International Council on Systems Engineering
A better world through a systems approach

Transforming Decision Making with AI and the DADM Framework

John DeHart and Jared Smith

Hello.

John DeHart

Senior Principal Engineer at Avian

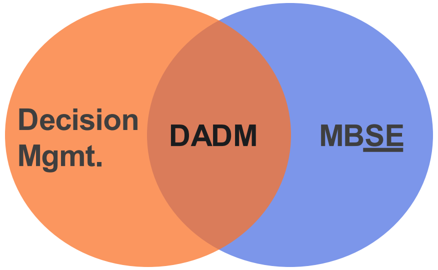
John is the architect of the Event-Driven Decision System (EDS), a next-generation decision support and execution framework. With a background in systems engineering, modeling and simulation, and AI-driven tooling, he leads advanced development efforts integrating ontologies, agents, and real-time decision pipelines for defense, acquisition, and emerging technology domains.

Jared Smith

Manager at Deloitte Consulting

Jared Smith has almost a decade of industry experience in MBSE and Digital Engineering for aerospace and defense programs and serves as Co-Chair of INCOSE's Decision Analysis Working Group.

Overview



We are developing a digital engineering framework that incorporates the process and data types from the Decision Analysis Data Model (DADM) to bootstrap a decision analysis and manage its execution and resulting objects.

1 Making Decisions Today

- Decision analysis is often fragmented, slow, and reliant on static reports or manual coordination.
- Complex trade studies require pulling data and models from disconnected sources, limiting traceability, speed, and confidence in outcomes.

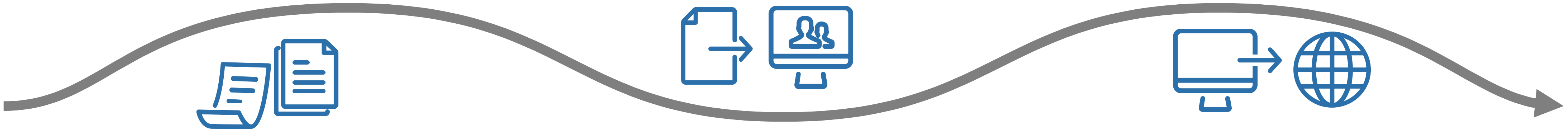
2 Enable AI-augmented Decisions

- AI agents bootstrap decision framing, generate alternatives, simulate outcomes, and score results.
- Rapidly converging on the best course of action.
- The platform ensures every decision is context aware, auditable, and leads to real-world execution, not just diagrams or documentation.

3 Bringing it All Together

- The roadmap extends DADMS-EDS beyond decision analysis into a full digital engineering environment; where models, agents and workflows are integrated across the system lifecycle.
- This foundation enables adaptive, autonomous engineering, from requirements extraction to systems validation and continuous improvement.

Developing the DADM



Document-Based Decision Analysis

Decision analysis best practices are captured in textbooks and written descriptions, while one-off execution largely occurs in spreadsheets and written reports.

Developing the DADM

In 2022, DAWG initiates DADM effort (an INCOSE FuSE product) to identify and capture common data and processes required to conduct a decision analysis in a digital model that supports INCOSE Vision 2035.

DADM V.1.0 Beta Released

In 2025, DAWG releases beta version of DADM to INCOSE members in the INCOSE SE Lab for experimentation, testing, and refinement of the model and call for participants on the

Remaining Challenges

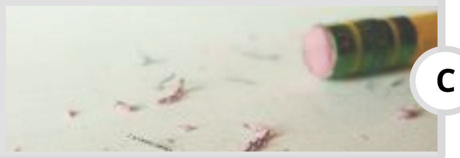
The DADM provides a big leap in consistency and scalability for conducting decision analyses, but several challenges remain to wide-spread adoption of the framework.

A LABOR & RESOURCE-INTENSIVE

B

TIME CONSUMING

Conducting a comprehensive, data-driven decision analysis can take weeks or months for a team of experienced experts. This time constraint limits the decisions that can afford a detailed analysis.



