Decision Analysis and Resolution

Tailorable Decision Analysis & Resolution process and tools for enterprise wide application
Outline

• Introduction
• ARDEC Systems Engineering
• Decision Analysis and Resolution (DAR)
• DAR Process
• Tailored application of DAR to Technical Trade Study
• Benefits
ARDEC Background

Artillery & Mortar Systems

Advanced Fuze Technologies

R&D

SUPPORT
TOTAL
LIFE
CYCLE

PROD

FIELD SUPPORT

Artillery & Mortar Systems

Special Operations Weapons & Demolitions

Smart Munitions

Advanced Explosives & Warhead Development

Combat Vehicle Armaments & Fire Control

Logistics R&D

Future Small Arms

Non-Lethal Technologies

One Shot - Multiple Kills

Providing over 90% of the Army's lethality...

For Victory the American Way... Fight to Protect in the Battle Field
Introduction

- ARDEC Systems Engineering (SE) Division
  - Established from ARDEC re-organization to focus on disciplined systems engineering

“System Engineering objectives provides the integrating technical process to define and balance system performance, cost, schedule, and risk.”

-Michael W. Wynne
Acting Under Secretary Of Defense
20 Feb. 2004

- System Engineering (SE) Process needed a consistent and effective process for making fact based decisions.
Decision Analysis and Resolution

Definition

• Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.
Decision Analysis and Resolution Impact

- Inconsistent DAR processes may...
  - Cause delays/bottlenecks when reviewers inquire how the decision came to being.
  - Raise the learning curve of new IPTs (must agree on common ones).
  - Not reach the best achievable solution.
Approach

- Used as Six-Sigma Green Belt Project – Major Initiative at ARDEC to use Lean/6-Sigma
- Methodologies/Tools Used
  - Brainstorming
  - Process Map
  - Voice of the Customer
  - FMEA
  - Quality Function Deployment
  - Product Selection Matrix
Enabling the American Warfighter to Dominate the Battlefield!
Enabling the American Warfighter to Dominate the Battlefield!
Enabling the American Warfighter to Dominate the Battlefield!

Start

Define Problem 100
- Define Customer
- Customer Requirements
- Operational Needs
- Approval Authority
- Brainstorming

Decide if Formal Evaluation Process is Necessary 200

Decision to Proceed

Yes

No
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Level 1 Decision Analysis and Resolution Process

Start

Define Problem
100
- Define Customer
- Customer Requirements
- Operational Needs
- Approval Authority
- Brainstorming

Define if Format Evaluation Process is Necessary
200
- Problem Statement

Yes

Define Project Plan
300
- Schedule

Select Evaluation Methods
400
- Multi-Attribute Utility Theory
- Expert Matrix
- QFD
- Reporting Method

Establish Required Evaluation Criteria (For Filter)
500
- Collect Customer Requirements
- Define Required Criteria for First Cut
- Define Evaluation Metrics
- Capture Data

Establish Desired Evaluation Criteria
600
- Collect Customer Requirements
- Define Desired Criteria for
- Define Evaluation Metrics
- Capture Data

Establish Desired Criteria Importance
700
- Define Importance of Criteria
- Create Weighting
- Structure Data
- AHP
- Desirability Curves

Filter Criteria

Evaluation Criteria

Define Alternatives
800
- Collect Alternatives
- Determine Applicability

Research Candidate Alternatives
900
- Collect Data
- Test M&S

Score Alternatives against Required Criteria
1000
- First Cut Filter
- Yes/No

Score Alternatives against Desired Criteria
1100
- Using defined scoring method
- Calculated Alternatives’ Score(s)

Alternatives Still Exist
- Yes

Analyze and Test Results
1200
- Perform Sensitivity Analysis
- Monte Carlo Analysis

Refined Set of Alternatives

No

Select Alternatives for Approval
1300
- Best Alternatives for Approval

Final Decision Acceptable
- Yes

End

Validated Set of Results

No

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Level 1 Decision Analysis and Resolution Process

Start

Define Problem 100
- Define Customer Requirements
- Define Operational Needs
- Define Approval Authority
- Brainstorming

