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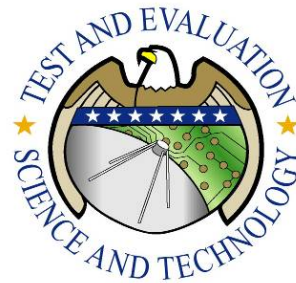
# A prescriptive and adaptive framework for UAS SoS Testing in LVC Environment

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# Outline

- PATFrame team
- PATFrame objectives & scope
- PATFrame stakeholders
- PATFrame tasks
- PATFrame features
- Next steps

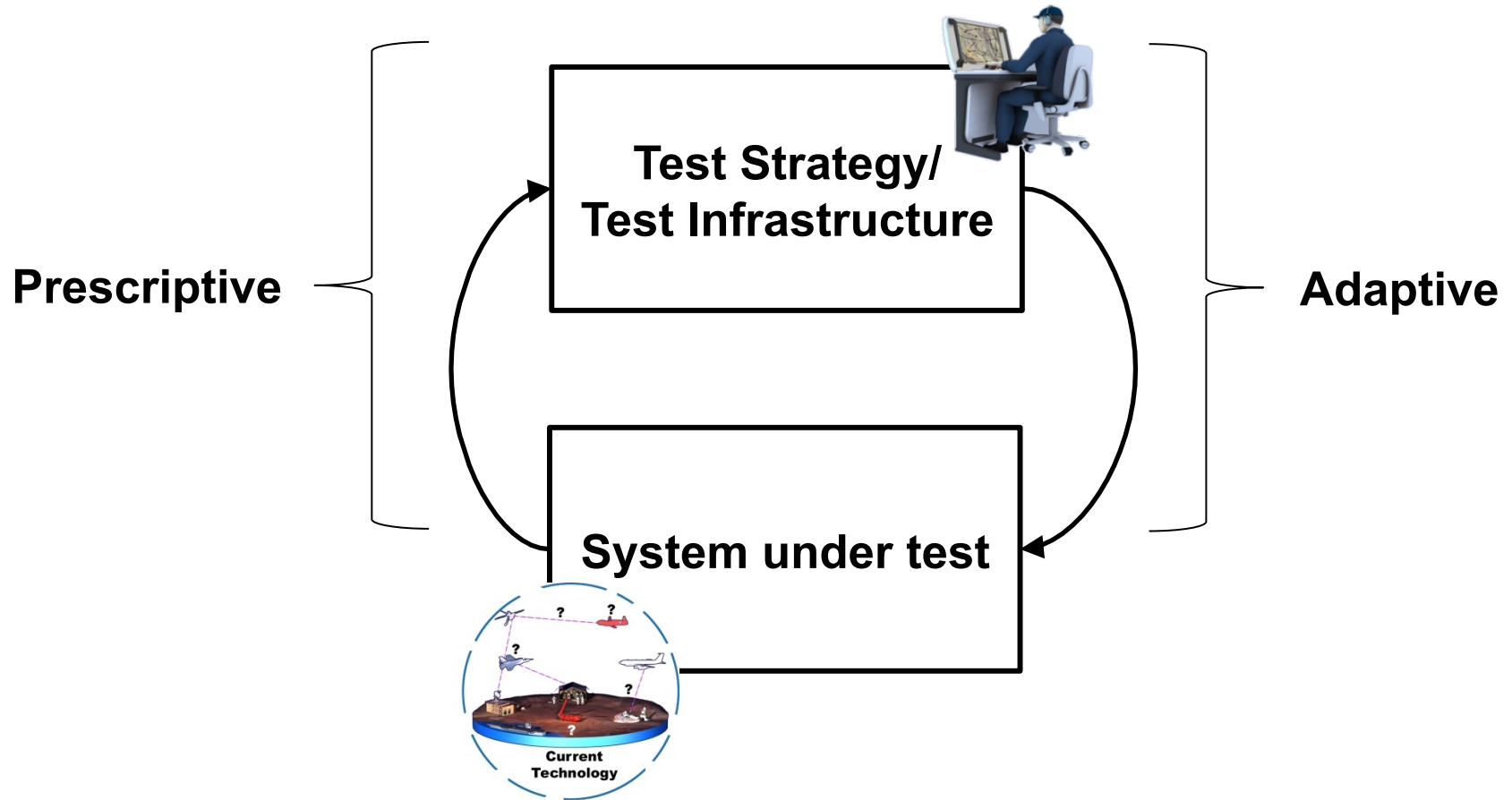
# Sponsors



# Transition Partners



# Prescriptive Adaptive Test Framework



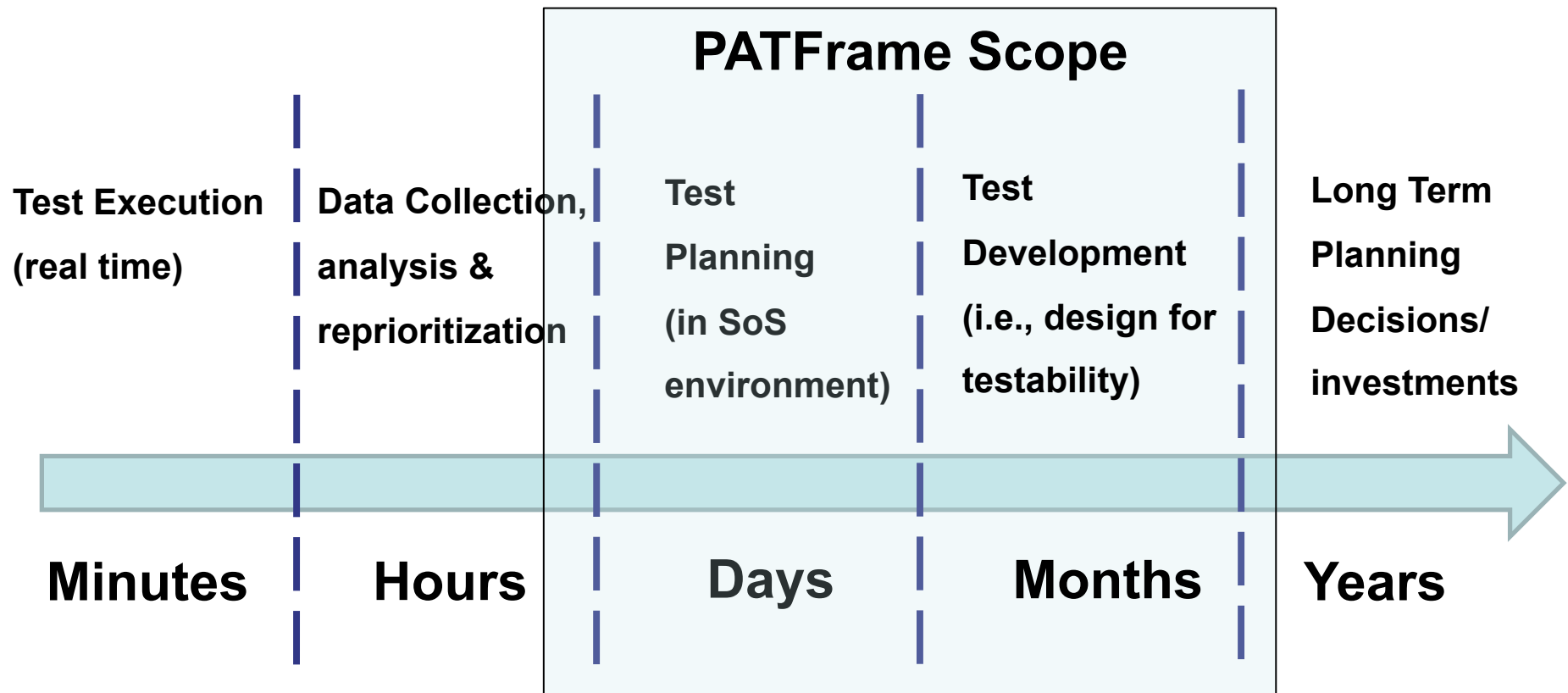
## PATFrame Objective

*To provide a decision support tool encompassing a prescriptive and adaptive framework for UAS SoS Testing*

