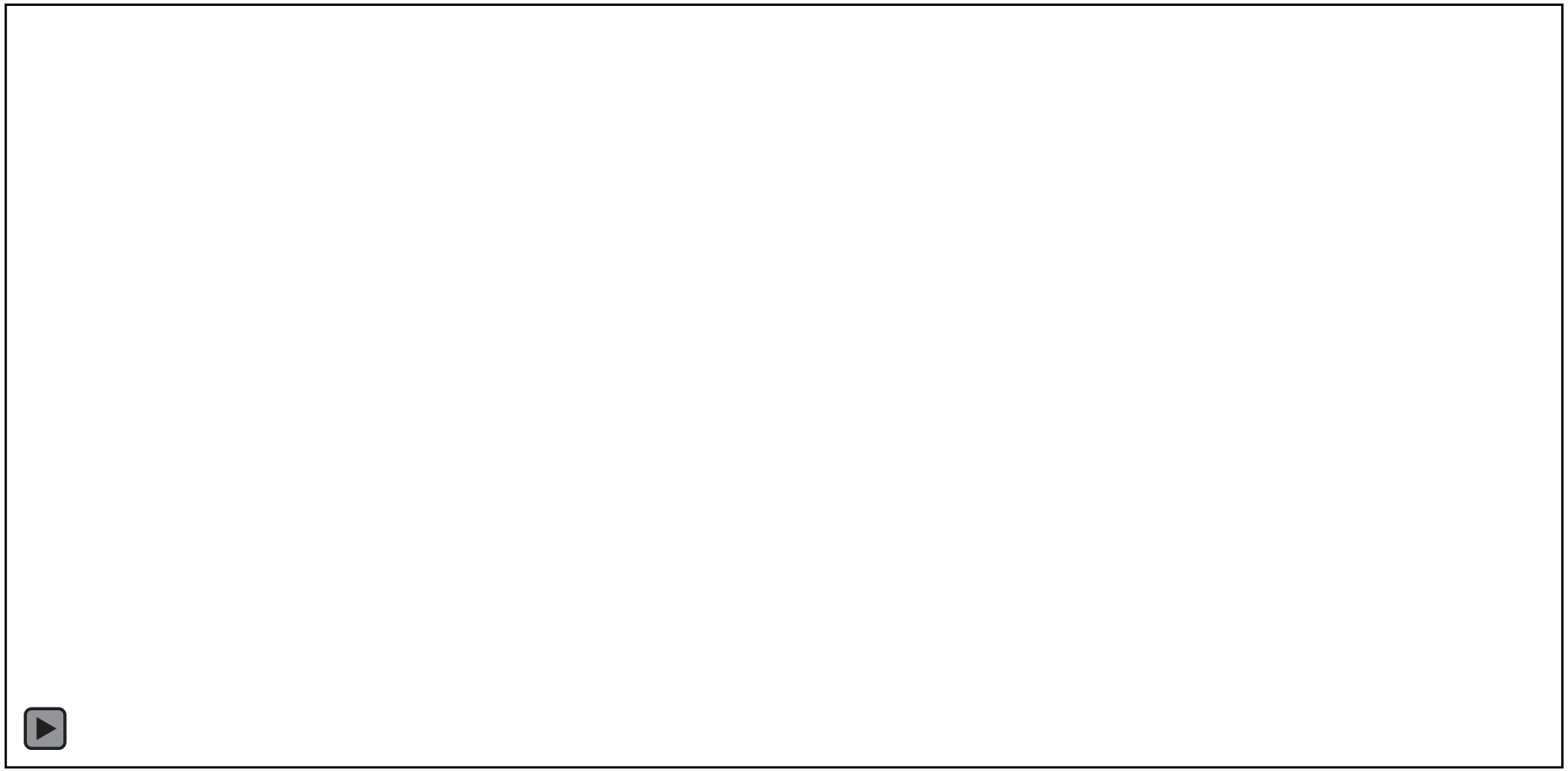
- “Build me a set of requirements for a submarine”



