System of Systems Integration Technology & Experimentation (SoSITE)

Architecting Composable-SoS Configurations

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• **Background:** DoD has long relied on tightly integrated weapons platforms using **top-down requirements allocation**

• **Challenge for a SoS-Architect:** When the environment changes, **must employ systems in unplanned ways**
  – Must be able to plug them together
  – Must have confidence that they satisfy the mission

• **Implication on Constituent Systems:**
  **Must provide broad characterization to support SoS-Architect**
Multiple Viable SoS Configurations, All Candidate Systems & Concepts Remain in Trade Space

Multiple Valid Solutions to Accomplish the Mission
- Increased Autonomy
- Increased Quantity
- Increased Precision

* categories are representative but not exhaustive

Broad Characterization of each Constituent System is needed

Cost Research
Constructive Sim Analysis
Virtual Analysis & Flight Test Results

IAF

Multi-Dimensional Datasets

Military Utility, Cost Leverage

Analytically Combine Datasets

SoS Configurations

Multiple Viable SoS Configurations, All Candidate Systems & Concepts Remain in Trade Space
Example Mission Decomposition
Deliberate Mission Decomposition Results in Interdependent Trades

Vertical Integration Of Analysis Pyramid

Campaign
Mission
Engagement
One-on-One
Engineering

Composition of Mission Package
- # of Sensor Platforms
- # of Weapons
- # of Other Platforms

Cost Leverage

Perform Mission Once
- P(Survive) for each Platform
- P(Kill) for primary and alternate Targets

Time to Execute
Blue Kill Chain

Find Target
- Sensor-Platform Quantity
- Employment
- Sensor Sensitivity

Location Errors

Strike Target
- Weapon Quantity
- Terminal Sensing Capabilities
- Warhead Type

Position Errors

Ingress
- Navigation Capabilities
- Flight Path

Warhead Effects

Perform Command & Control
- Platform Employments
- Datalink Types
- Tasks needing to be performed

Human Performance

Communicate to Support OpCon

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Mission Decomposition & Interdependent Trades

**Deliberate Mission Decomposition**

**System Characterization within Mission Decomposition**

*Many constituent systems waiting to be composed to execute a defined mission*

**Filter on Mission Requirements**

\[
P(\text{Complete Specific Task } #1) \geq X \\
P(\text{Complete Specific Task } #2) \geq X \\
P(\text{Complete Primary Mission}) \geq X
\]

**System Delivery**

*Note: Include Tactics/Employment Trades*

**Compose SoS Configuration from Available Systems**

**Many Composed SoS Configurations**

**Apply Cost Calculations**

**SME Evaluation**

*Each Constituent System Must be Broadly Characterized to Enable Performance Evaluation in a SoS Configuration*

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Phase-2 Rapid Integration & Experimentation

<table>
<thead>
<tr>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
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NAVAIR China Lake Test Range

* Focus areas are notional from Phase-1 BAA. Shown for informational purposes only.

Experimenting on SoS Disaggregated Mission Architectures, Maturing & Evaluating Innovative SoS Engineering Techniques

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Maturing Tools for Composing SoS’s

Enhancing Toolsets via Innovative SoS Integration Technologies

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