Define if Format Evaluation Process is Necessary 200

Define Project Plan 300
- Schedule

Select Evaluation Methods 400
- Multi-Attribute Utility Theory
- Expert Matrix
- QFD
- Reporting Method

Establish Required Evaluation Criteria (For Filter) 500
- Collect Customer Requirements
- Define Required Criteria for First Cut
- Define Evaluation Metrics
- Capture Data

Establish Desired Evaluation Criteria 600
- Collect Customer Requirements
- Define Desired Criteria for Define Evaluation Metrics
- Capture Data

Establish Desired Criteria Importance 700
- Define Importance of Criteria
- Create Weighting
- Structure Data
- AHP
- Desirability Curves

Define Alternatives 800
- Collect Alternatives
- Determine Applicability

Research Candidate Alternatives 900
- Collect Data
- Test M & S

Score Alternatives against Required Criteria 1000
- First Cut Filter
- No
- Yes

Score Alternatives against Desired Criteria 1100
- Using defined scoring method

Analyze and Test Results 1200
- Perform Sensitivity Analysis
- Monte Carlo Analysis

Select Alternatives Still Exist
- Yes
- No

Select / Rank Alternatives for Approval 1300
- Validated Set of Results
- Best Alternative(s) for Approval

Final Decision Acceptable
- Yes
- End

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Level 1 Decision Analysis and Resolution Process

Start

Define Problem
100
- Define Customer
  - Requirements
  - Operational Needs
  - Approval Authority
  - Brainstorming

Define Project Plan
300
- Define Evaluation Process is Necessary

Select Evaluation Methods
400
- Multi-Attribute Utility Theory
- Expert Matrix
- QFD
- Reporting Method

Establish Required Evaluation Criteria
(For Filter)
500
- Collect Customer Requirements
- Define Required Criteria
- First Cut
- Define Evaluation Metrics
- Capture Data

Establish Desired Evaluation Criteria
600
- Collect Customer Requirements
- Define Desired Criteria
- Define Evaluation Metrics
- Capture Data

Define Alternatives
800
- Collect Alternatives
- Determine Applicability

Research Candidate Alternatives
900
- Collect Data
- Text M&S
- Test

Score Alternatives against Required Criteria
1000
- Data for Alternatives
- First Cut Filter
- Yes/No

Score Alternatives against Desired Criteria
1100
- Using defined scoring method
- Calculated Alternatives' Score(s)

Select / Rank Alternatives
for Approval
1300
- Best Alternatives(s) for Approval
- Final Decision
- Acceptable

Validate Set of Results

Analyze and Test Results
1200
- Perform Sensitivity Analysis
- Monte Carlo Analysis

End
Select / Rank Alternatives for Approval

Final Decision Acceptable

Yes

End

No

Identify deficiency in criteria/alternatives

Best Alternative(s) for Approval
ARDEC Enterprise Application

- DAR process to be approved as part of formal ARDEC SE Standard Process
- Projects are required to tailor and use process for their application
- Identified methodologies/tools for each process step to facilitate process execution
Tailored DAR Process

- Application for FCS Active Protection System (APS) Technical Trade Study for RDECOM.
  - Identify Science and Technology Investments needed to get to an objective APS system.

- ARDEC DAR process focused competing organizations’ efforts to determine path-forward for the APS technical trade study

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DAR Benefits

- Project risk will be reduced by applying the defined DAR process.
- Fact-based decision will be made rather than subjective decisions.
- Increased quality decisions
  - Defendable
  - Stakeholder buy-in
  - Flexible
  - Valid
### Return on Investment

<table>
<thead>
<tr>
<th>Quality or Customer Satisfaction</th>
<th>Co$t</th>
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| • DAR Process created to enhance the ARDEC capability to deliver quality products to the Warfighter.  
  • Tools capability to support ARDEC project execution | Savings from…  
  • Reuse  
  • Standardization  
  • Best Practice application  
  • Savings: $11.3K/use |

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<tr>
<th>Schedule</th>
<th>Risk</th>
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| • Defined DAR process provides for better time and resources scheduling needed to execute.  
  • Lowers the learning curve DAR application | • Defined DAR process reduces risk by providing a tailorable framework for making decisions |
Questions?