C SUSCEPTIBLE TO HUMAN ERROR

D

LIMITED TO SME EXPERIENCE

Objectives and analysis are only as good as the SMEs you have access to at the time of the analysis, many of whom have competing priorities and split-focus.

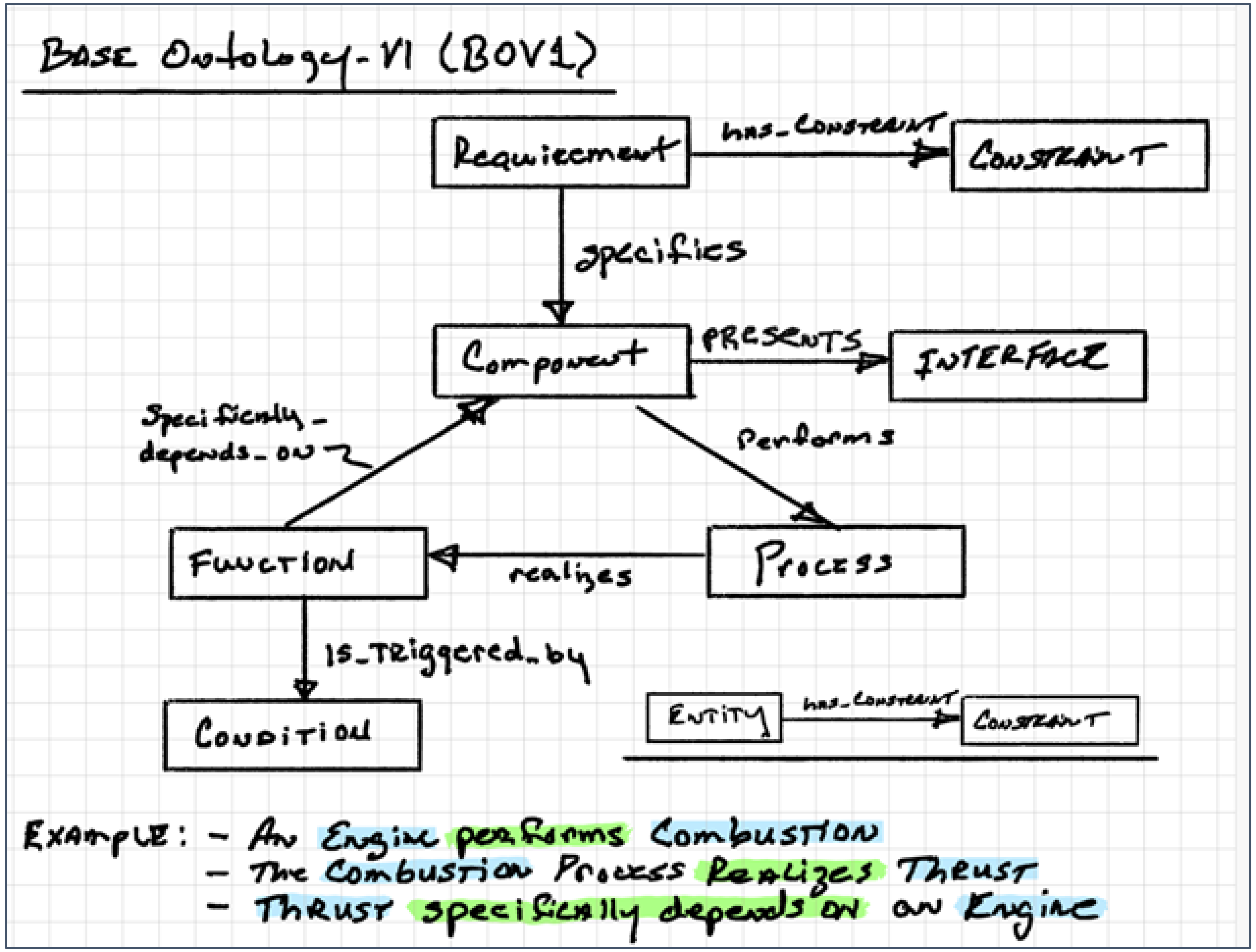
E REQUIRES MANUAL EXECUTION

Enabling AI-Augmented Decisions

- Lessons Learned from the development of DADM v1
  - AI can mitigate many of the challenges of decision management.
  - The SysML based process definition model was difficult to implement, it’s not easily instantiated and executed.
  - Business Process Modeling Notation (BPMN), an alternative standard, bridges this gap.
    - Easily integrates with AI agents using existing libraries.
    - More easily instantiated, executed, and integrated.

