The Role of Architecture to Influence the Development Planning Trade Space

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Agenda

- Purpose
- Development Planning Process
- Types of Architecture
- Definition of Trade Space and Trades
- Elements Of Architecture
- How Architecture Defines Trade Space and Trades
  - Mission Capability Needs Analysis
  - Capability Solution Analysis
  - Analysis of Alternatives
  - Engineering Analysis
- Summary
The purpose of this paper is to;
- Define the role architecture plays in defining trade space in Development Planning
- Define the elements of architecture that influence the activities in the process
- Discuss how those elements define the trade space boundaries
NDIA Development Planning Process

- An Industry View of Development Planning

Mission Capability Needs Analysis
- Analysis of Future Threats, Strategy & Needs
- Advanced Concept Engineering
- Capability Analysis
- Gap Identification

Capability Solution Analysis
- Bound the Solution Space
- Solution Identification
- Solution Integration
- Evaluate Solution Candidates
- Generate Documents

Material Development Decision
- Develop Acquisition Decision Memo
- Communicate Guidance

MDD is an inherently Government Effort. Industry makes an investment decision to develop technologies, prototypes, etc.

AoA
- Plan
- SoS Assessment
- Candidate Assessment
- Prepare Analysis
- Conduct Analysis
- Generate Reports

Engineering Analysis
- SoS Refinement
- System Concept Refinement
- Programmatic
- Program Planning
- Technical Planning
- Program Plans
- Specifications & Standards

From NDIA Development Planning Working Group
Levels Of Architecture in Development Planning

Mission Architecture: “The job(s) to be done”
- Understand the Job
  - Identify mission capabilities/needs
  - Capture how operations are executed
  - Understand the mission flow and activities
  - Identify mission interactions
  - Identify mission nodes/relationships
  - Identify information exchanges

System of Systems (SoS) Architecture: “The tool kit to do the job”
- Understand the SoS Interactions
  - Identify SoS capabilities and needs
  - Capture SoS interaction
  - Understand the system flow and states within the SoS
  - Identify system nodes/interactions/relationships within the SoS
  - Identify message exchange

System Architecture: “The tool in the tool kit”
- Understand the System
  - Identify the system capabilities/gaps
  - Capture how the components interact
  - Understand the internal system flow and activities
Trade Space and Trades

- Trade space is the solution space to be investigated
  - Is essential in obtaining the executable solution
    - Must be broad enough for completeness
    - Must be bounded enough to exclude non-solutions

- Trades are the methods and activities used in that investigation
  - Used to define and evaluate solution candidates
  - Allows selection of the most viable solution
    - Must investigate essential aspects of solution requirements
    - Must not exclude viable solutions

Trades Investigate the Trade Space
**Key Elements Of An Effective Architecture**

There is a consistent set of elements present in architectures.

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Architectural Elements

- **Definition/Objective**
  - The description of what is to be accomplished
  - May or may not require a materiel development

- **Threat Definition**
  - The reasons or expected situations which drive the need
  - The threat is defined by the adversary
    - Motivations
    - Methods
    - Structure of the Adversary

- **Graphical Overview**
  - Graphical representation of the mission
    - Captures the elements and relations
Architectural Elements

- **Functional Flow**
  - The list of the tasks that are required to be executed in order
  - Captures the relationship between the tasks and the order of execution

- **Timelines**
  - Capture the timing required
    - Urgency of each function
    - Timing of the threat

- **Nodes and Interactions**
  - Representation of the high level elements
  - How they interact

- **Operation Resource Flow**
  - Captures the inputs and output of each node
  - Where each input comes from and where each output goes
Architectural Elements

- Attributes and Measures
  - How we know the mission and tasks are being performed
  - How well this is being accomplished

- Attributes
  - Characteristics that describe the ability to execute the mission in a satisfactory manner

- Measures
  - How this ability is evaluated

- Each attribute has one or more measures
- Are derived from the other architecture elements
- Provide a direct mapping to the trade space and trades

The Link to the Trade Space and Trades
Mission Capability Needs Analysis

- The current or “as-is” Mission Architecture is understood
- Trade Space and Trades driven by;
  - Current Capabilities, Measures, and Desired Capabilities
- Ranked Capability Gaps derived from the Trade Space through the Trades

![Diagram of Mission Capability Needs Analysis]

- Mission Objectives
- Mission Functional Flow
- Mission Attributes
- Current Capabilities
- Measures (MOEs)
- Desired Capabilities
- Trade Space and Trades
- Ranked Capability Gaps

Architecture Elements: Black
Supported Elements: Blue
Capability Solution Analysis

- The “as-is” and “to-be” System of Systems (SoS) Architectures are understood
- Mission Functional Flow mapped to the systems that execute

Ranked Capability Gaps ➔ SoS Attributes ➔ SoS Functional Flow

Current Capabilities ➔ SoS Attributes ➔ Measures (MOPs and COIs)

Desired Capabilities ➔ SoS Attributes ➔ Measures (MOPs and COIs)

Trade Space

Conceptual Solution Candidates ➔ Trades ➔ Ranked Solution Candidates ➔ Materiel Development Decision

Architecture Elements

Supported Elements
Analysis of Alternatives

- A Government function
  - Mirrored by Industry in preparation for and anticipation of a subsequent Request For Proposal (RFP)

- Investigate the solutions candidates

- Evaluate candidates against a pre-described set of criteria

- Select the desired solution

- Consists of:
  - Relevant trade studies
  - Evaluation criteria and critical success factors
  - Each candidate to be evaluated in the AoA is integrated into the “as-is” Mission and SoS Architectures to create a series of “to-be” Architectures
  - Integration readiness assessment
    - SoS architecture identifies the interfaces that need to be assessed
Analysis of Alternatives

- Driven by Mission and SoS Architectures
- Measures (MOEs, MOPs, COIs) drive the Trade Space
Engineering Analysis

- System Architectures are developed or refined
- Bounds the systems to be changed or developed
- Defines the System Measures as requirements

Desired Solution Candidate

SoS Functional Flow

System Attributes

Measures (MOEs, MOPs, and COIs)

Desired Capabilities

System Measures (Requirements)

Trade Space

Trades

Point of Departure Design
Architecture’s Influence

- Elements of the Architecture Define the Attributes and Measures
- Attributes and Measures directly define the Trade Space and Trades
Summary

- Utilization of Architecting

- Provides the foundation for defining the Trade Space and Trades
- Insures the completeness and relevance of the trade studies
- Reduces irrelevant trades
- Allows focus on the trades of primary importance
Questions?

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