Georgia Tech Research Institute

Model-Based Roadmapping:
Time-Dependent Tradespace Analysis

Thursday, October 24th 2019

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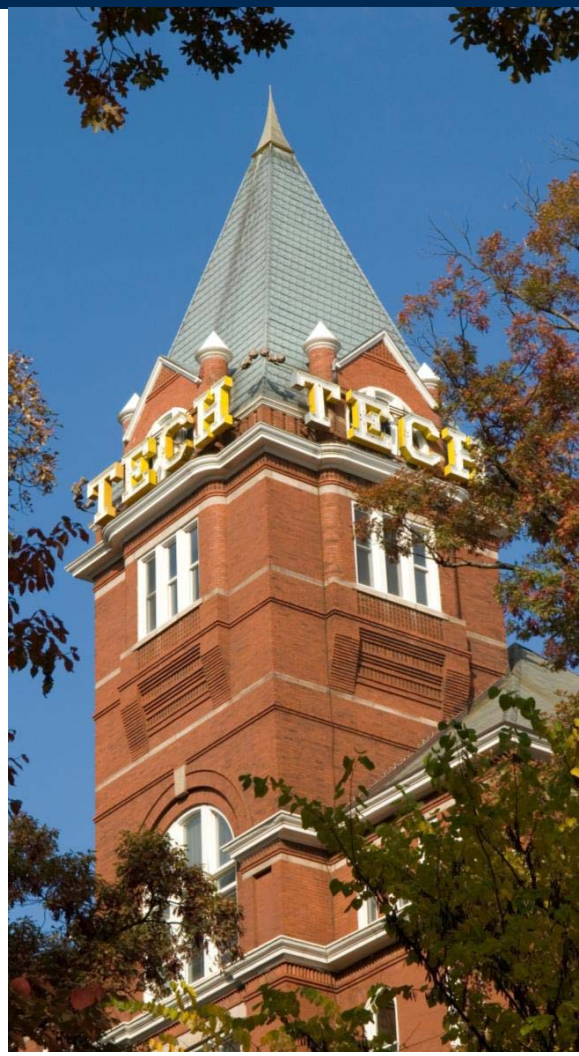
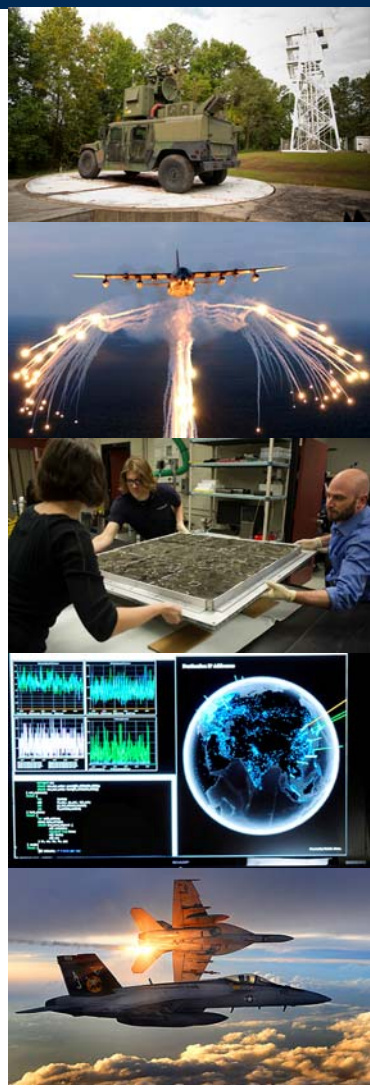
Georgia Tech Research Institute



Overview

- Goals of Today's Presentation
- Motivation
  - UPDATE: Highlights from Tuesday's Executive Panel
- Exemplar Roadmaps from Today/Recent History
- A Generalized Model-Based Approach
- Research Target

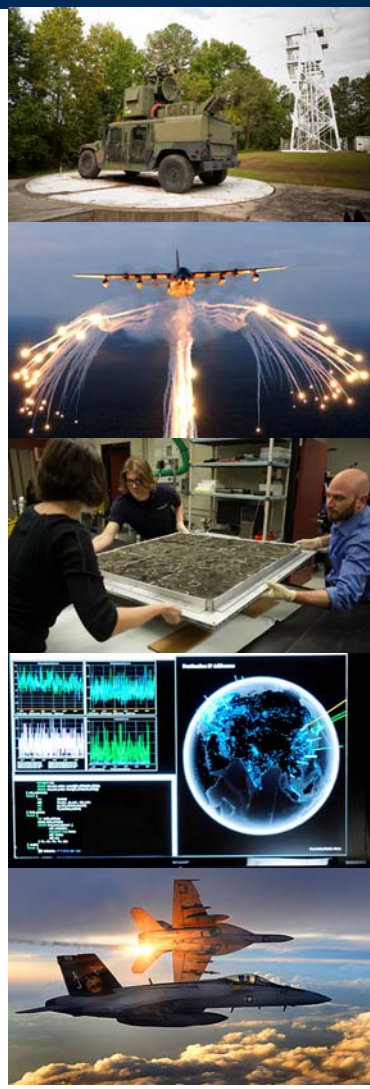


Goals for Today's Presentation

1. Review internal research motivated by common challenge identified across DoD sponsors

2. Cover efforts to date
   a. Considerations for the framework
   b. Conceptualization of approach
   c. Data modeling approach

3. Solicit feedback on approach to improve remaining research effort and end prototype



Motivation

- The responsibility to develop and maintain roadmaps/flight plans/passage plans is common across the DoD.
- Current roadmaps are document-based and therefore static
  - There is no dynamic roadmap management capability, supporting "what-if" analysis and generation of x* briefing material.
- Multiple research sponsors seeking support in road-mapping approaches with more analytical rigor

22nd S&ME NDIA Execute Panel Highlights

I hate roadmaps…because they become the objective…but I need them.
– Christi Gau Pagnanelli, Boeing Defense

[Government] needs to craft roadmaps with industry, but they still need to be owned by [us].
– Col Jonathan Luminati, USAF

