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Architectures for Decision Analysis

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Standard Form 298 (Rev. 8-98)  Prescribed by ANSI Std Z39-18
Overview

- Goals
- The “Big Picture” Military Enterprise
- Methodologies Overview
  - Architecture Development (DoDAF)
  - Decision Analysis (DAF)
  - Cost Analysis (WBS)
- Methodology Integration
  - Semantics
  - Ontological Example
- Synergy & Benefits
Goals

- Understand the “big picture” military enterprise
- Understand methodologies working within this enterprise
  - Architecture Development (DoDAF)
  - Decision Analysis (DAF)
  - Cost Analysis (WBS)
- Integrate the methodologies into a common analytical approach
- Appreciate the benefits of methodology integration
- Active discussion
The “Big Picture” Military Enterprise
Methodologies Overview
DoD Architecture Framework (DoDAF) Methodology Overview

- **Operations focus** - identifies required processes and resources for a specific set of operations

- **Data-centric**
  - Structured analysis
  - Object-oriented analysis

(Ref 5)
Architecture Products Supporting Analysis

All Views (AVs)
What are the assumptions or constraints for this architecture?
Are we all talking about the same thing here?

Operational Views (OVs):
• What does the operational picture look like?
• What are my operational nodes? What information is required?
• Who is responsible?
• What activities need to happen to realize the operational picture?
What are the constraints to the activities?

System Views (SVs):
• What systems do we need? What are the interfaces between the systems?
• Unnecessary overlap in system functionality?
• What are the system limitations?
• What are the required system sequences?
• What technology does the system rely on?

Technical Views (TVs):
• What technical standards apply to my systems?
Decision Analysis Methodology Overview

- Decision defined as an irrevocable allocation of resources
  - Decision maker has authority over the resources
  - Decision analysis prescribes a recommended alternative
    - Via a mathematical and logical process
    - Within the context of a decision situation

- Characterizing a decision situation
  - Objectives
    - What decision maker wants to achieve by making the decision
  - Outcomes
    - What an alternative is expected to achieve
  - Alternatives
    - Feasible allocations of resources

- Final insights
  - Alternative predicted outcomes
  - Outcomes related to attainment of objectives
  - How uncertainties in the analysis affect the recommendation
Cost Methodology Overview

- Cost analysis spans entire system lifecycle
- System Work Breakdown Structure (WBS)
  - Composed of subsystems
  - Costs assessed per “scenario”
    - Mission
    - Ground
    - Launch
- Focused on operations & support phase

System Lifecycle

<table>
<thead>
<tr>
<th>Concept Refinement</th>
<th>Technology Development</th>
<th>System Dev &amp; Demonstration</th>
<th>Production &amp; Deployment</th>
<th>Operations &amp; Support</th>
</tr>
</thead>
</table>

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Methodology Integration

- Semantics - “the study of meanings…”\(^2\)
- Terms of Reference
  - Ontology
    - “…a specification of a conceptualization”\(^3\)

Example Ontology
Methodology Integration (Cont.)

Terms of Reference (Cont.)

- Resources
  - people, equipment, systems, money
- Capability - the ability to execute a specified course of action
- Activity - a unit, organization, or installation performing a function or mission
- Organization - a formal group of people with one or more shared goals
- Personnel - those individuals required in either a military or civilian capacity to accomplish the assigned mission
- Skills - great ability or proficiency; expertness that comes from training, practice, etc.
- Training - the teaching of vocational or practical and relates to specific useful skills
- Facility - A real property entity consisting of one or more of the following: a building, a structure, a utility system, pavement, and underlying land
Methodology Integration (Cont.)