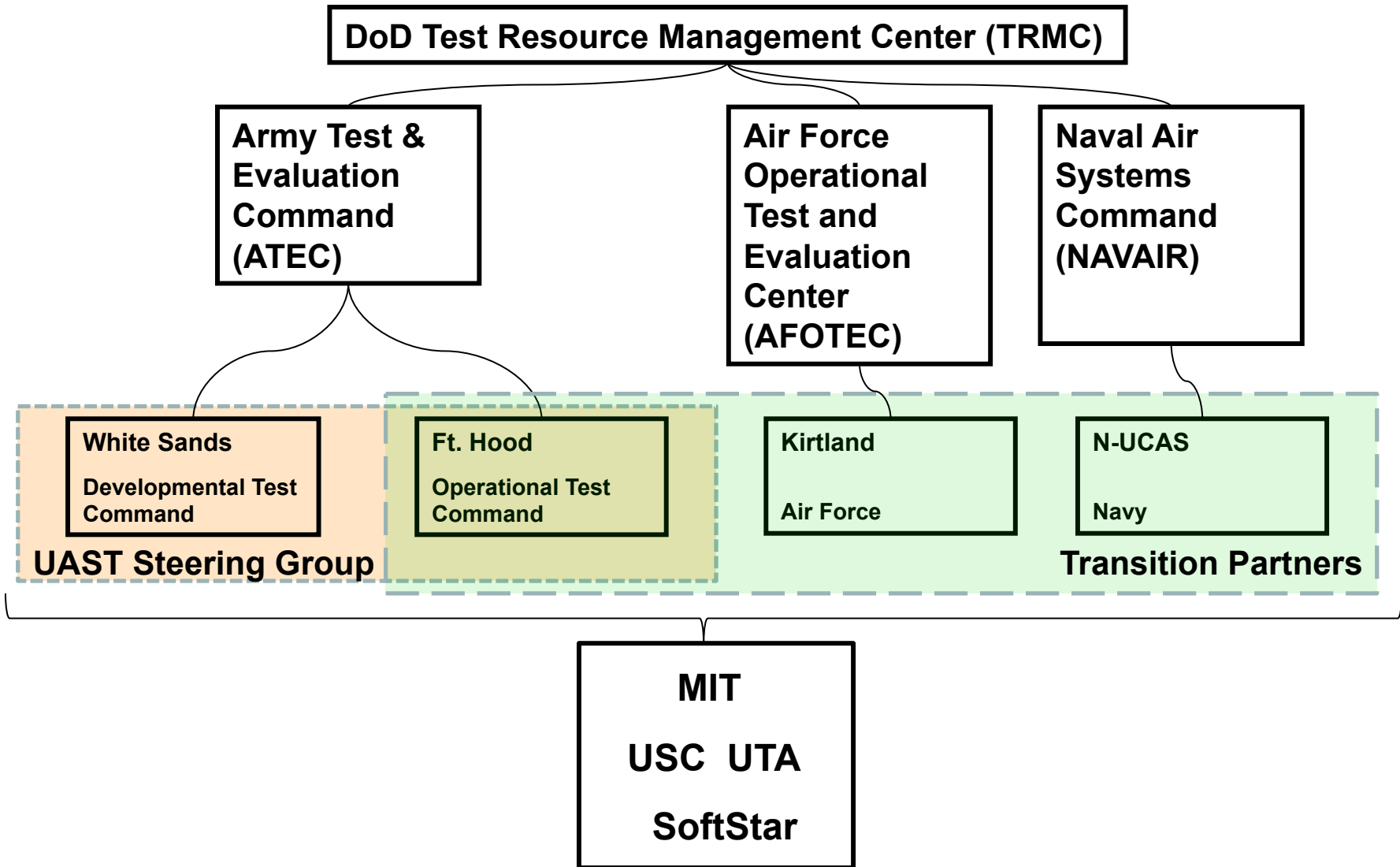
- PATFrame will be implemented using a software dashboard that will enable improved decision making for the UAS T&E community
- Focused on addressing BAA topics ***TTE-6 Prescribed System of Systems Environments*** and ***MA-6 Adaptive Architectural Frameworks***
- Three University team (MIT-USC-UTA) draws from experts in test & evaluation, decision theory, systems engineering, software architectures, robotics and modeling