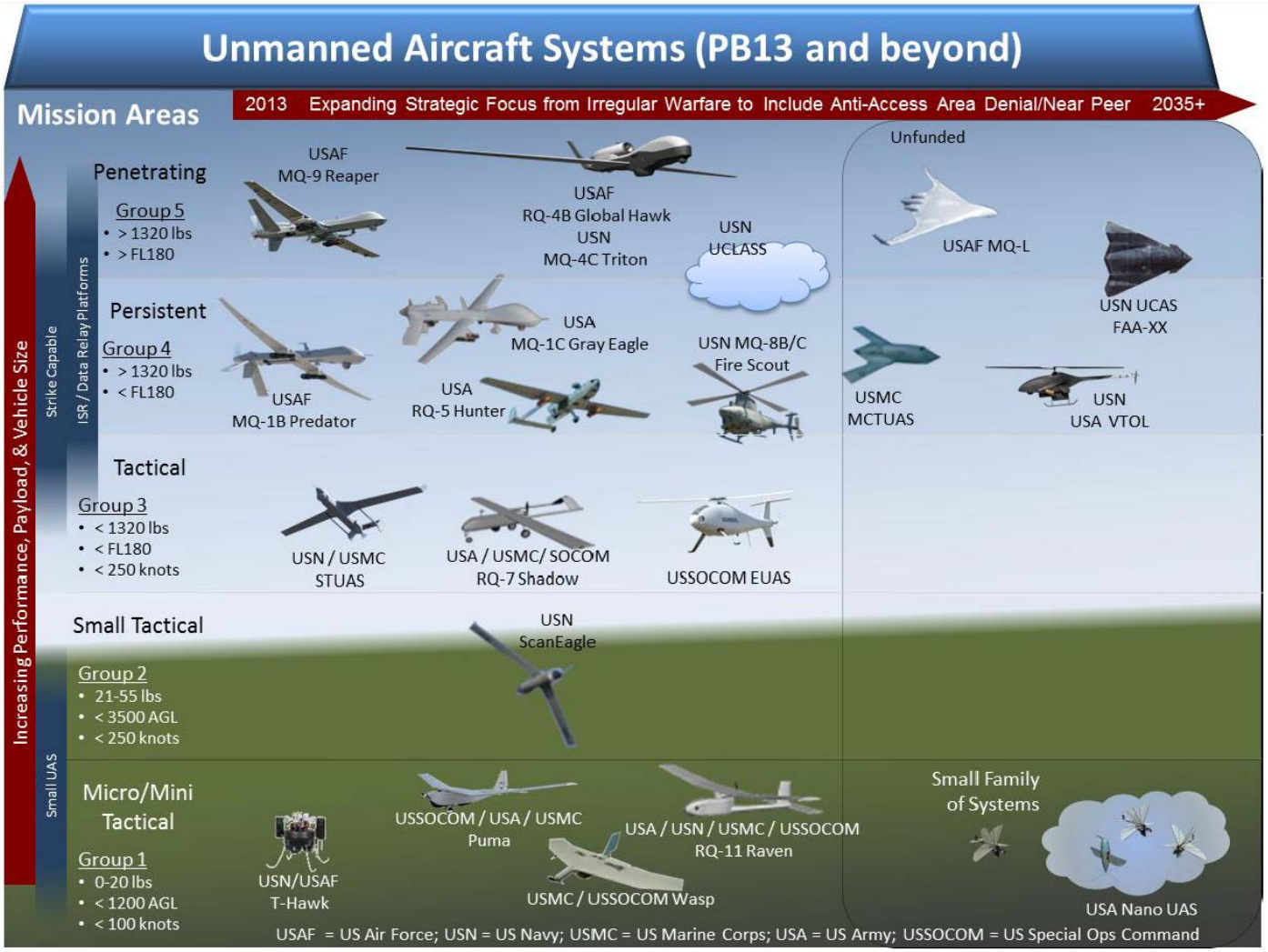
You have to be flexible.
– Guy Slominski, Raytheon Company

Come with intellectual humility…Build in margins.
– Col Jonathan Luminati, USAF

Celebrate failures…Did you learn what you needed to learn?
– Guy Slominski, Raytheon Company

Key to successful innovation is adaptability. As the environment changes, the roadmap changes.
– Christi Gau Pagnanelli, Boeing Defense