Provide Structure with Ontologies

- AI needs guidance to respond predictably
- Ontologies = Structure
- Enable interoperability
- Must be simple and instantiable



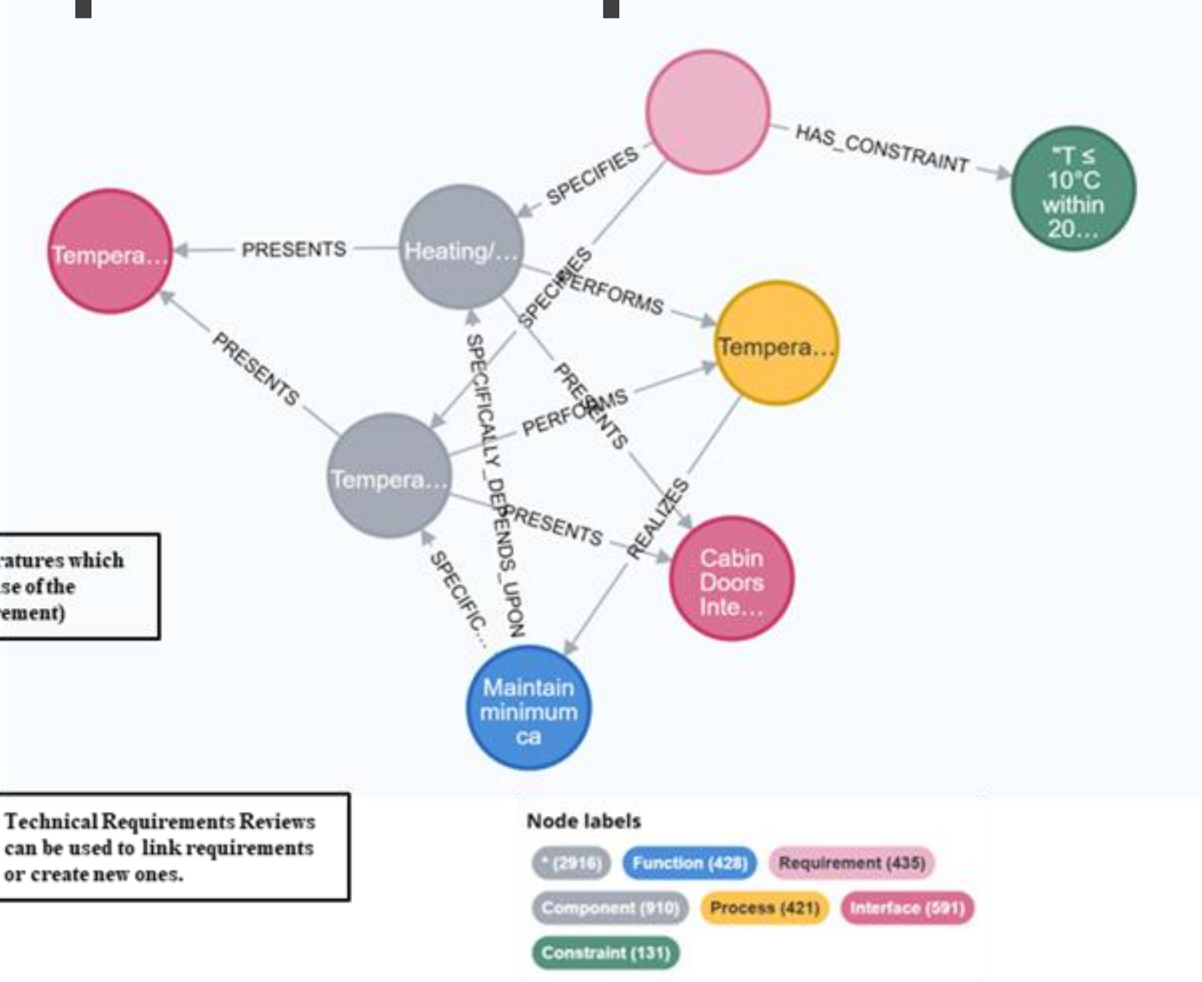
Example Conceptual System Ontology (B. Smith, Buffalo Univ.)