https://youtu.be/A2SF6VHFvFU

Building Use Cases

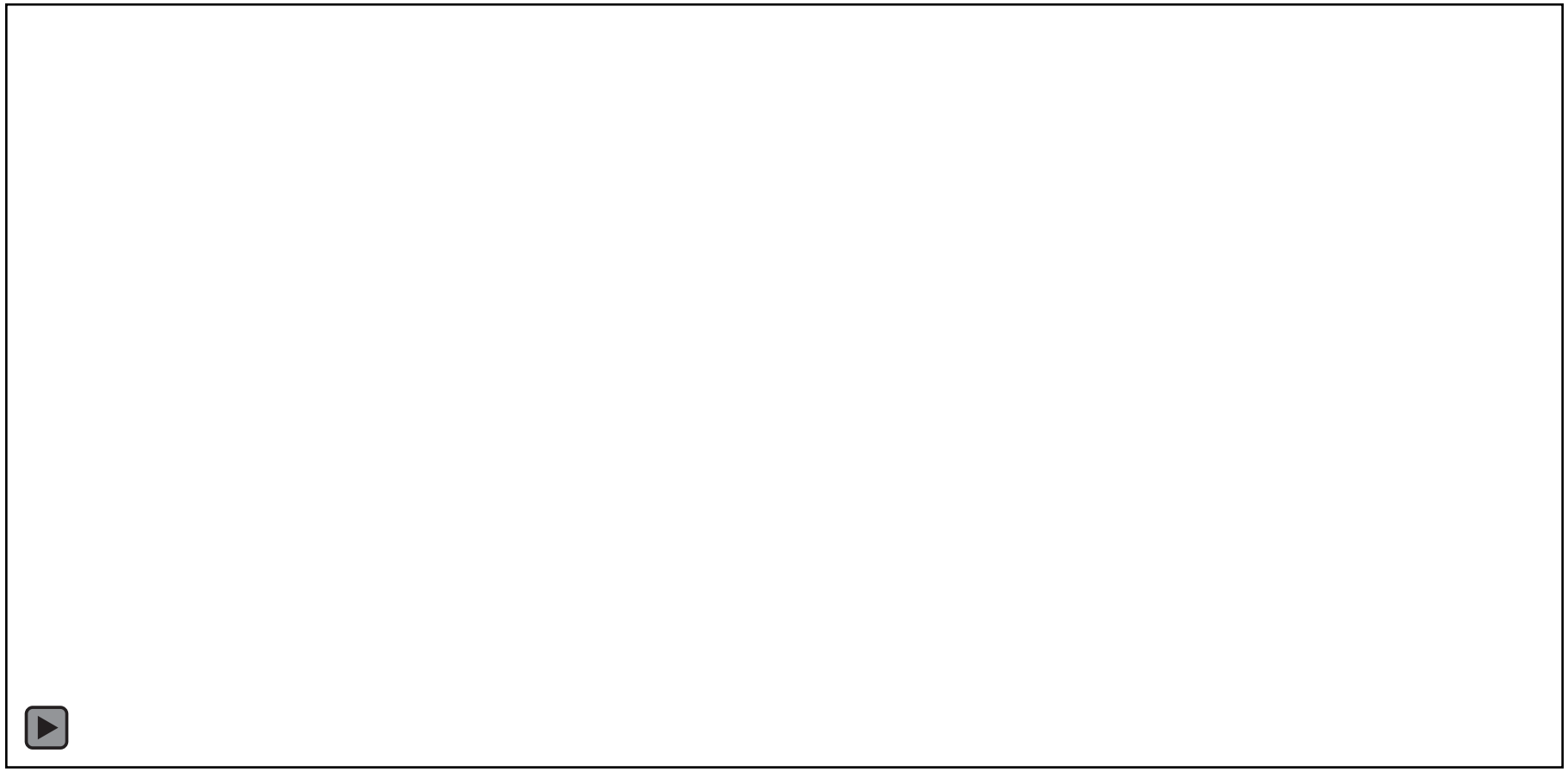
- **“Build me a set of use cases for a submarine, using these selected elements”**



https://youtu.be/RAgeQFIdfYE

Building Blocks

- **“Build me a set of blocks for a submarine, using these selected elements”**



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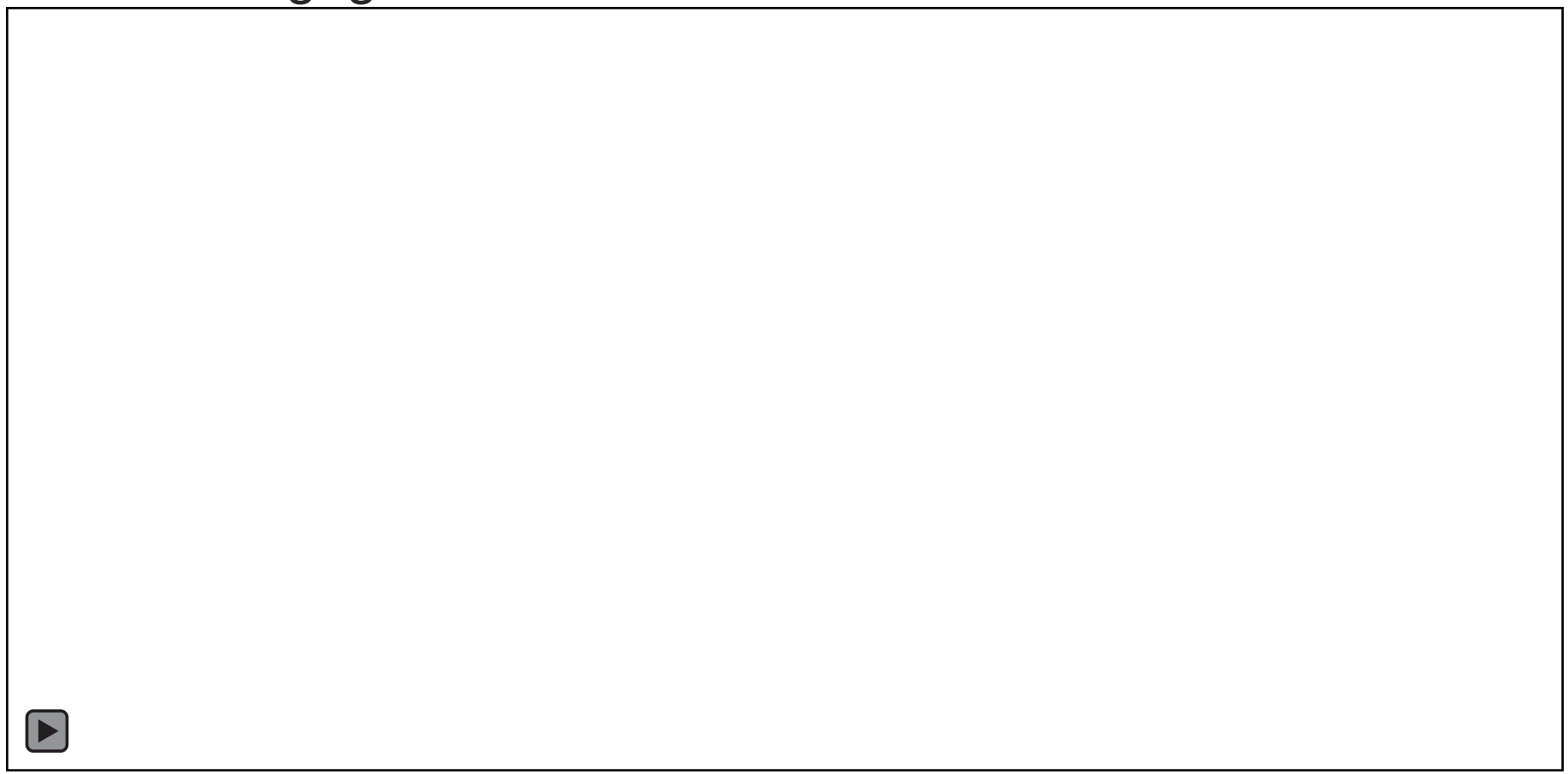
Traceability