Current Approaches



Current Approaches

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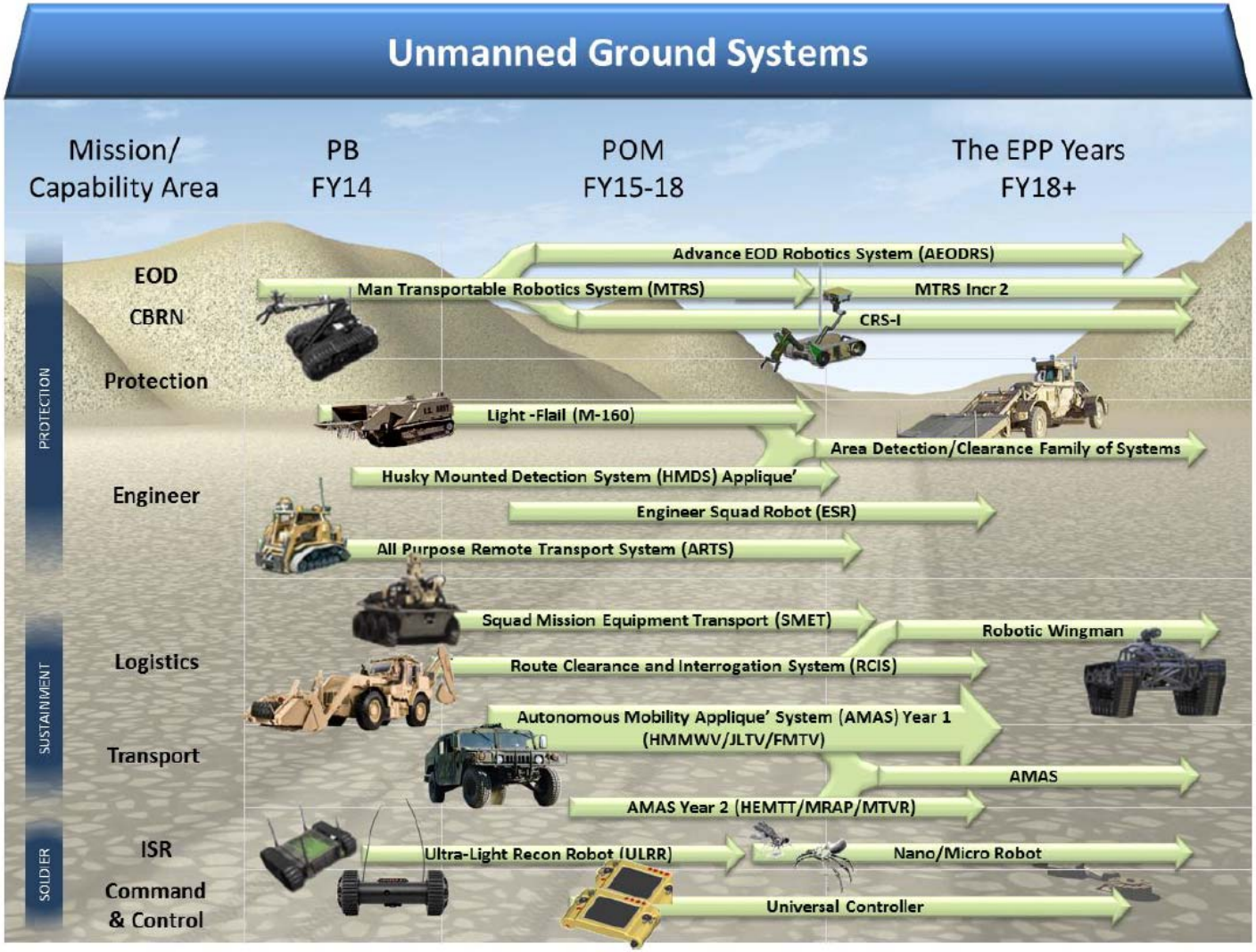
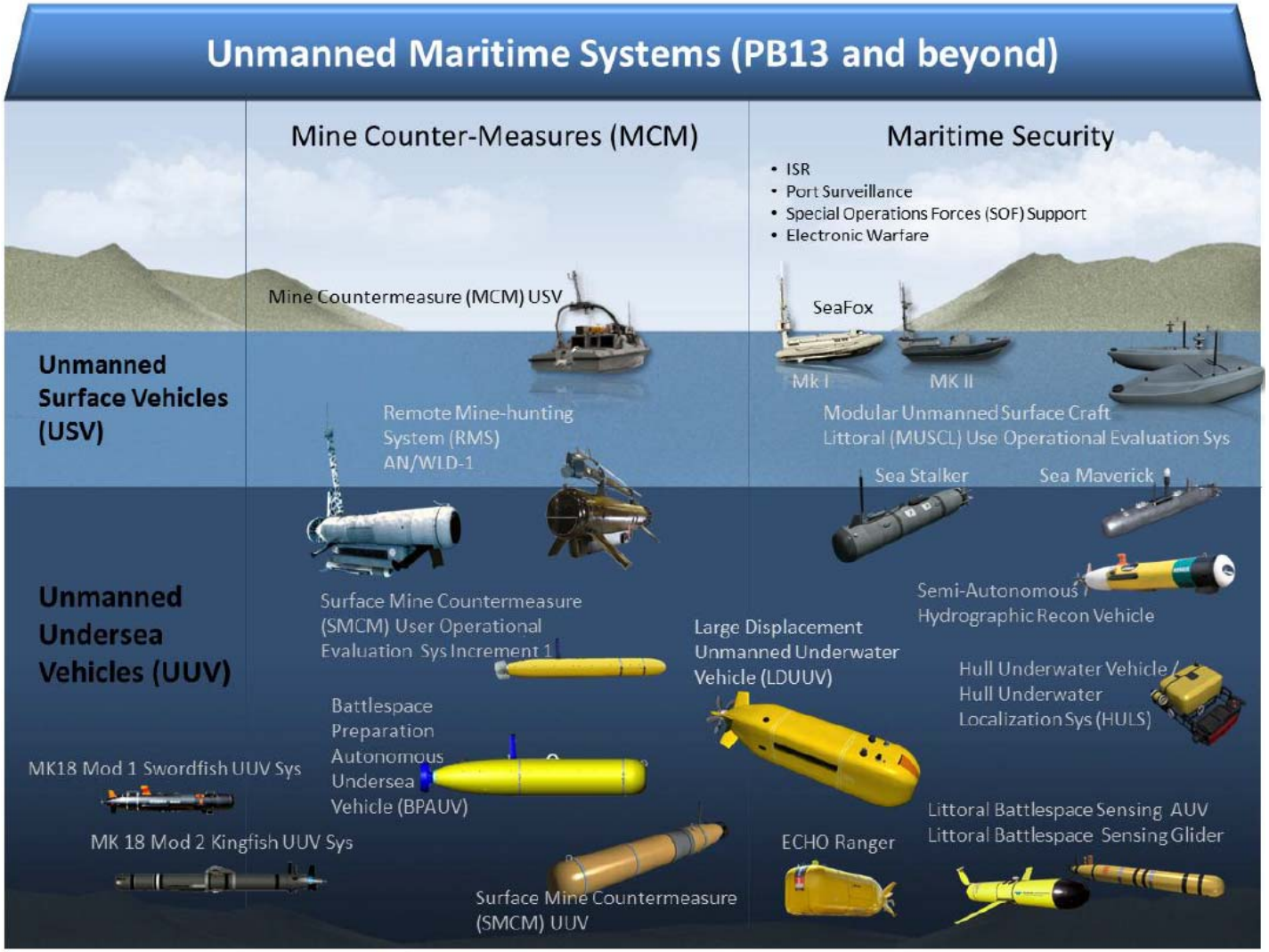
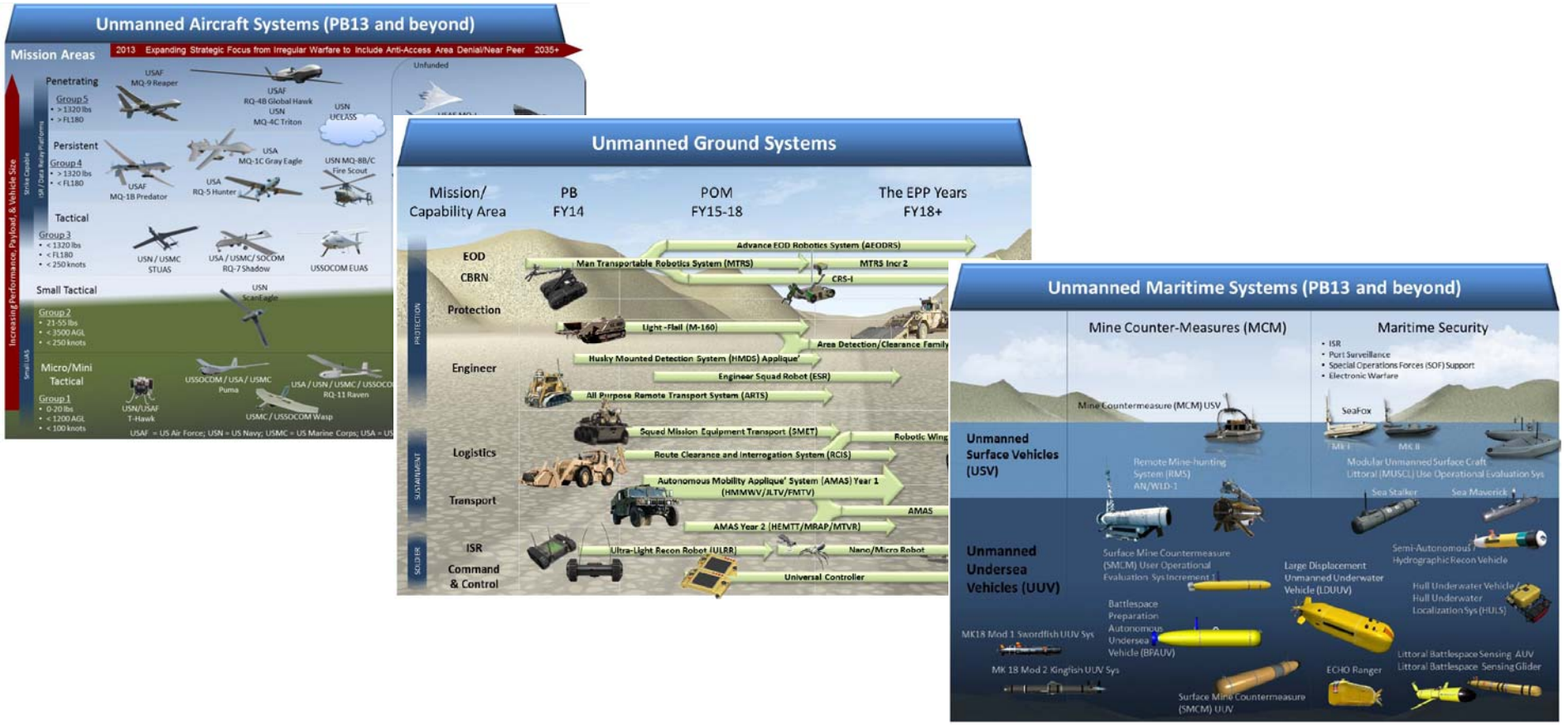