Using Ontology to Shape Concepts

requirement_id	ce7e236f-26aa-4532-b5bb-8b683b7eca2a
recommended_requirement	"Ensure the cabin temperature reaches the minimal acceptable temperature ([redacted] within [redacted] minutes) or [redacted]C within [redacted] minutes from start-up or closure of the cabin doors, whichever occurs last, considering ventilation and heating/cooling system performance."
requirement_type	Performance
function	Maintain minimum cabin temperature
process	Temperature control and monitoring
components	Heating/cooling system, Temperature sensors
interfaces	Cabin Doors Interface, Temperature Control Interface
constraints	"T[redacted]C within [redacted] minutes [T] or [redacted]C within [redacted] minutes [O]"
special_classification	None
security_classification	Unknown
requirement_pattern	Contains 'will'
technical_review	The requirement specifies clear time-based targets for maintaining a minimum cabin temperature, which is essential for occupant comfort and safety. Potential issues include the need for precise temperature control systems and adequate ventilation.
source	-{ 2 Items "file": "([redacted]).pdf" "page": 58 }
original_text	The cabin [redacted] temperature will reach the minimal acceptable temperature within [redacted] minutes [T] [redacted] minutes [O] from start [redacted] up or from closure of the cabin doors, whichever occurs last.

The model injects temperatures which are required to make sense of the requirement. (bad requirement)

Technical Requirements Reviews can be used to link requirements or create new ones.