- **Requirements Table**

#	Name	Text	Refined By	Satisfied By
1	REQ-001 Submarine Depth Capability	The submarine shall operate at a maximum depth of 300 meters.	Operate at Maximum D	Hull
2	REQ-002 Submarine Speed	The submarine shall achieve a maximum speed of 25 knots when submerged.	Achieve Maximum Spee	Propulsion System
3	REQ-003 Submarine Endurance	The submarine shall have an endurance of 90 days without resupply.	Sustain 90 Days Endurar	Propulsion System
4	REQ-004 Submarine Crew Capacity	The submarine shall accommodate a crew of 50 personnel.	Accommodate Crew	Crew Quarters
5	REQ-005 Submarine Stealth	The submarine shall have a noise level not exceeding 110 decibels.	Maintain Stealth	Hull
6	REQ-006 Submarine Armament	The submarine shall be equipped with torpedoes and anti-ship missiles.	Engage with Armament	Armament System
7	REQ-007 Submarine Communication	The submarine shall have secure communication systems for underwater operations.	Communicate Underwa	Communication System
8	REQ-008 Submarine Navigation	The submarine shall be equipped with an inertial navigation system.	Navigate with Inertial Sy	Navigation System
9	REQ-009 Submarine Power Supply	The submarine shall have a nuclear power plant for propulsion and onboard systems.	Operate Nuclear Power	Power Plant
10	REQ-010 Submarine Safety	The submarine shall have emergency escape systems for all crew members.	Execute Emergency Esca	Safety System

Building Activities

- **“Build me a set of activities using these selected elements”**
  - Use Case “Engage with Armament” is selected



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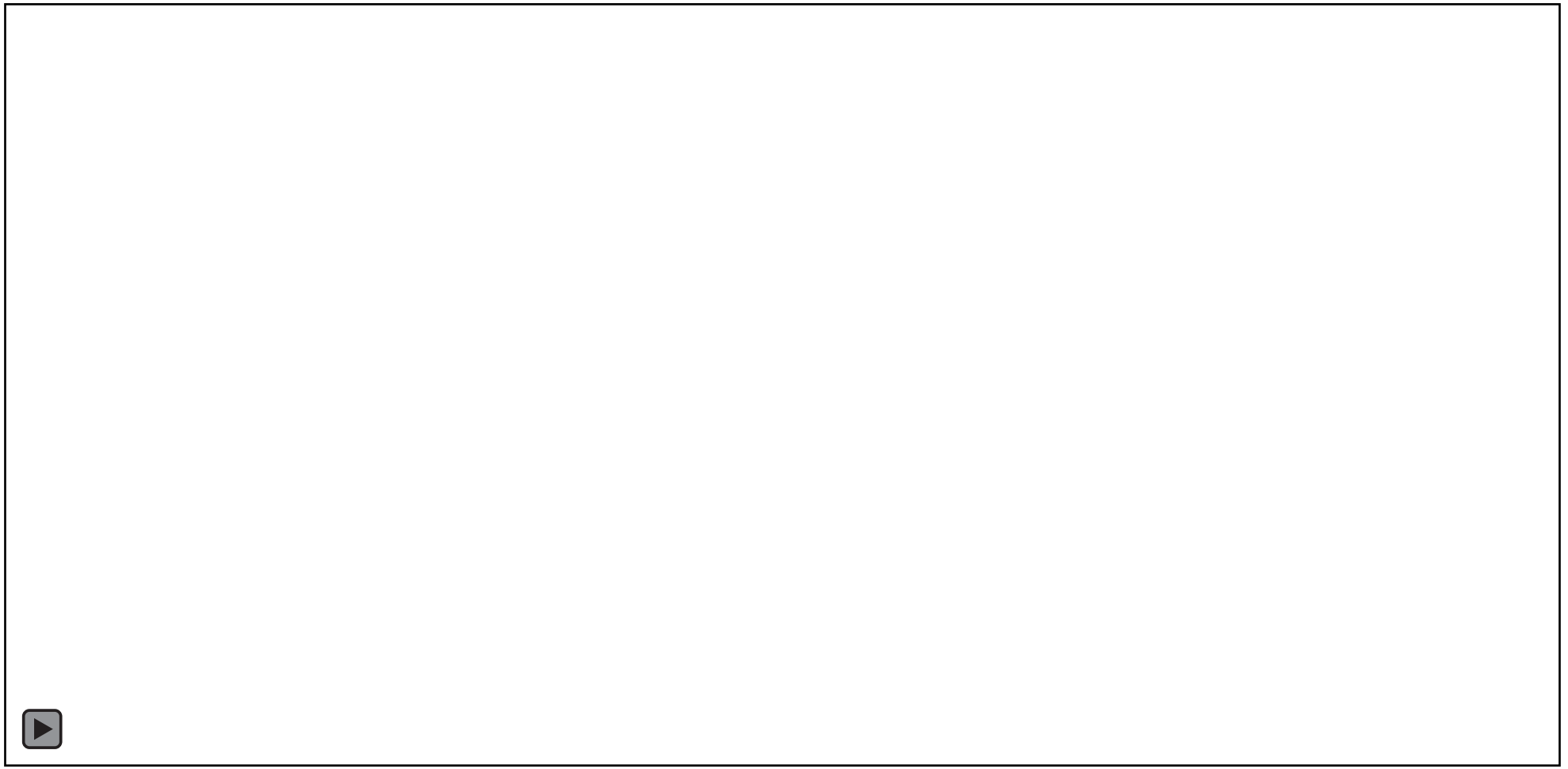
Building Interfaces - Systems Signals