Current Approaches



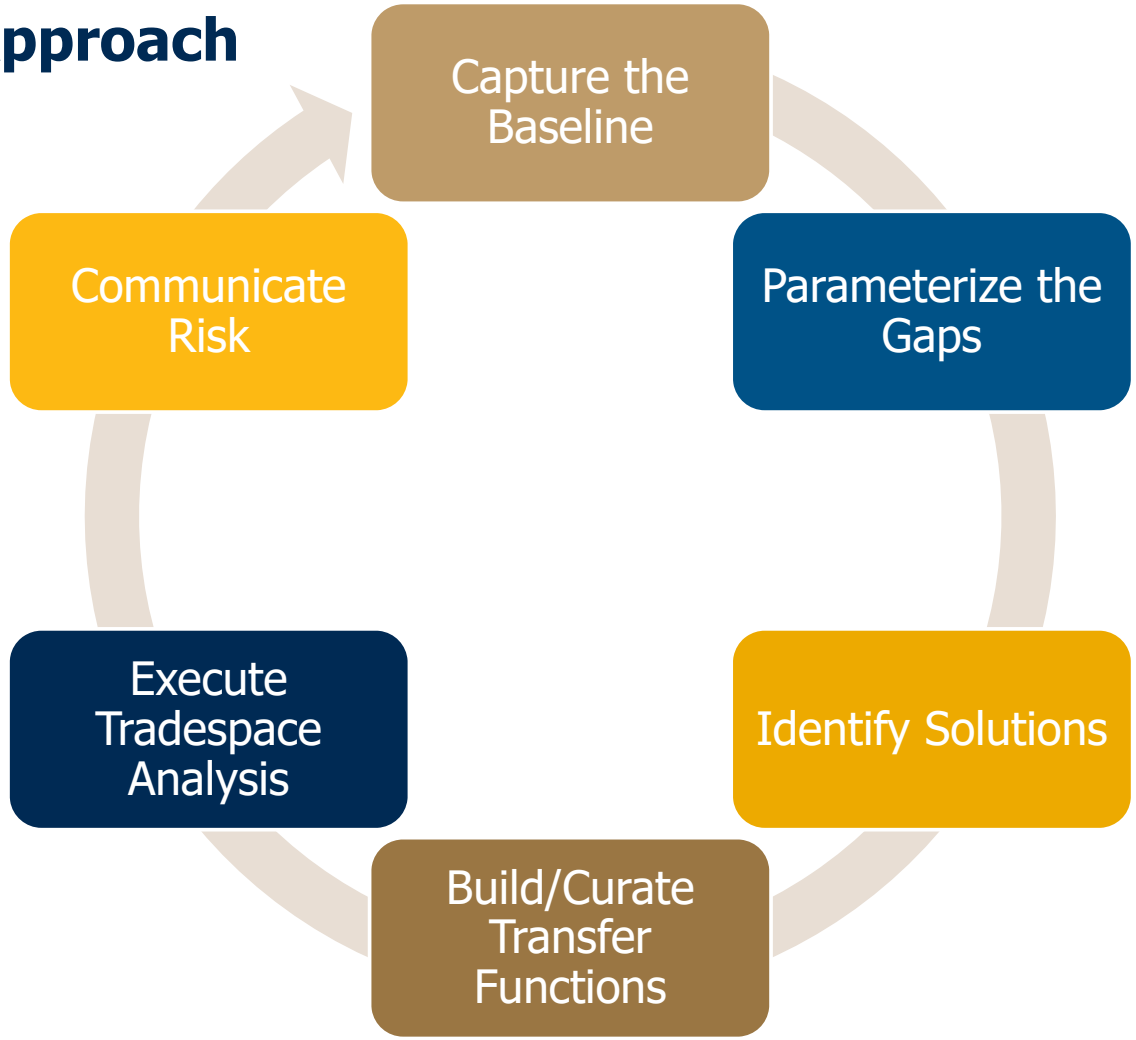
Considerations for the Framework – What are these missing?



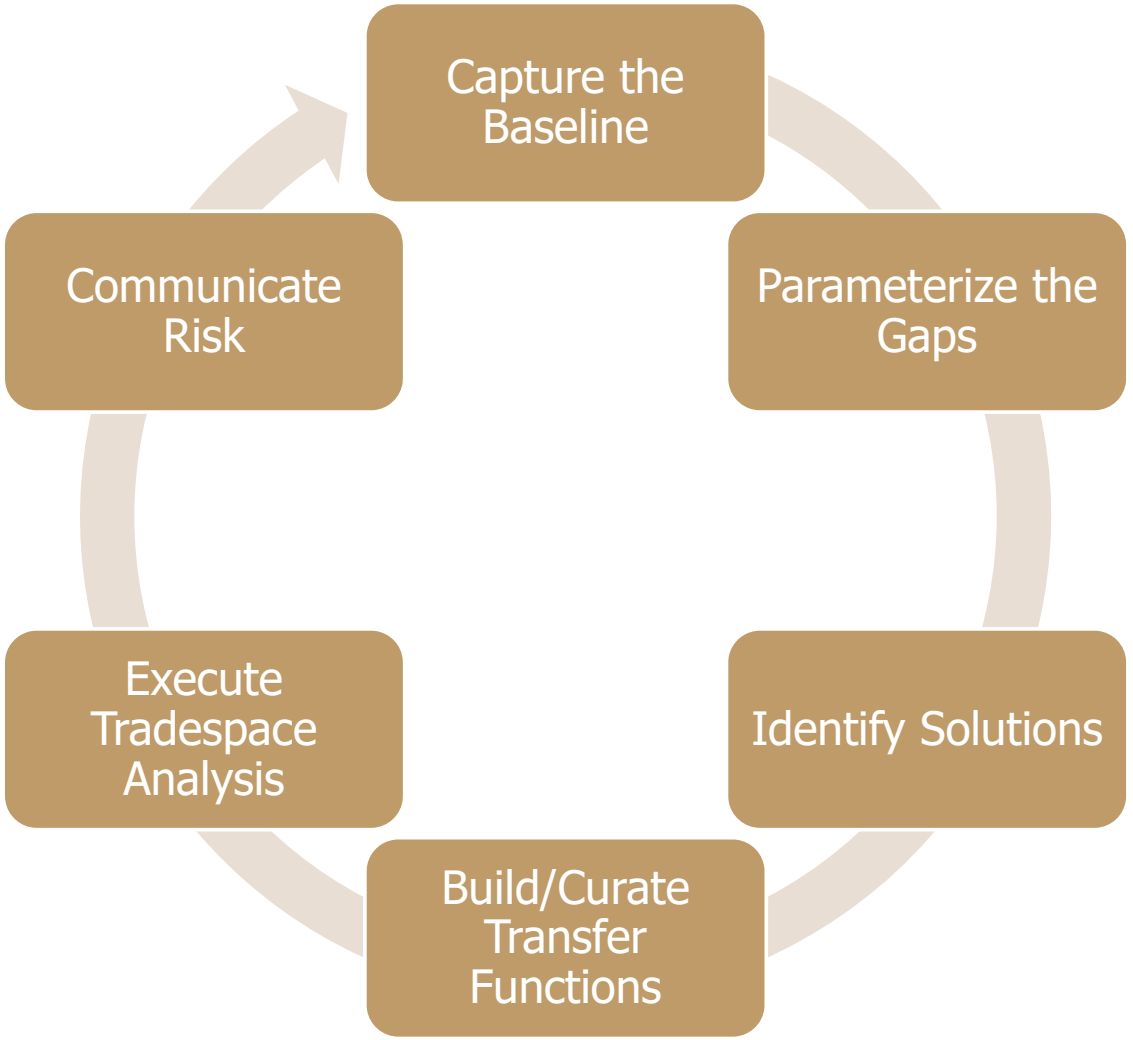
Considerations for the Framework

- Discretization of time needs to be configurable
  - i.e. Individual years vs. Near/Mid/Far timeframes
- Enable inclusion of hypothetical future solutions to assess potential value
- Generally, threat-focused. Roadmap in the sense of exposing capability gaps overtime and assessing impact of bringing online future capability
- Purely proficiency-based, or also assess sufficiency? Open question.
- Need to be sufficiently opinionated for framework to be useful and performant
  - Avoid paralysis by flexibility.