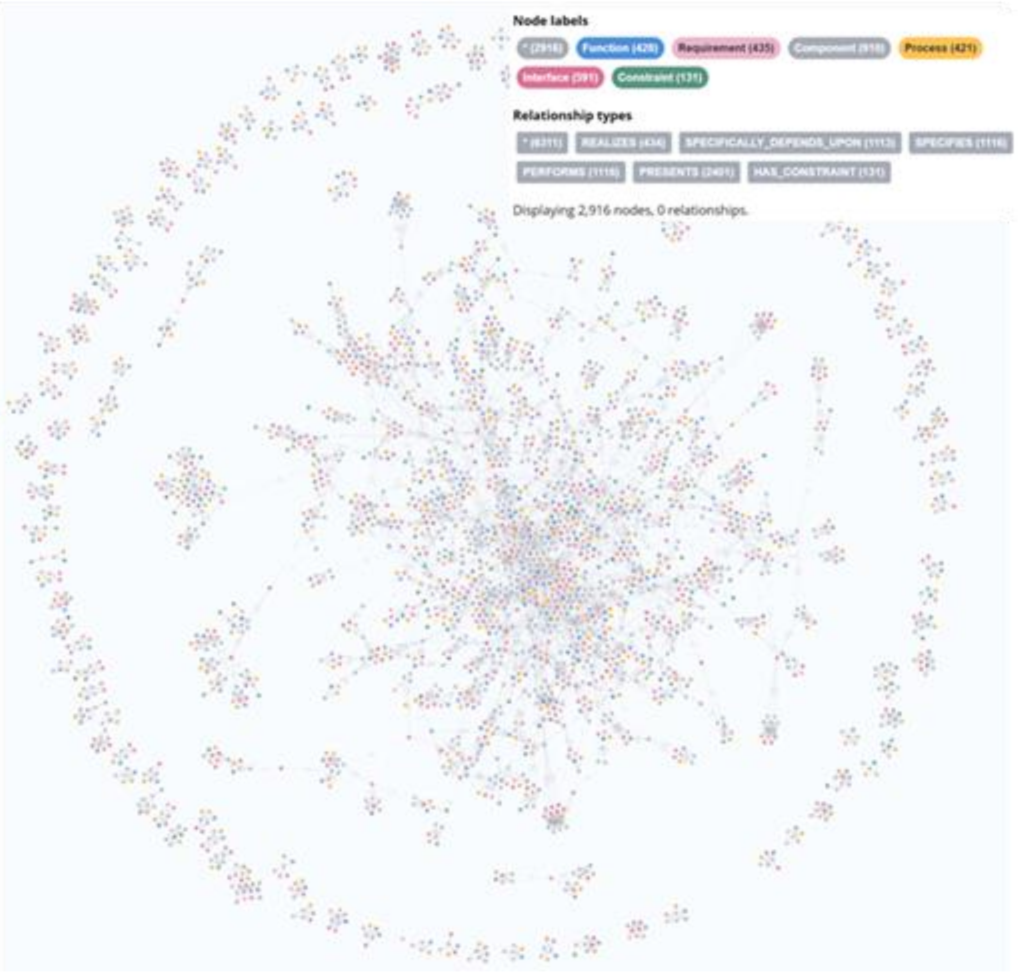
Graph All Concepts

Vector Store Extracted Requirements Example

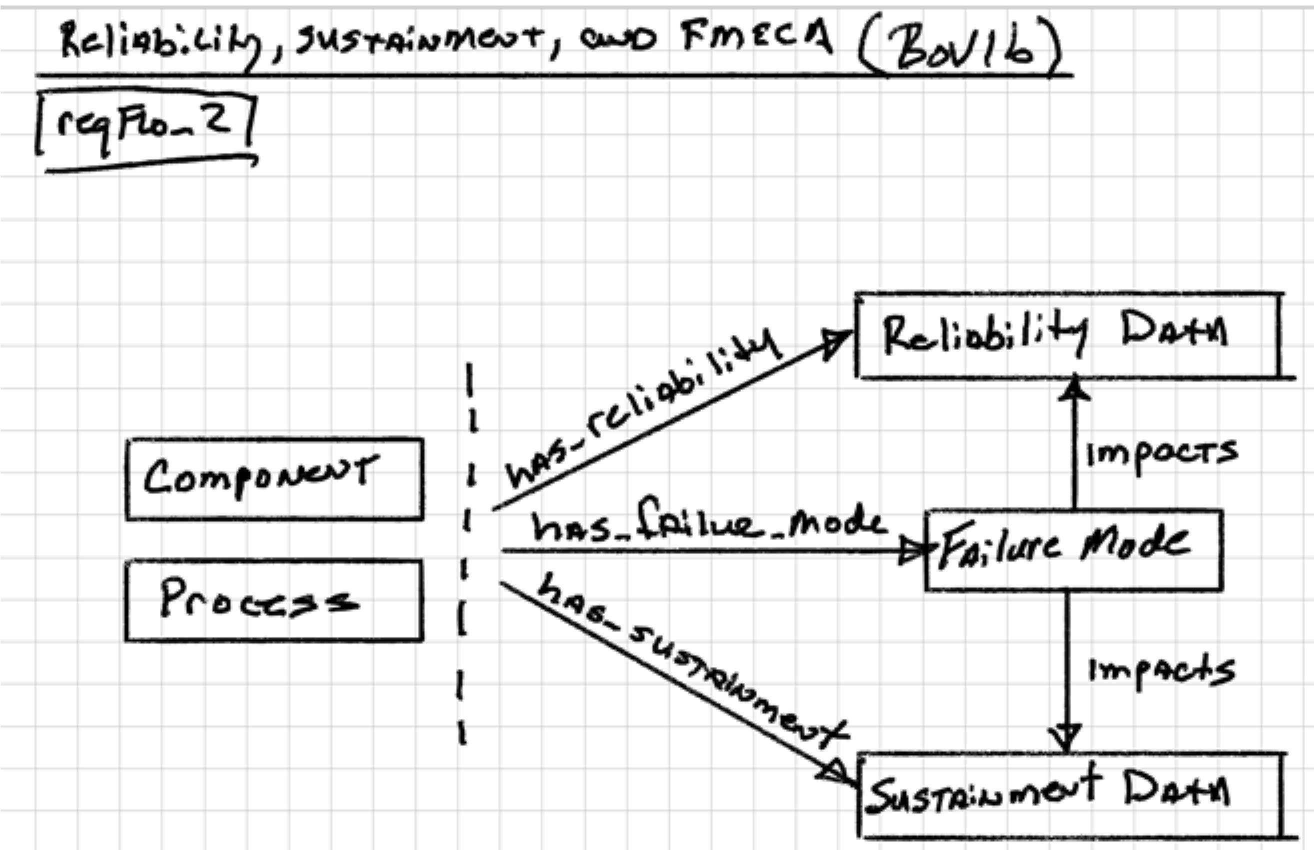
requirement_id	7d676feb-8753-4f78-8cc4-1016a97262a2
recommended_requirement	"Ensure that FLRAA can autonomously deploy and aerial refuel beyond [redacted] [0], including auxiliary fuel tanks, with at least two crew members onboard, and provide clear guidelines for crew training and safety procedures."
requirement_type	Design Constraints
function	Enable autonomous deployment and aerial refueling capabilities
process	Autonomous system operation, Refueling process
components	FLRAA system, Auxiliary Fuel Tanks
interfaces	Communication Interface, Navigation Interface
constraints	"Self-deployment of [redacted] [0]"
special_classification	KSA
security_classification	Unclassified
requirement_pattern	Contains 'will'
technical_review	The requirement highlights the need for autonomous deployment and aerial refueling capabilities, which is critical for mission success. However, potential issues arise from the lack of specific details on system requirements, crew training, and safety protocols.
source	{ 2 items "file": "[redacted].pdf" "page": 22 }
original_text	[redacted] Self -Deployment and Aerial Refuel – [redacted] With no less than two crewmembers, FLRAA will be capable of self -deployment of [redacted], [redacted] [0] including the use of auxiliary fuel tanks, without refuel.