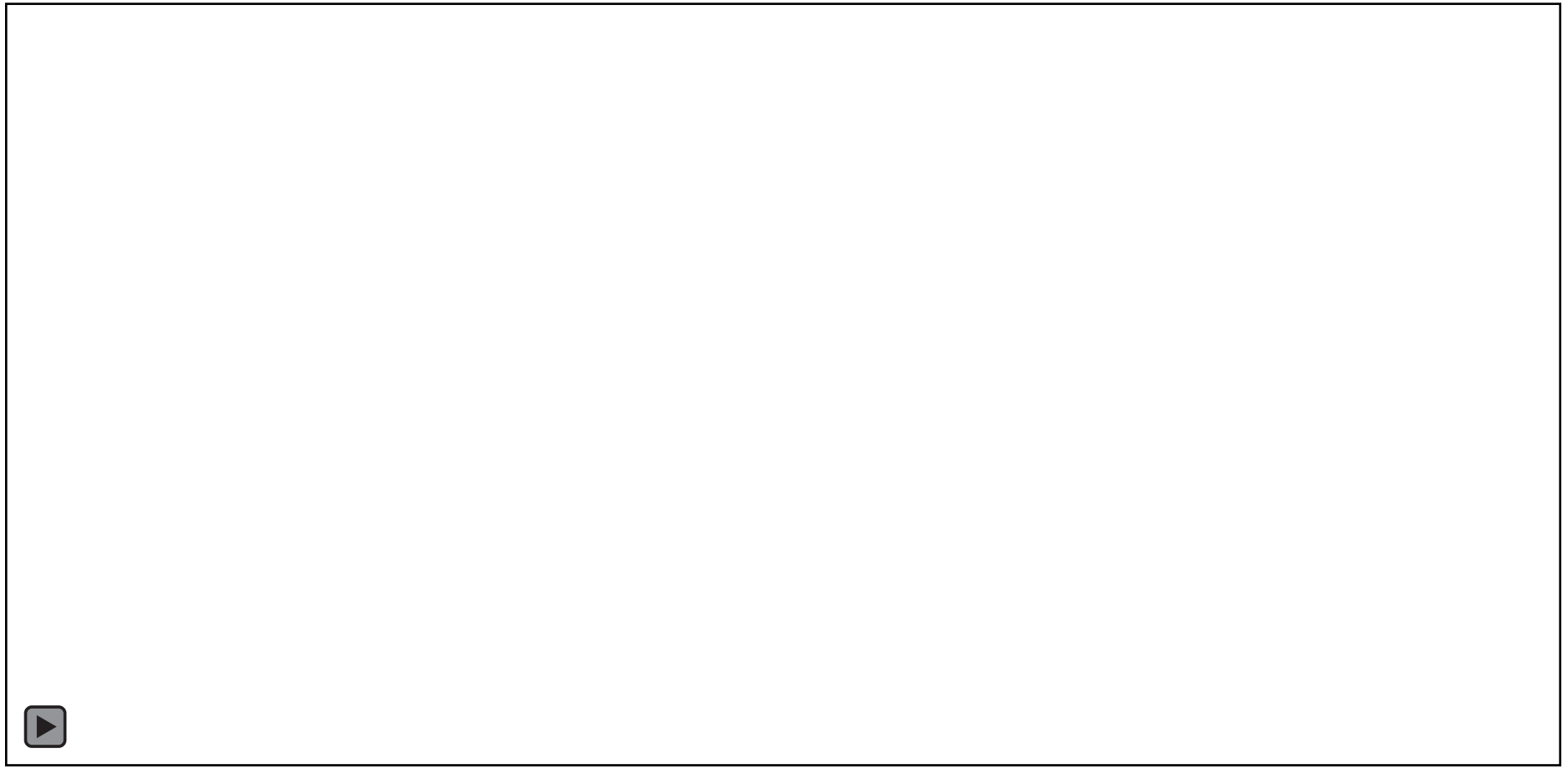
- “Build me a set of signals using these selected elements”