Generalized Approach

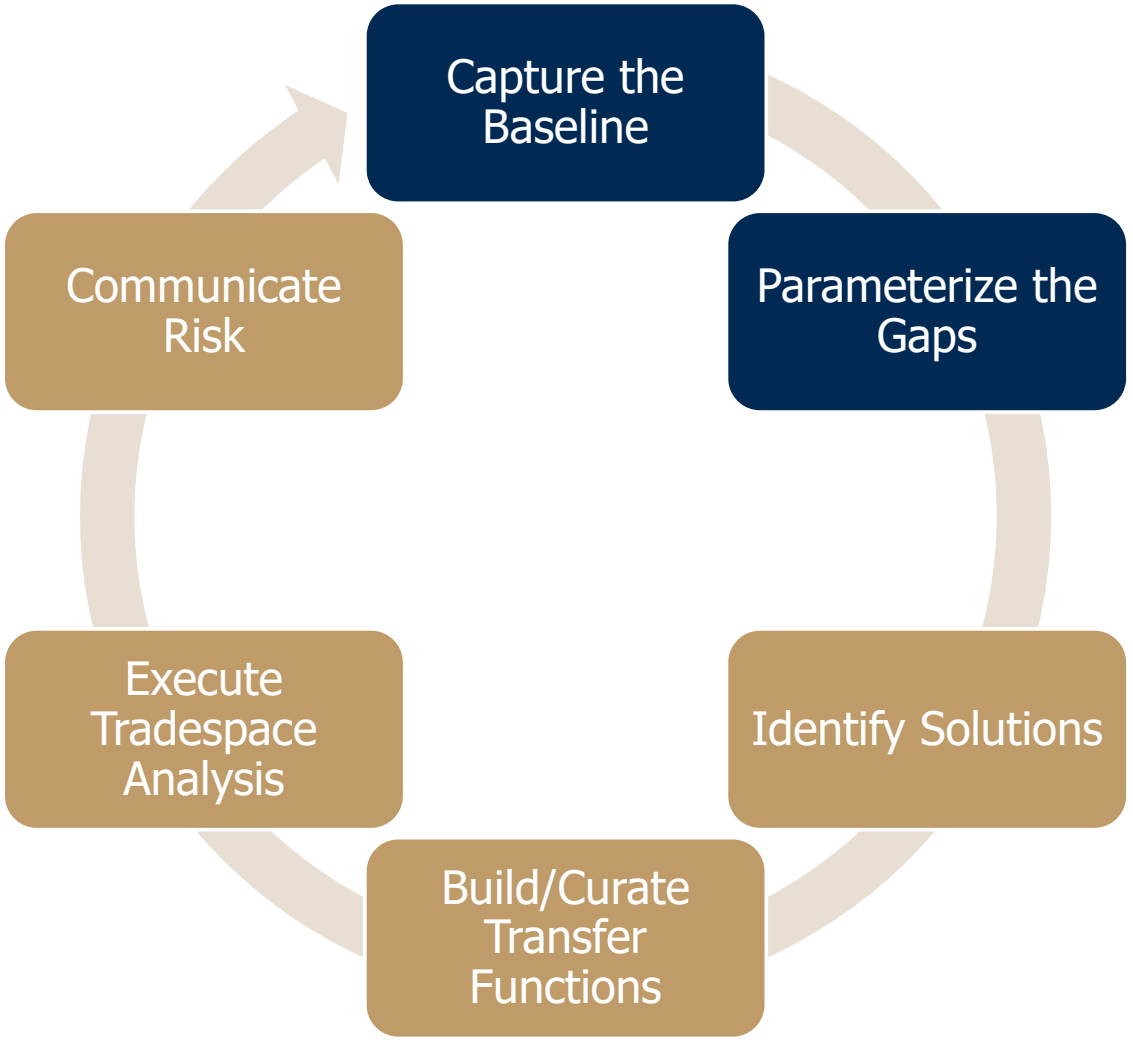


Generalized Approach

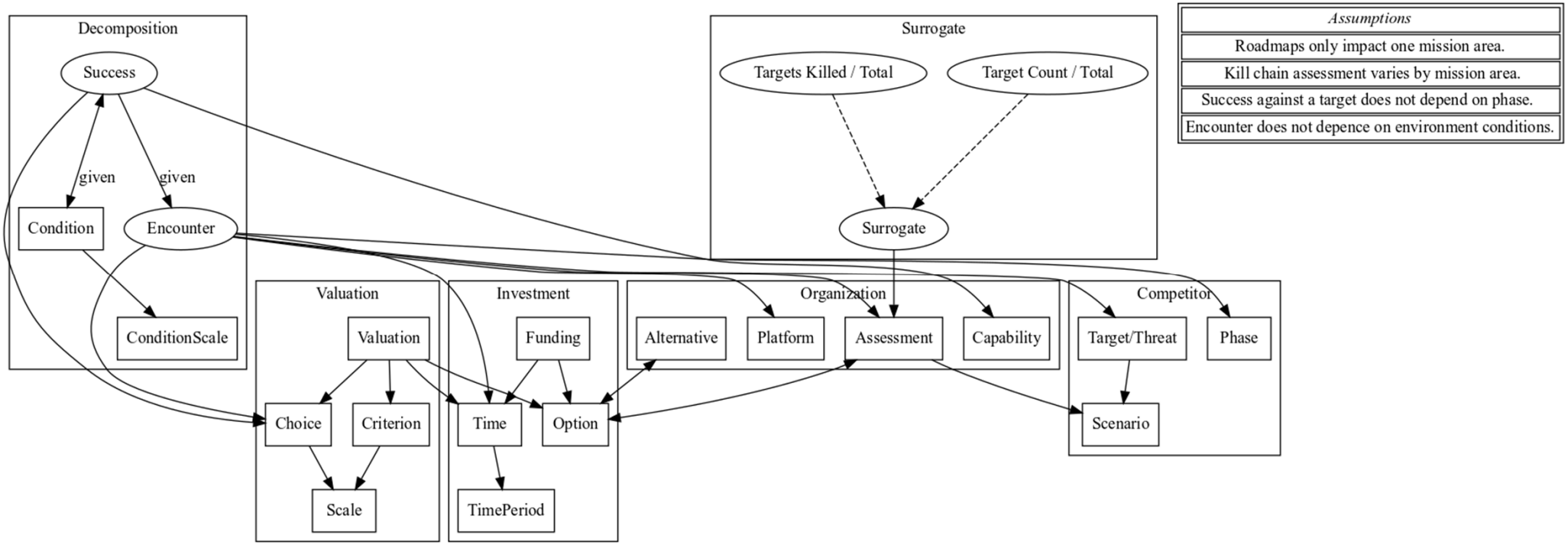


Generalized Approach

- Mission-centric and threat-focused
- Decompose mission into specific functions
  - e.g. Kill-Chain Decomposition: **F**2**T**2**E**A
- Baseline capability is measured *against* adversary(ies) and environment
  - i.e. not absolute, but relative
  - e.g. think threat platform portfolio or target sets