- **Function** - what something is used for
- **System** - All of the devices and organizations forming the space network. These consist of: spacecraft; mission packages(s); ground stations; data links among spacecraft, mission or user terminals, which may include initial reception, processing, and exploitation; launch systems; and directly related supporting infrastructure, including space surveillance and battle management and/or command, control, communications and computers\(^1\)
- **Product** - the sum of all physical, psychological, symbolic, and service attributes
- **Standard** - common or compatible technical procedures and criteria\(^1\)
- **Service** - an act of help or assistance
Example Ontology Modeling Approach

- **Ontology Basics**
  - Created through iteration
  - Existing entities should not need to be modified
  - Can add new entities

- **“Thin slicing” approach**
  - First-order look, “gut feel”
  - Caution: “…bad becoming normal.”

- **Not nodal analysis**

- **Not trying to be all inclusive**

- **All constraints not identified**
Example Ontology

- Capability
  - Activity
    - Organization
      - Personnel
        - Skills
          - Training
    - Function
      - System
        - Product
          - Technical Standard
    - Service

- Consists of
- Requires
- Performs
- Provides
- Governs
- Contains
- Requires
- Provides
- Requires
- Provides

Concept Refinement
- Technology Development
  - System Dev & Demonstration
  - Production & Deployment
  - Operations & Support

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Near-Space Example

- Coordination of RF Troop Movement
- Organization
- Facility
- Medium Balloon
- Technical Standard
- Service

- Capability
- Requires
- Contains
- Provides
- Governs
- Performs
- Requires
- Provides
- Contains
- Requires
- Provides
- Governs
- Performs

Concept Refinement Technology Development System Dev & Demonstration Production & Deployment Operations & Support
Near Space Example – DoDAF Perspective

- **OV-5 (Op Act)**: Coordination of BF Troop Movement
  - Requires: Radio Operator, Radio Ops Skills
  - Performs: Radio School
  - Consists of: OV-4 (Org Rel)

- **Function Levels**
  - **Provision**
    - **System**
      - **Product**
        - Medium Balloon
          - **Technical Standard**
            - TV-1 (Tech Std)
      - **Service**

- **Capability**
  - Consists of: Activity
  - Activity requires: Coordination of Movement
  - Activity performs: coordination

- **Organization**
  - Consists of: Radio Operator
  - Requires: Radio Ops Skills
  - Provides: Radio School
Near Space Example – Decision Analysis Perspective

Decision Situation - Context

What resources do we need to coordinate BF troop movement?

Feasible Allocation of Resources in Context

- Radio Operator
- Radio Ops School
- Bandwidth
- FCC/NTIA Standard
- PRC-148 Radio
- Talon TOPPER
- Medium Balloon

- Resource
- Resource
- Resource
- Resource
- Resource

Coordination of BF Troop Movement

V Corps

Provide comm. relay channels

Radio School
Near Space Example – Cost Perspective

Ground Costs

Mission Costs

Situational Awareness

consists of

Coordination of Troop Movement

$7K

V Corps

performs

Provide comm. relay channels

Talon TOPPER

performs

Radio School

Radio Ops Skills

Radio Operator

Radio School

$1K

$5K

$1K

$500

Medium Balloon

PRC-148 Radio

FCC/NTIA Standard

$500

$500

contains

provides

governs

governs

Bandwidth

Mission Costs

$7K

Ground Costs

Provide comm. relay channels

Talon TOPPER

performs

Radio School

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$500

contains

provides

governs

governs

Bandwidth

Mission Costs

$7K

Ground Costs
Synergy & Benefit

Who is providing SA, what are they doing to provide SA and how much is SA going to cost?

Situational Awareness

$7K

Coordination of BF Troop Movement

V Corps

Provide comm. relay channels

Talon TOPPER

PRC-148 Radio

Medium Balloon

FCC/NTIA Standard

Radio Operator

Radio Ops Skills

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require

provides

Query in context = more informed decision making
Summary

Creating and using an ontology focused on warfighter capabilities and integrated multi-discipline methodologies can provide continuity throughout an enterprise to facilitate more informed decision making.

Discussion!!!

– Can this be done better?
– Is it worth it to integrate each methodology?
Backups
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