https://youtu.be/mtDiTTmEWk0

Building Interfaces- Interface Blocks

- **“Build me a set of InterfaceBlocks using these selected elements”**



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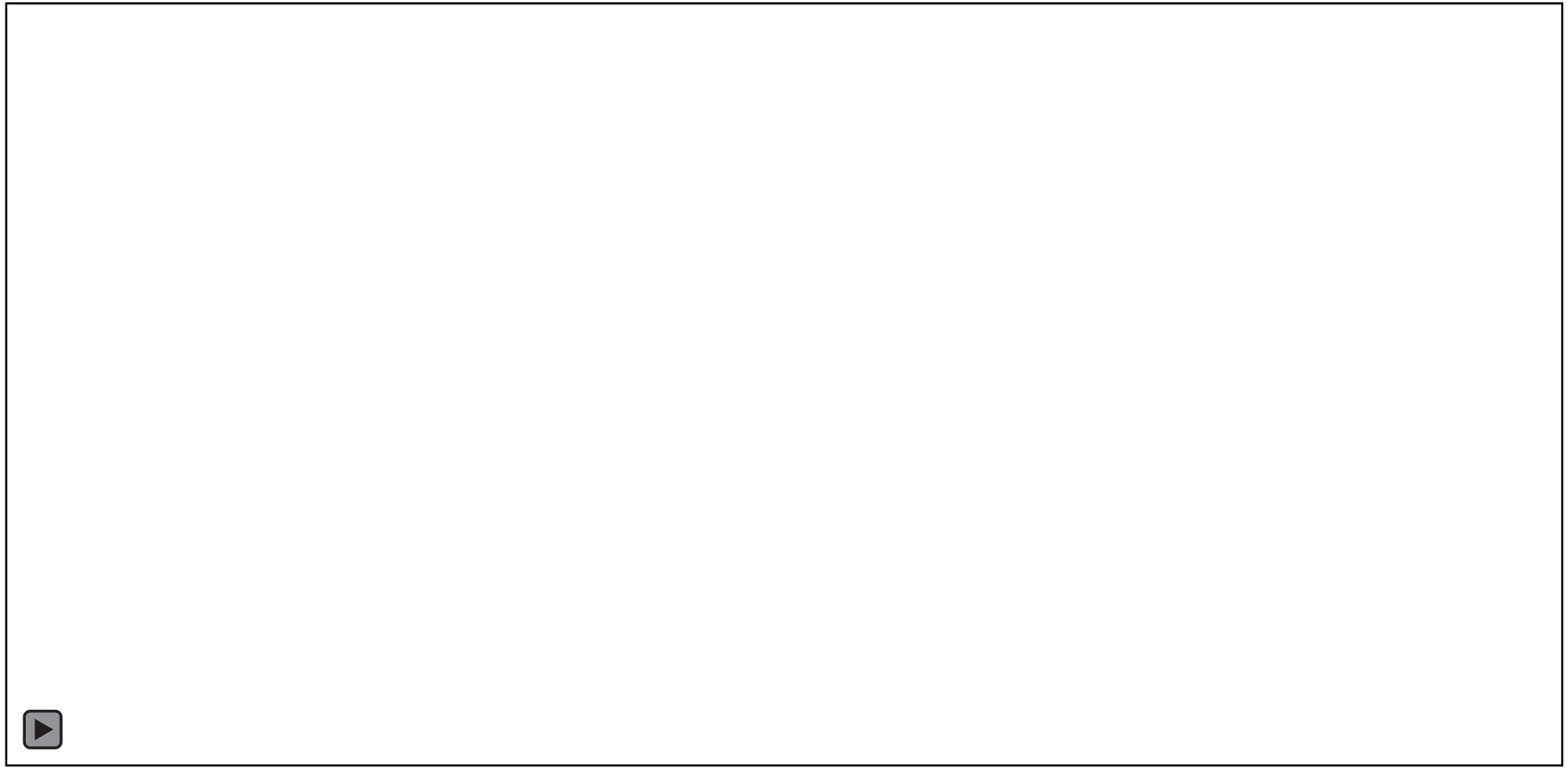
Building Interfaces- Ports

- “Build me a set of ports using these selected elements”



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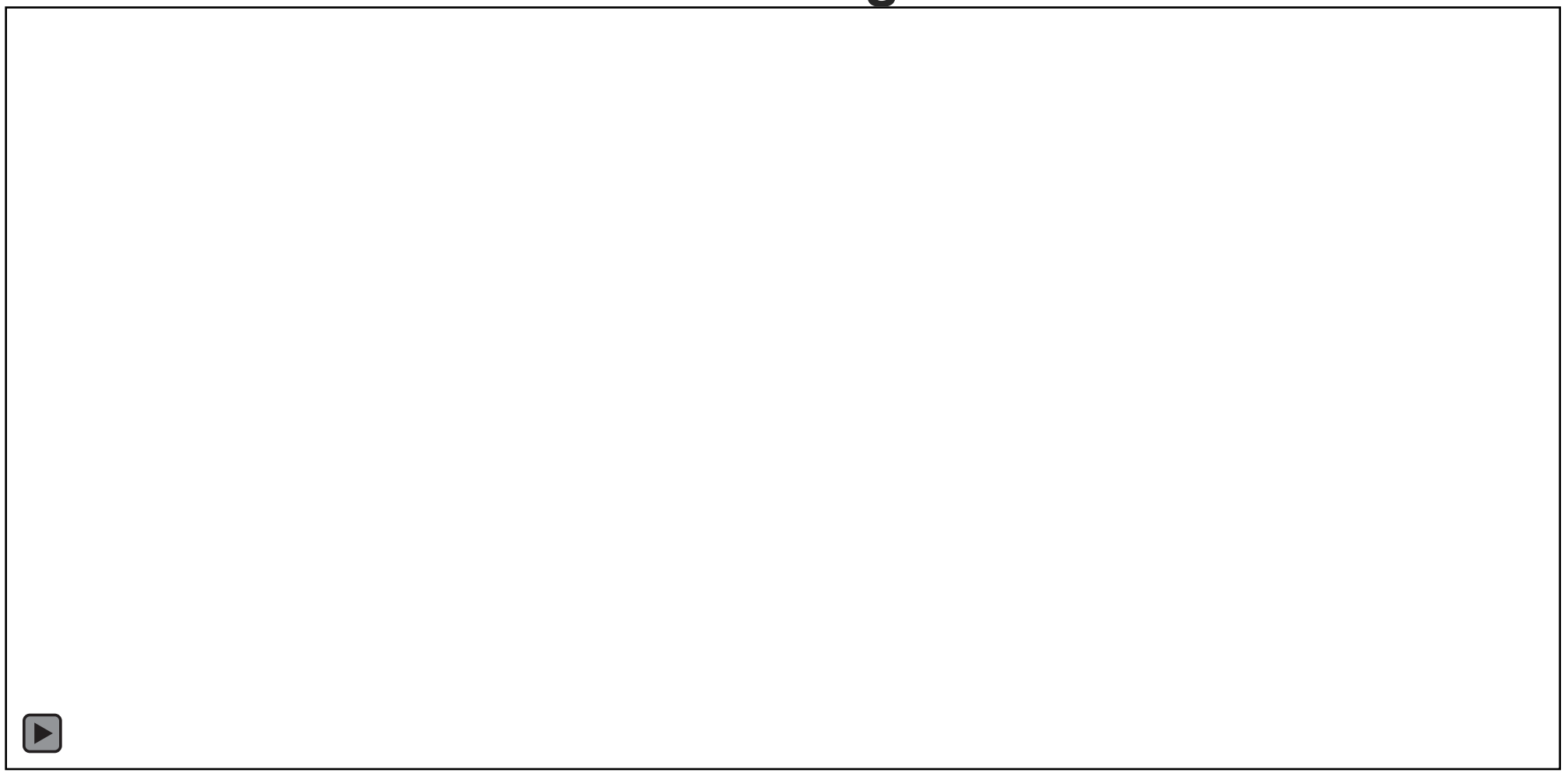
Building Interfaces- Connectors