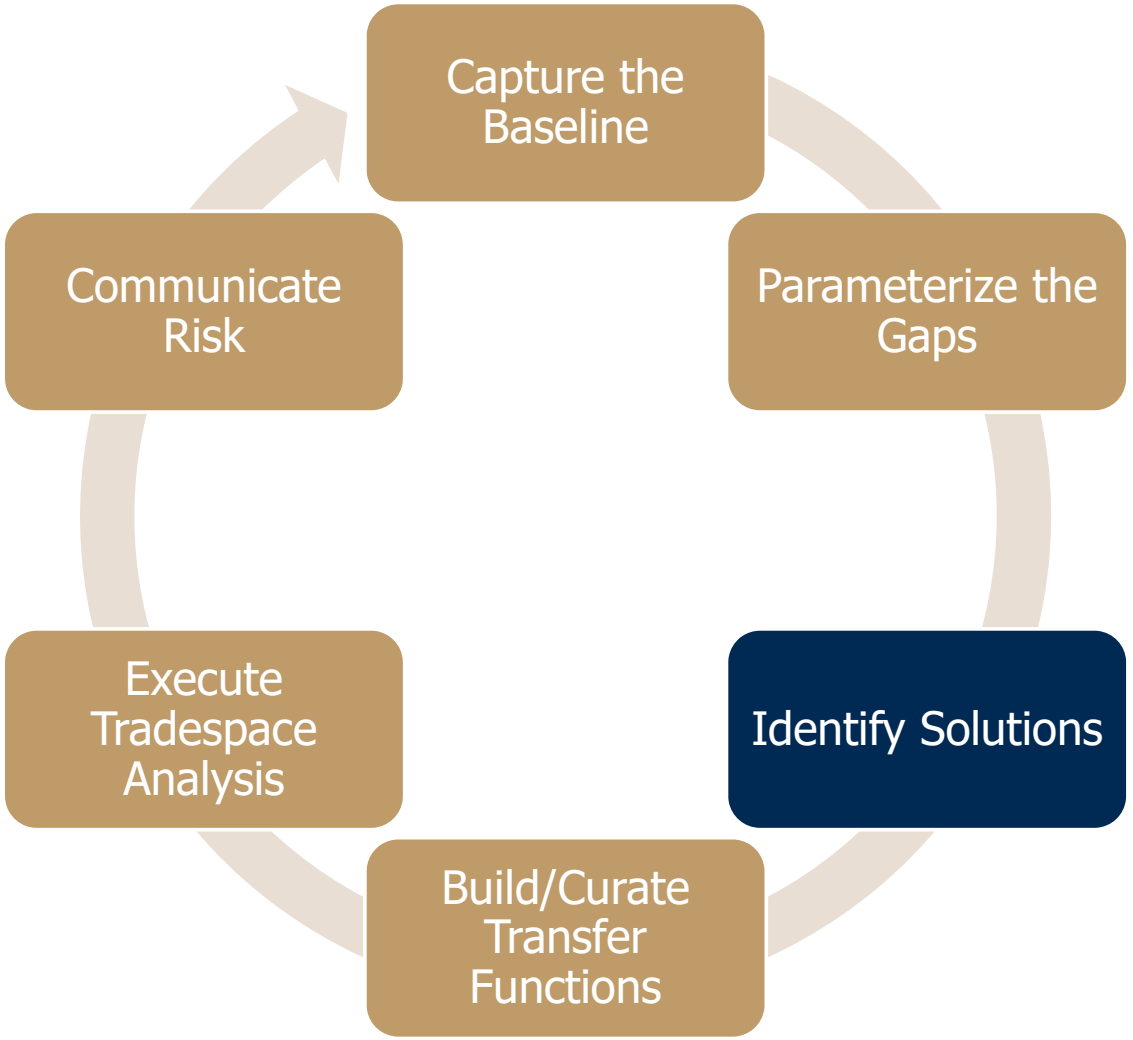


In Progress Data Model



Generalized Approach

- Capture the current plan
  - What existing planned programs address a (the) gap(s)?
- Completed parameterization allows for "what-if" solutions to enter tradespace in addition to future programs
- Time-based increases complexity
  - Dependencies between options and future branches of solutions
  - Threat gets a vote

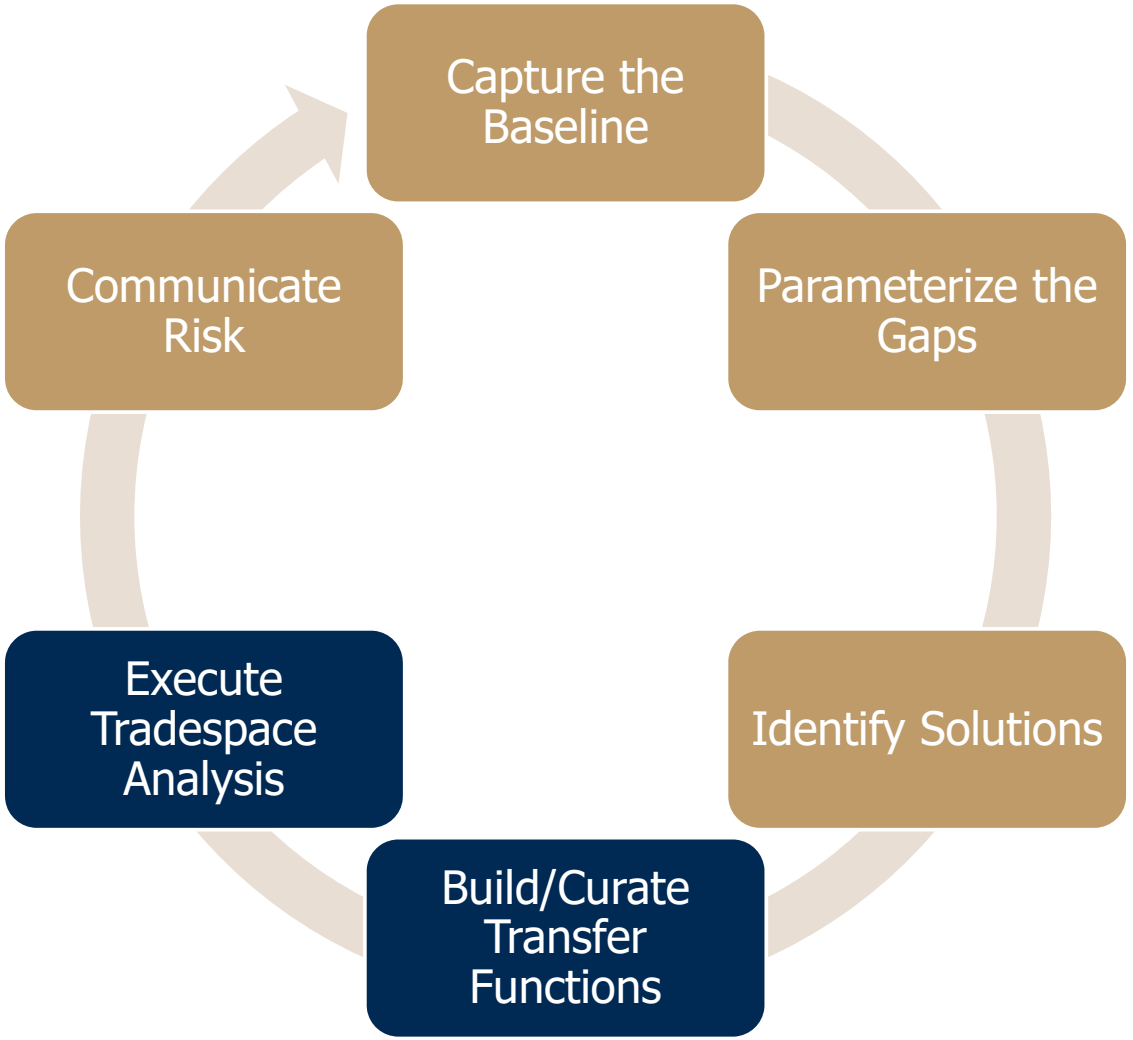


Generalized Approach

- At the simplest level, need to capture the delta impact to a functional-capability based on if ***and when*** an identified solution is included in the roadmap