Output

Requirements Knowledge Graph – 435 Requirements



Extending the Ontology



Example:

1. Reliability:

Fuel Injector: has_reliability: ReliabilityData
{MTBF: 1000 Hrs, Failure Rate: .001/hr}

2. Sustainment

Cooling System: has_sustainment: Sustainment Data
{maintenance Interval: 200 hrs, Repair Time: 2 hrs}

3. FEMCA:

Fuel Injector: has_failure_mode: Clogging
{effect: Combustion Failure, criticality: High}

Cooling System: has_failure_mode: Leakage
{effects: Overheating, criticality: medium}

4. Impacts:

Clogging: Impacts: Reliability Data
{MTBF: Reduced by 50%}

Leakage: Impacts: SustainmentData
{Maintenance Interval: Reduced to 100 hrs}

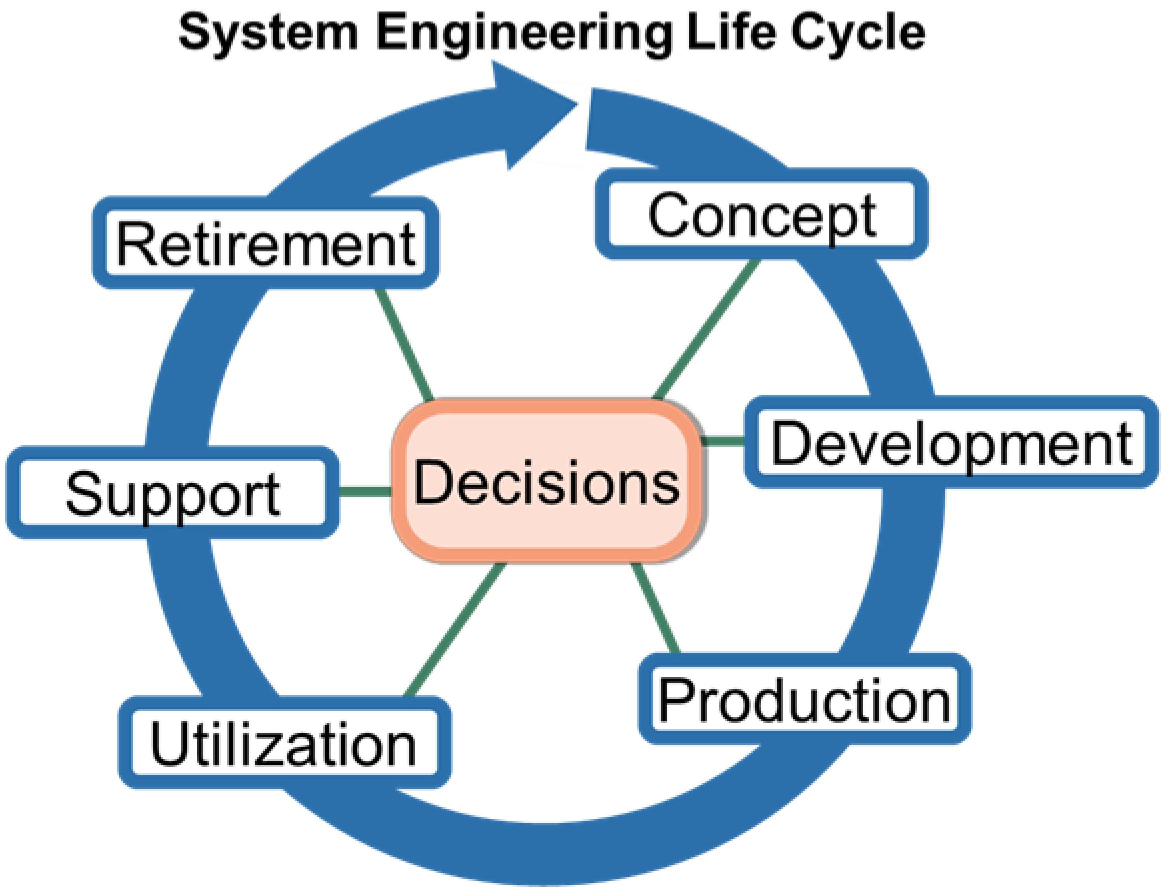
Don't over complicate it…

Bootstrap the Architecture

- Stuff the pipe
- Get 60-80% solution
- Refine with SMEs
- Repeat (probabilistic convergence)
- ***Control, Test, and Validate the Context***

Bringing it All Together

- Process of Processes
- Bootstrap entire lifecycle
- Execute Lifecycle
  - Project Progression
  - Project Adjustments
  - Complete Project



Real Decision Management

True decision management goes beyond a decision.

Necessitating Event(s)

Understanding and managing the events that trigger the need for a decision and the events a decision triggers.

Previous & Future Decisions

Managing the full decision hierarchy and the relationship between past, current, and future decisions.

Decision Database & Querying

Developing and managing a database of decisions to support standardization and enable consistent querying.

Decision Quality

Measuring and documenting decision outcomes to then assess the quality of past decisions.

Decision Improvement

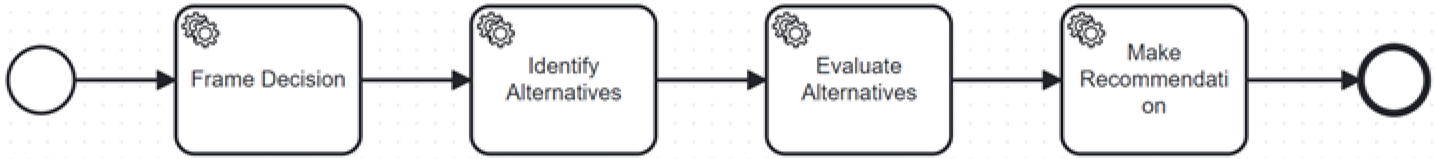
Performing analytics on past decision data to inform and improve future decisions.