- “Build me a set of interfaces using these selected elements”



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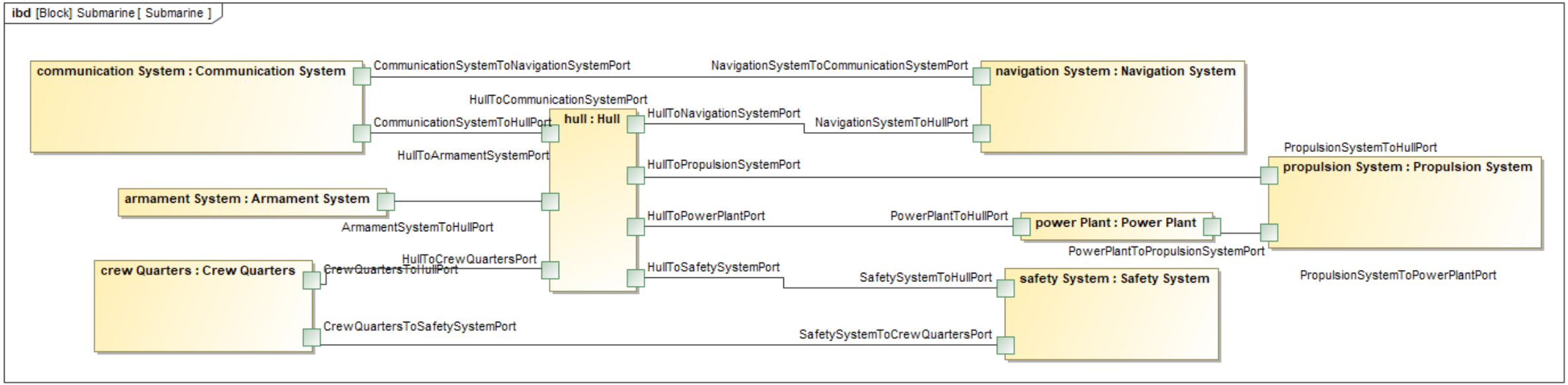
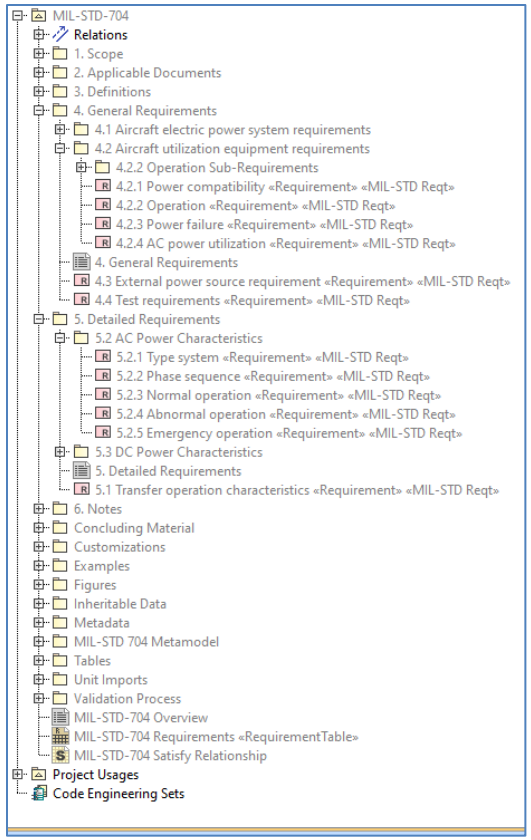
Building Interfaces-Internal Block Diagram (IBD)