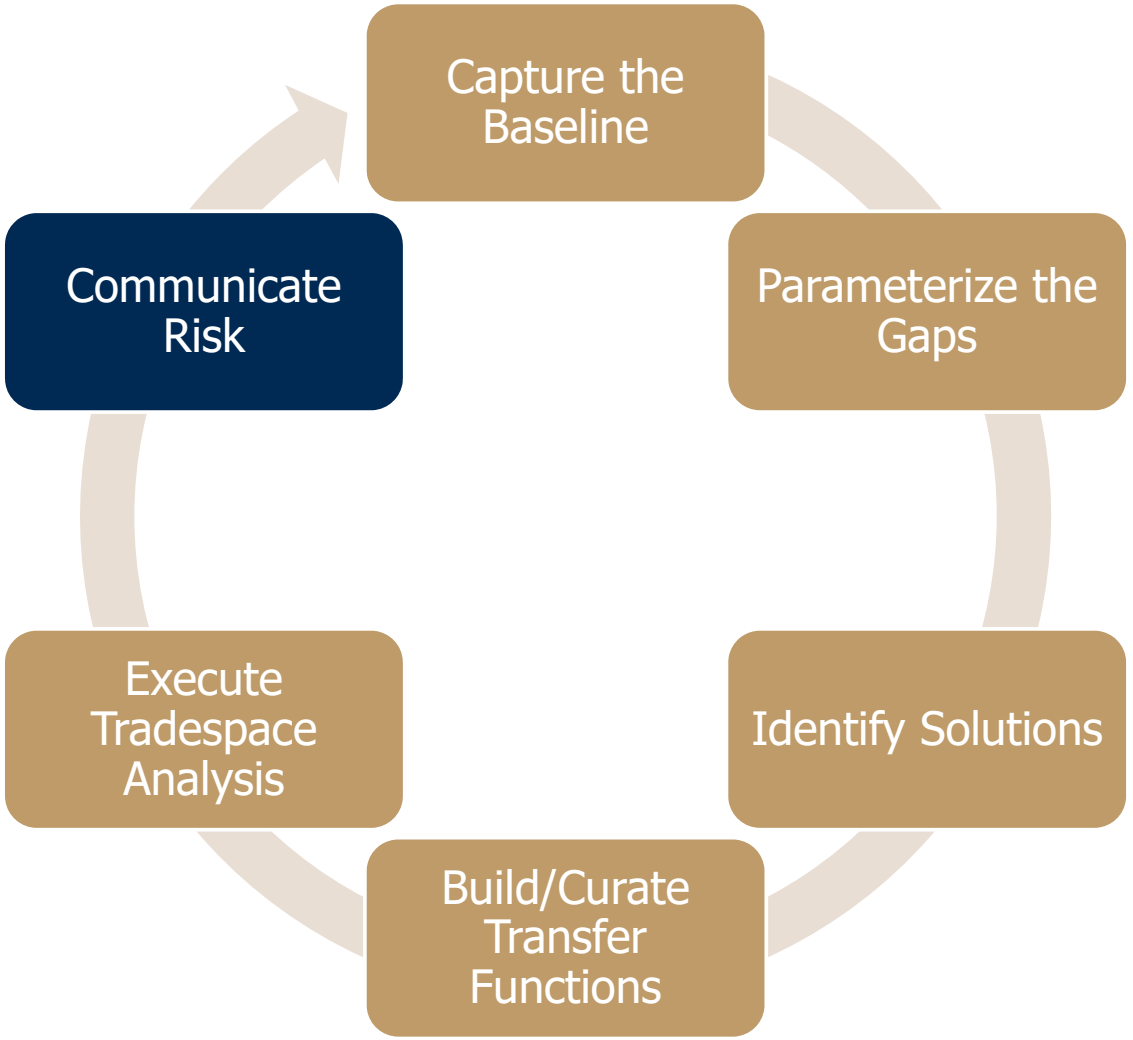
- Level of fidelity can vary greatly
  - Look-up table
  - Gap closure percentage
  - Algebraic expression
  - Bayesian Network
  - Physics-based model

- Transfer functions must be computable!

