



Reduction of Decision-Making Time in the Air
Defense Management

M.Metin İŞCAN

Overview of Air Defense

- Detection
- Identify
- Intercepts
- Destroys

C2 functions for air defense

- Target detection,
- Target tracking,
- Target identification/classification,
- Threat evaluation,
- Weapons assignment:

Real-time decision system

- Information management and data fusion,
- Situation assessment,
- Evaluation of alternatives,
- Decision

Prominent studies

- Tactical Decision Making under Stress
- Evaluating the Performance of TEWA Systems
- Threat Evaluation and Weapon Allocation

Threat Analysis Parameters

- Proximity parameters
 - CPA,
 - Time to CPA,
 - CPA in units of time,
 - time before hit,
 - Distance,
- - Capability parameters,
 - target type,
 - weapon type,
 - fuel capacity,
 - max. radius of operation,
- - Intent parameters,
 - target's kinematics,
 - number of recent maneuvers

Threat Analysis

Step 1

- Problem Identification

Step 2

- Create Value Hierarchy

Step 3

- Develop Evaluation Measures

Step 4

- Create Value Functions

Step 5

- Weight Value Hierarchy

Problem Identification

- Determining the threat levels that gathering from sensors

Threat Analysis

Step 1

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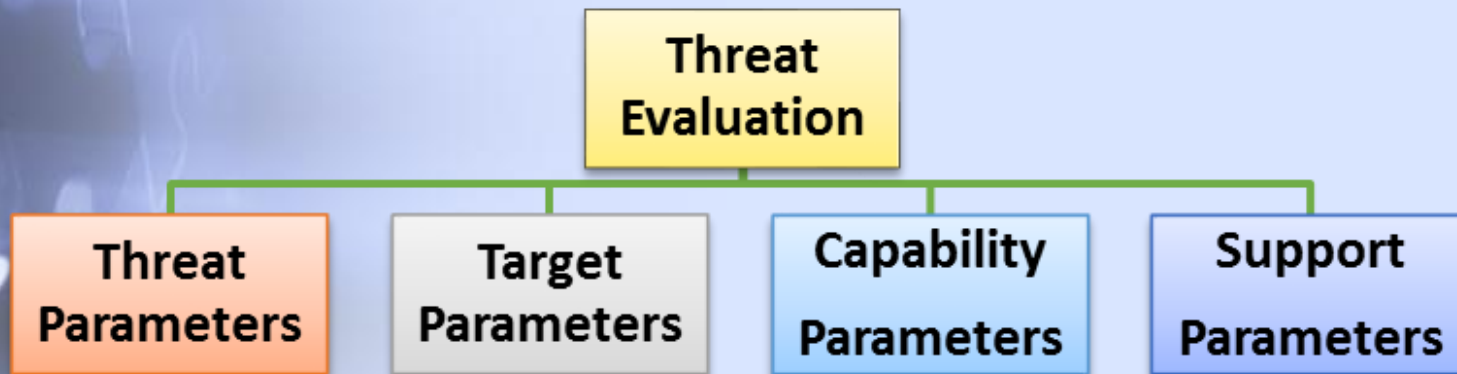
Step 4