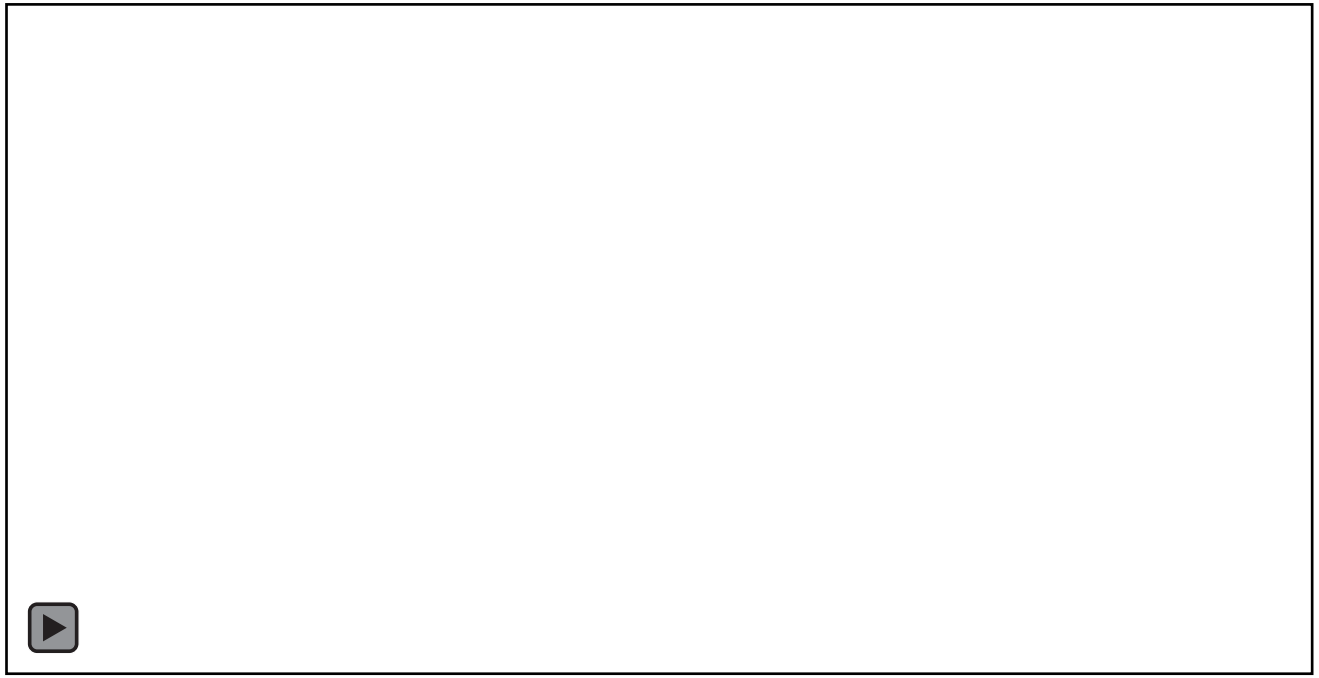
MBSE-LLM APPLICATION

MBSE-LLM Application: Modeling MIL-STDs

- **MIL-STD-704F**
  - Fully modeled requirements, traceability, and inheritable blocks



- **"Build me a set of requirements from Section 4 of MIL-STD-704F**



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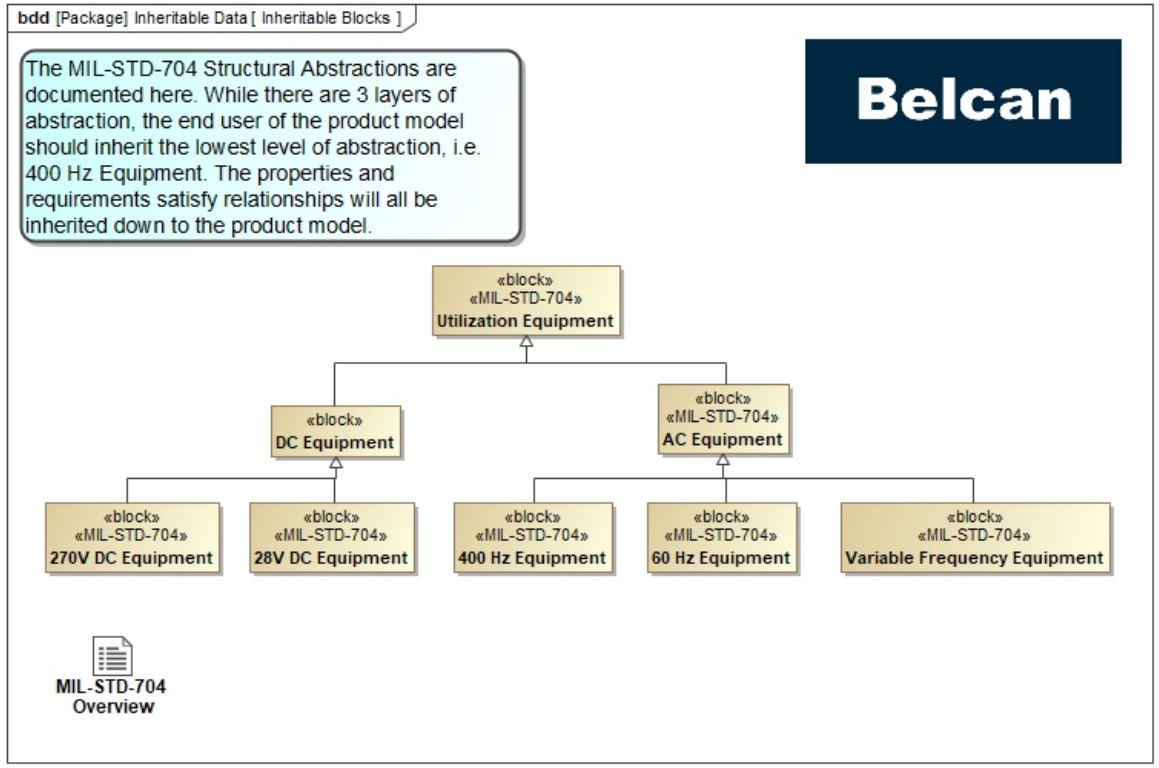
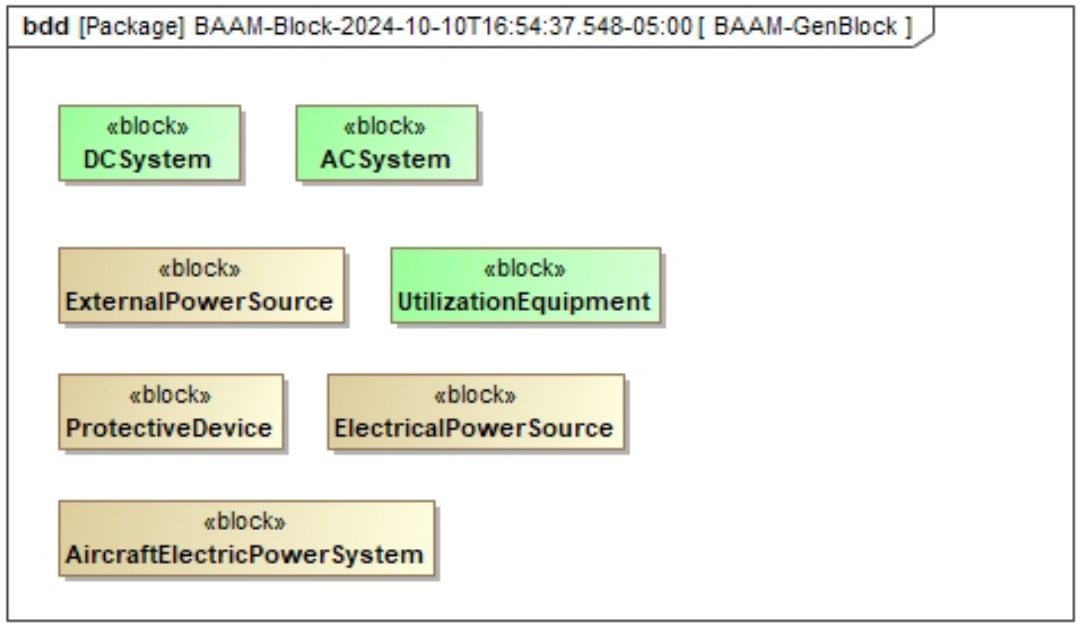
MBSE-LLM Application: Modeling MIL-STDs