Introducing EDS – The Future of Decision Execution

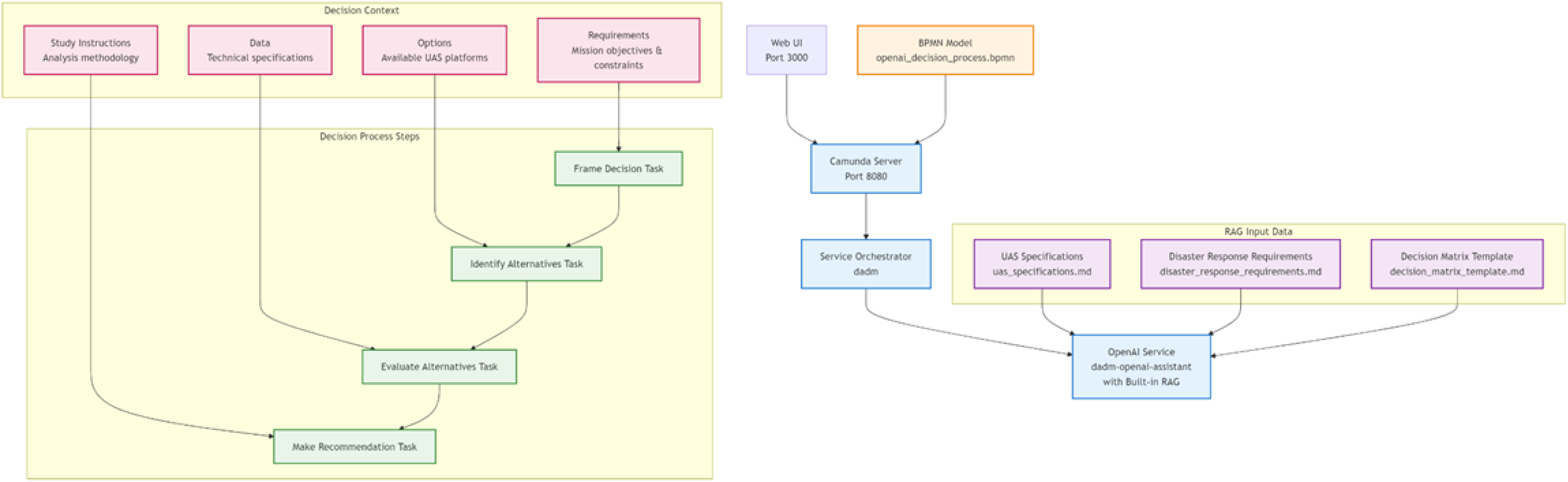
- From DADM to EDS: A Live, Event-Driven Decision Ecosystem
  - EDS builds on the foundation of DADM, moving from static documentation to a real-time, dynamic decision environment.
  - Every process in EDS is triggered by a real-world event, flows through a guided decision loop, and always results in a measurable, actionable outcome.
  - EDS enables rapid analysis, simulation, and decision support, so teams can act and adapt in real time.
  - The system is designed to replace static reports and one-time decision with continuous cycle of execution, feedback, and improvement.

Event In Decision Cycle Action/Event Out Learning & Feedback (repeat)

Demo



System Architecture for UAS Decision Process Demo



Why It Matters to INCOSE & DoD

- Decision Management is an emerging problem
- Decision-making today:
  - is more complex
  - carries greater consequences
  - less time to make them

Where We Go Next

- Engineering is just a series of decisions
- No longer solving just decision points
- Understanding decision space
- Decision-to-decision interactions and sensitivity

For More Information…

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Thank You

Questions?

35th Annual INCOSE international symposium

hybrid event

Ottawa, Canada
July 26 - 31, 2025