# Time Scale for Testing Decisions



# PATFrame Stakeholders

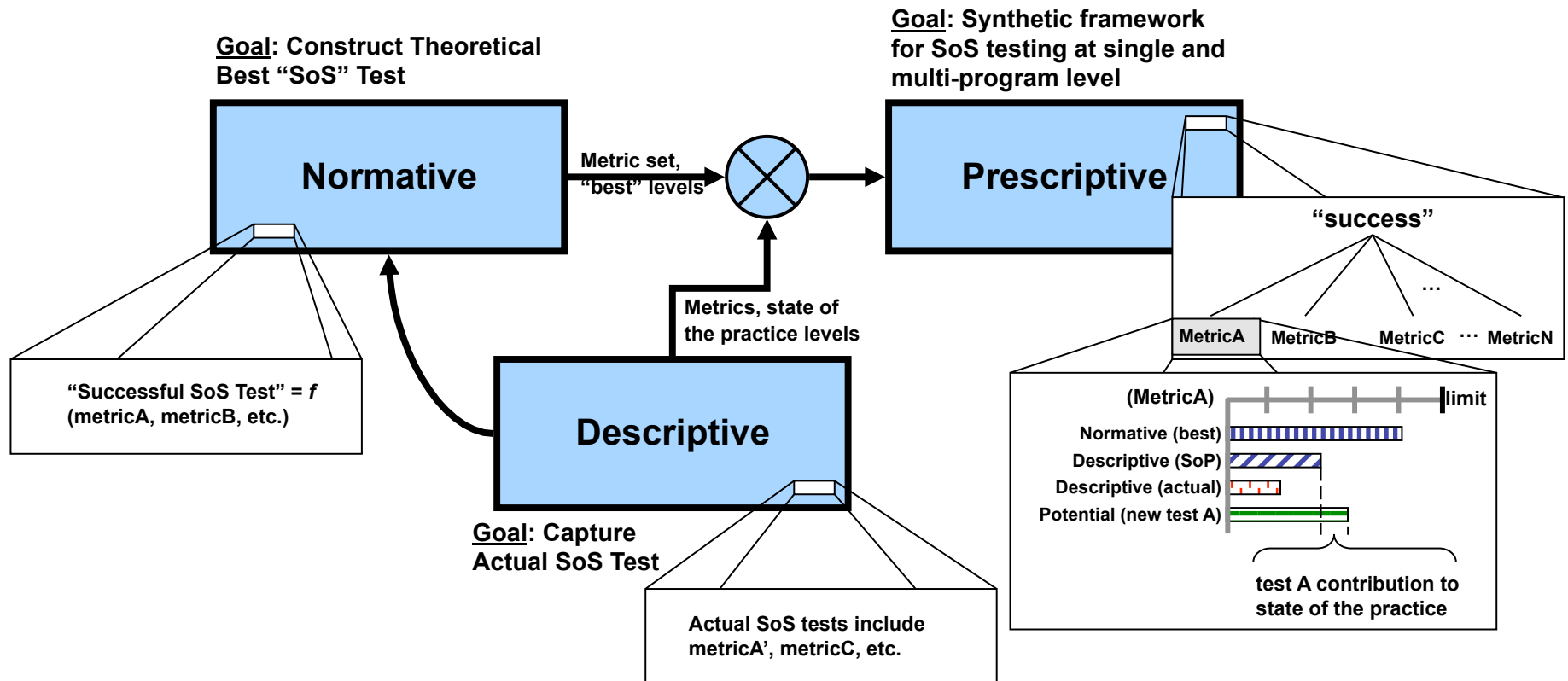


# PATFrame kickoff meeting Fort Hood, TX - Aug 2009

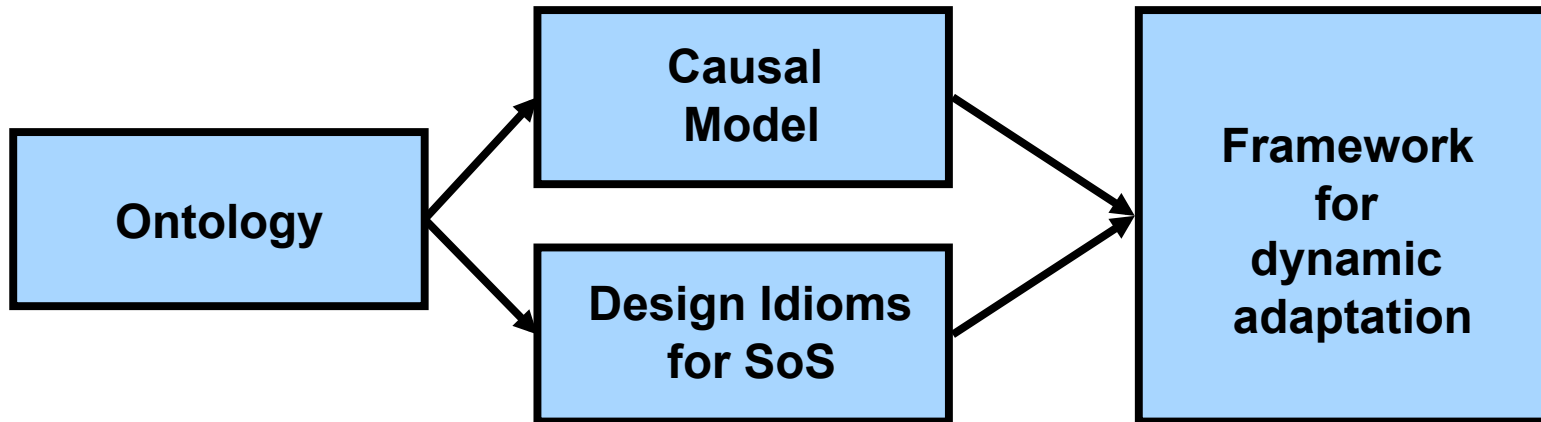




# Task 1: Prescribed System of Systems Environment



## Task 2: Adaptive Architectural Frameworks



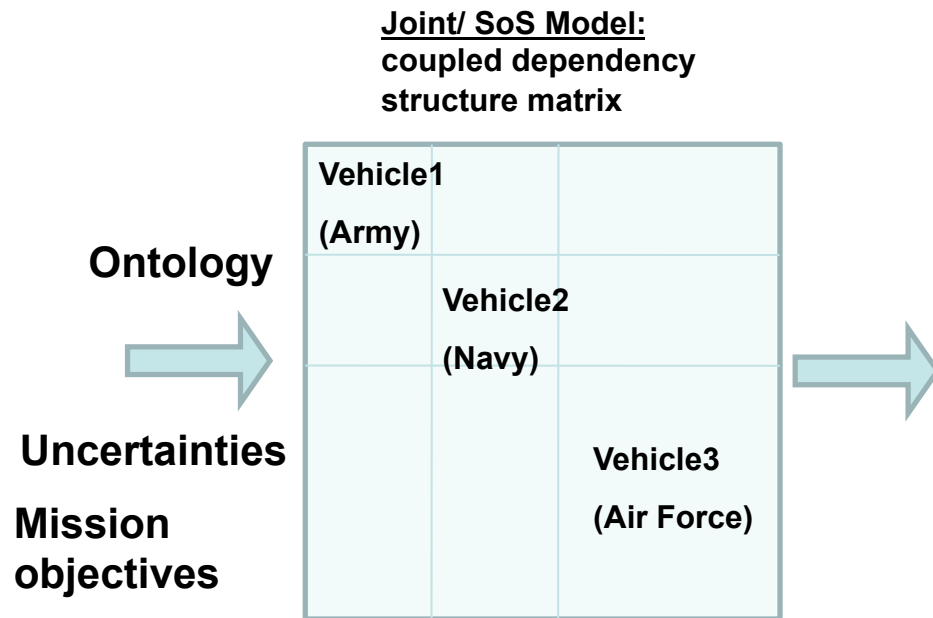
# Integrated Test Management

Features under development:

- System modeling (adaptive architectures, dependency matrices)
- Risk prediction (leading indicators, knowledge-based forecasting)
- Test planning (real options)
- Test resource estimation (parametric modeling)
- Test evaluation & adaptation (system dynamics)