- **Inheritable Blocks - Manual**



- **Inheritable Blocks – LLM**
  - "Build me blocks, define a set of inheritable blocks from these requirements"



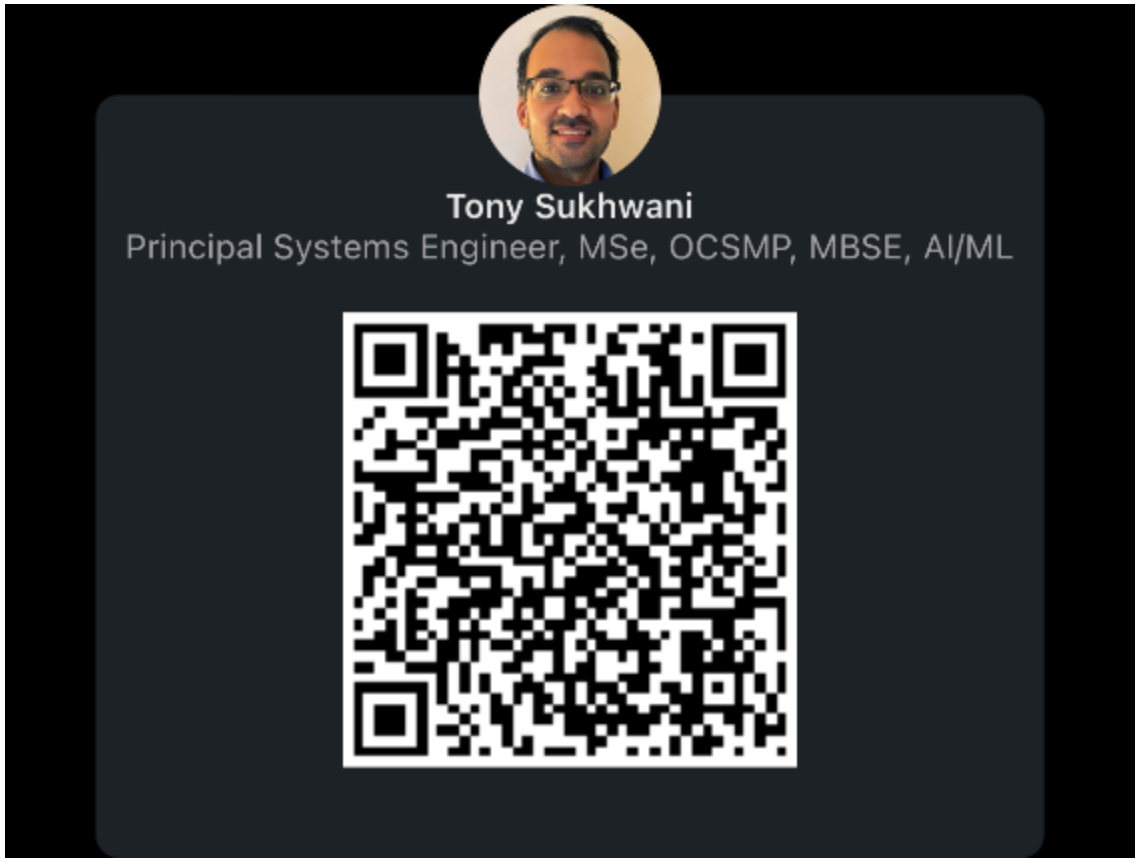
CONCLUSIONS AND QUESTION

Conclusion

- **LLMs will not replace engineers, but if used correctly will enhance our productivity**

- **Additional capabilities in work:**
  - Clippy-like agent to assist in model development
  - Value properties, State Machine
  - Learning from a meta-model/schema

- **Connect with me on LinkedIn!**



QUESTIONS?