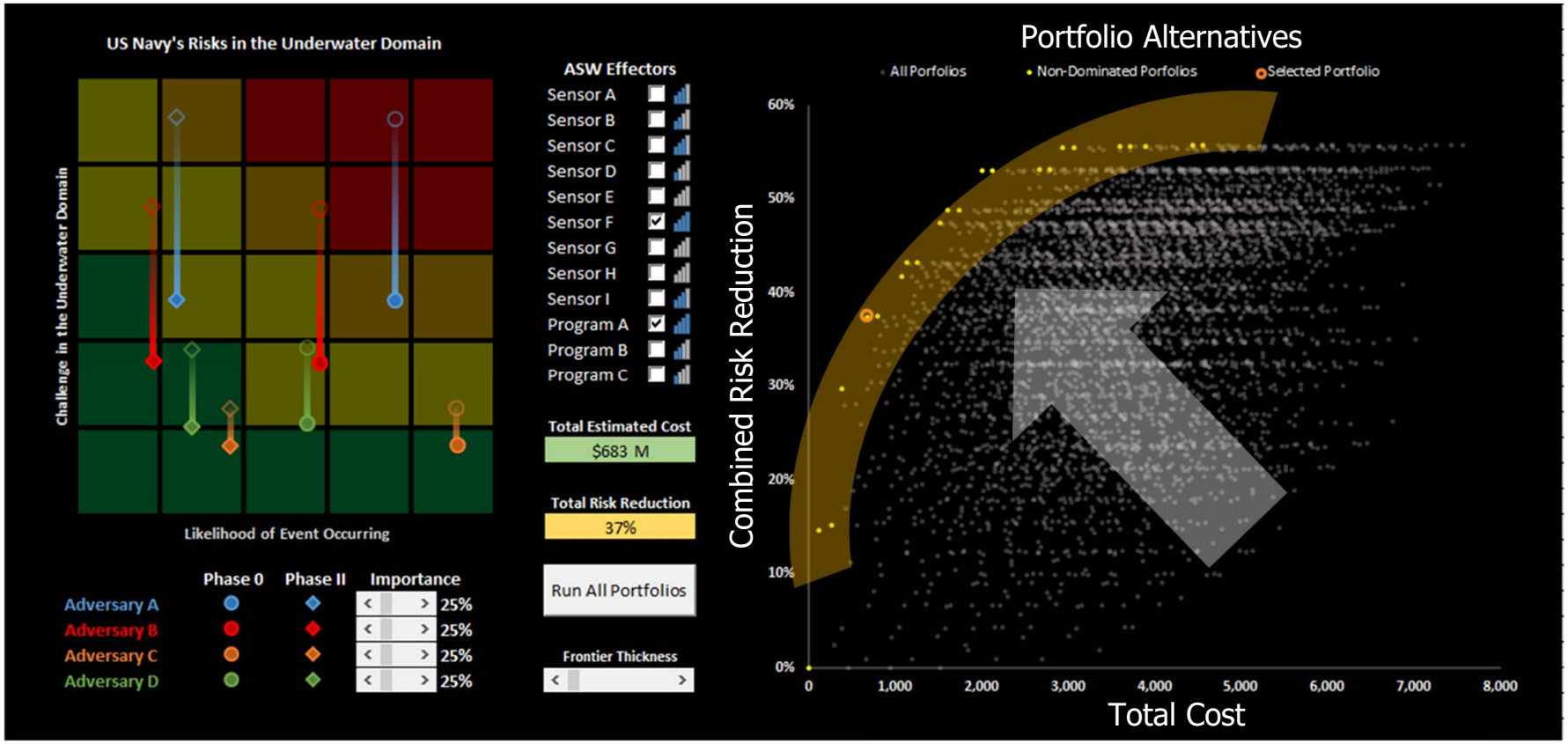


Generalized Approach

- Framework/Approach does not provide "optimized" portfolio
- The model is a representation of reality, and is hopefully useful, but it is not comprehensive – SME-in-the-loop
- New visualization approaches being designed and developed to enable comparison between roadmap alternatives
- Communicate **Risk** to decisions makers
  - What functional gaps remain?
  - Are vulnerabilities time-dependent?



Exemplar Visualizations



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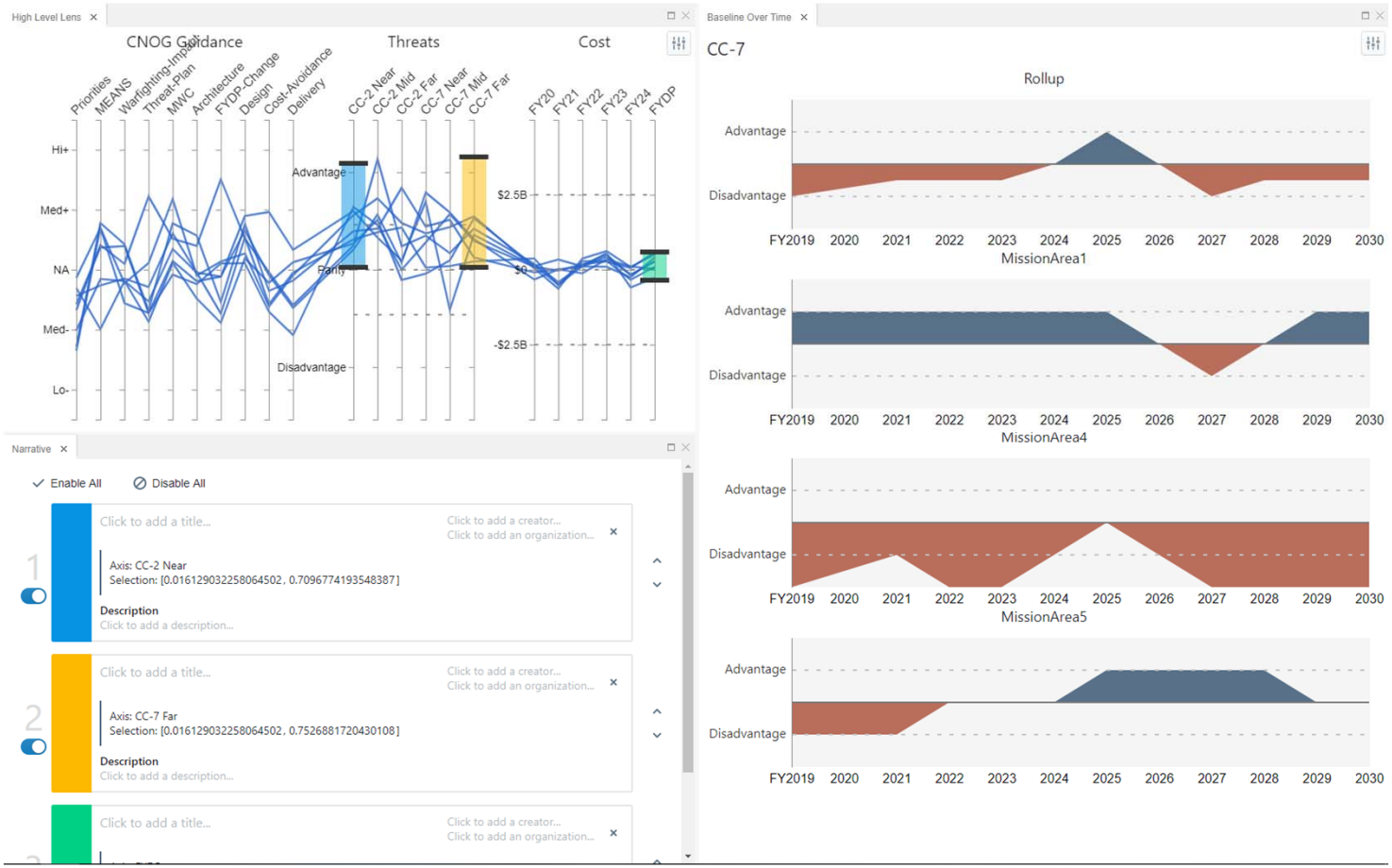

Dynamic Roadmap Research Target

Integrated Warfighting-Readiness data/models expose strategic risks

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Scenario 1 Loss 20YY
Scenario 2 Mission Fail 20YY
Scenario 3 Mission Risk 20YY
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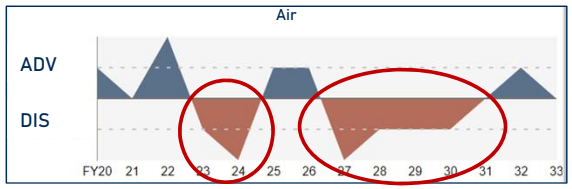
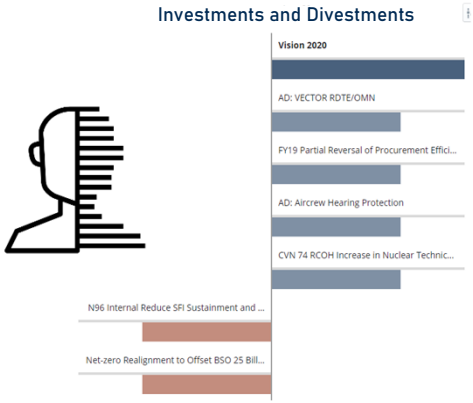
Data/model drilldown exposes specific capability & capacity gaps



Collaboration of computer and Resource Sponsors generate alternatives to close gaps while balancing capability with readiness



Evaluate distribution and uncertainty of risk

Assess future capabilities for alignment with Future Force Architecture strategy