# Real Options as Prescriptive and Adaptive Framework for SoS Testing

- Use case:
  - Question: what to test? (i.e. what SoS test scenarios to prescribe?)
  - Inputs: models of autonomous/net-centric system of systems, major uncertainties
  - Outputs: enablers and types of real options for responding to uncertainties as candidate test scenarios (i.e. identification of how SoS can adapt)

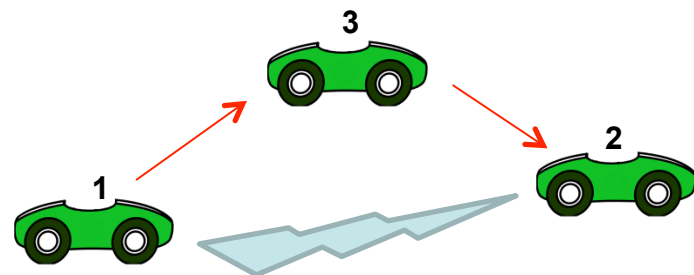


<http://lean.mit.edu>

## Identification of Real Options:

**Objective:** Maintain Vehicle1 ↔ Vehicle2 comm.  
**Uncertainty:** proximity of vehicles 1 and 2

1. Real option to adjust comm. range using flexible range comm. systems on vehicles 1, 2
2. Real option to use Vehicle3 as relay



# System of System Risk Based Testing

**Risk Identification**

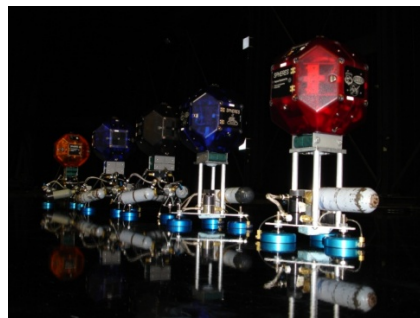
Long life expectancy  
 Multiple stakeholders  
 Multiple requirements

Number of interfaces  
 Complexity of system integration  
 Environment Operation

**Risk Mitigation**

Operation and Usability in Environment  
 Requirements Balance  
 Incremental Technology Maturation  
 Optimized Utilization

## Synchronized Position Hold Engage Reorient Experimental Satellites (SPHERES)



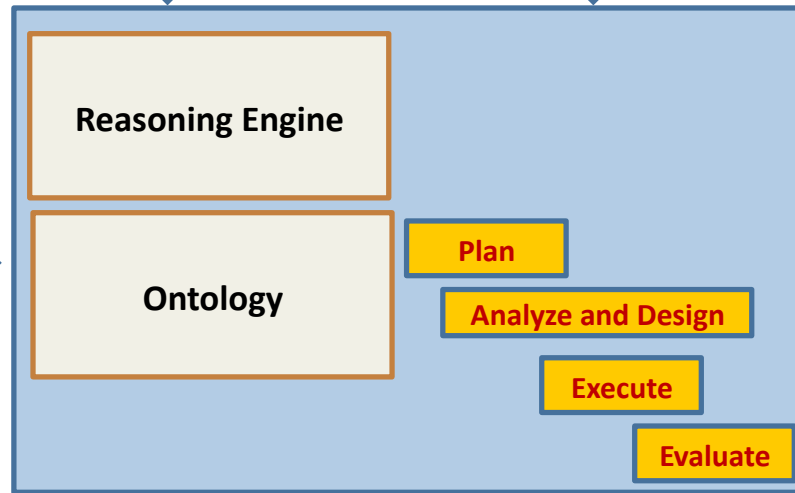


### Primary Inputs to PATFrame

- Models of the system under test
- Model of the SoS environment
- Mission needs/goals
- Test Requirements
- Available resources and time

Knowledge Base

Analysis Techniques



### Primary Outputs for Test and Evaluation

- How should my test strategy change?
- What realizable options are available?
- Which test do I run and in what order?
- When am I done Testing?

Risk & Uncertainty Analysis (leading indicators)

Process Analysis ( System Dynamics)

## Next Steps

- PATFrame workshop tomorrow (**10:30-4:30**)
- Evolve uses cases with transition partners
- Obtain feedback on PATFrame features
- PATFrame workshop **March 11** in Los Angeles (at USC)
- Continue alignment with Net-centric systems investment area