- Create Value Functions

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Create Value Hierarchy



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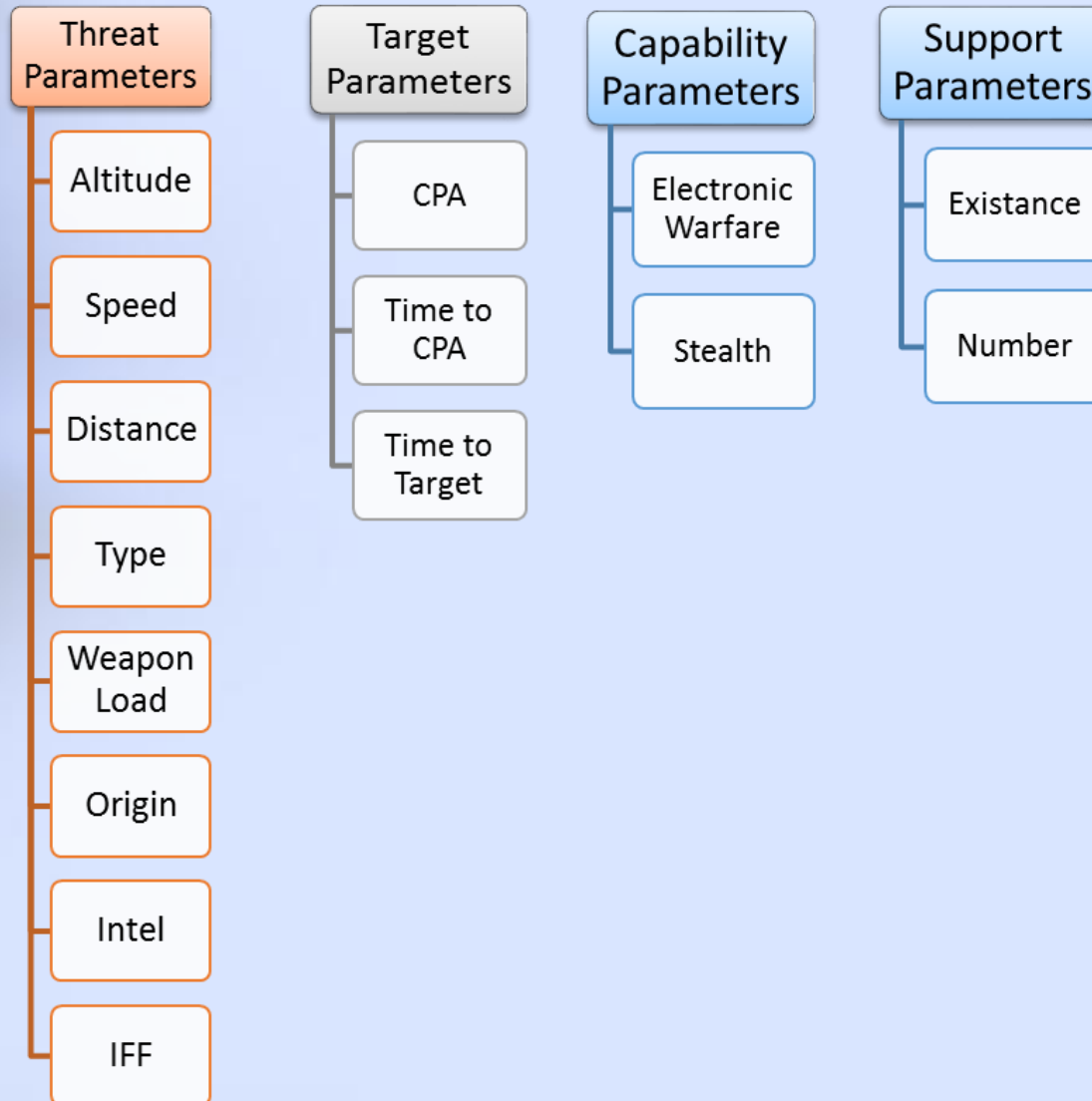
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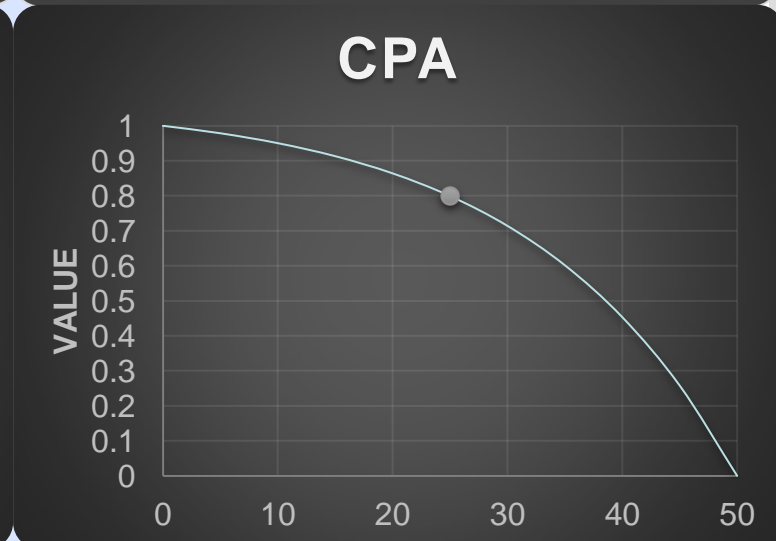
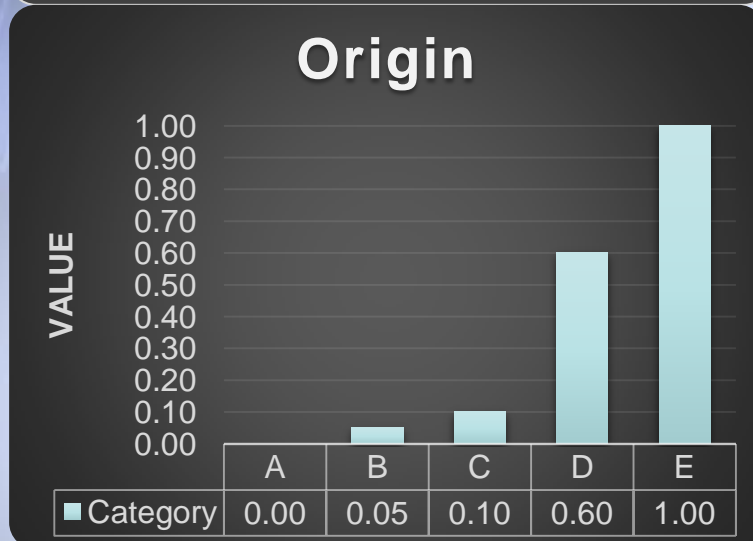
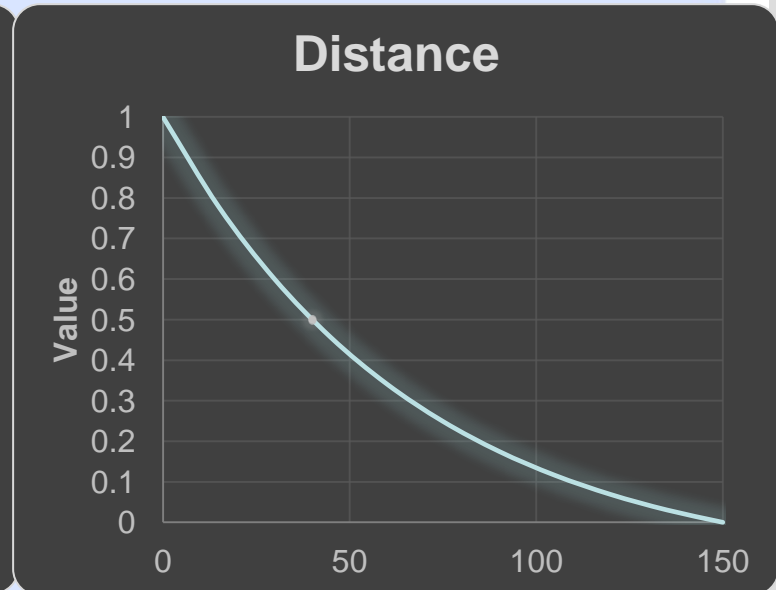
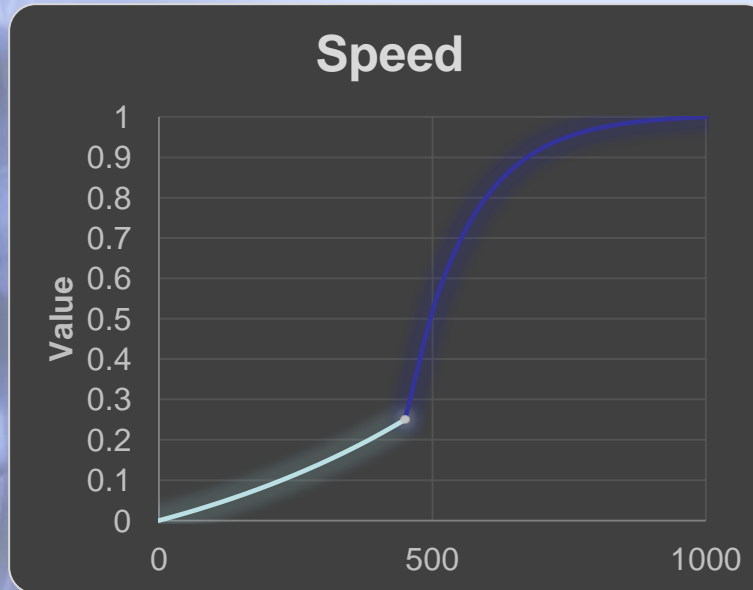
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Weight Value Hierarchy

Measure Name	Weight (True or Relative)
İrtifası	0,07875
Sürati	0,07875
Rota	0,045
Uçak Tipi	0,0225
Silah Menzili	0,045
Kökeni	0,09
İstihbarat	0,09
CPA	0,09
CPA'ya Olan Zaman	0,07
CPA'dan hedefe olan zaman	0,04
EH kabiliyeti	0,125
Görünmezlik	0,125
Destek Varlığı	0,05
Destek sayısı	0,05

Threat Analysis

Step 6

- Alternative Generation Value Model

Step 7

- Alternative Scoring

Step 8

- Deterministic Analysis

Step 9

- Sensitivity Analysis

Step 10

- Conclusions & Recommendations

Threat Analysis

Step 6

- Alternative Generation Value Model

Step 7

- Alternative Scoring

Step 8

- Deterministic Analysis

Step 9

- Sensitivity Analysis

Step 10

- Conclusions & Recommendations

Threat Analysis

Step 6

- Alternative Generation Value Model

Step 7

- Alternative Scoring

Step 8

- Deterministic Analysis

Step 9

- Sensitivity Analysis

Step 10

- Conclusions & Recommendations

Threat Analysis

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- Deterministic Analysis

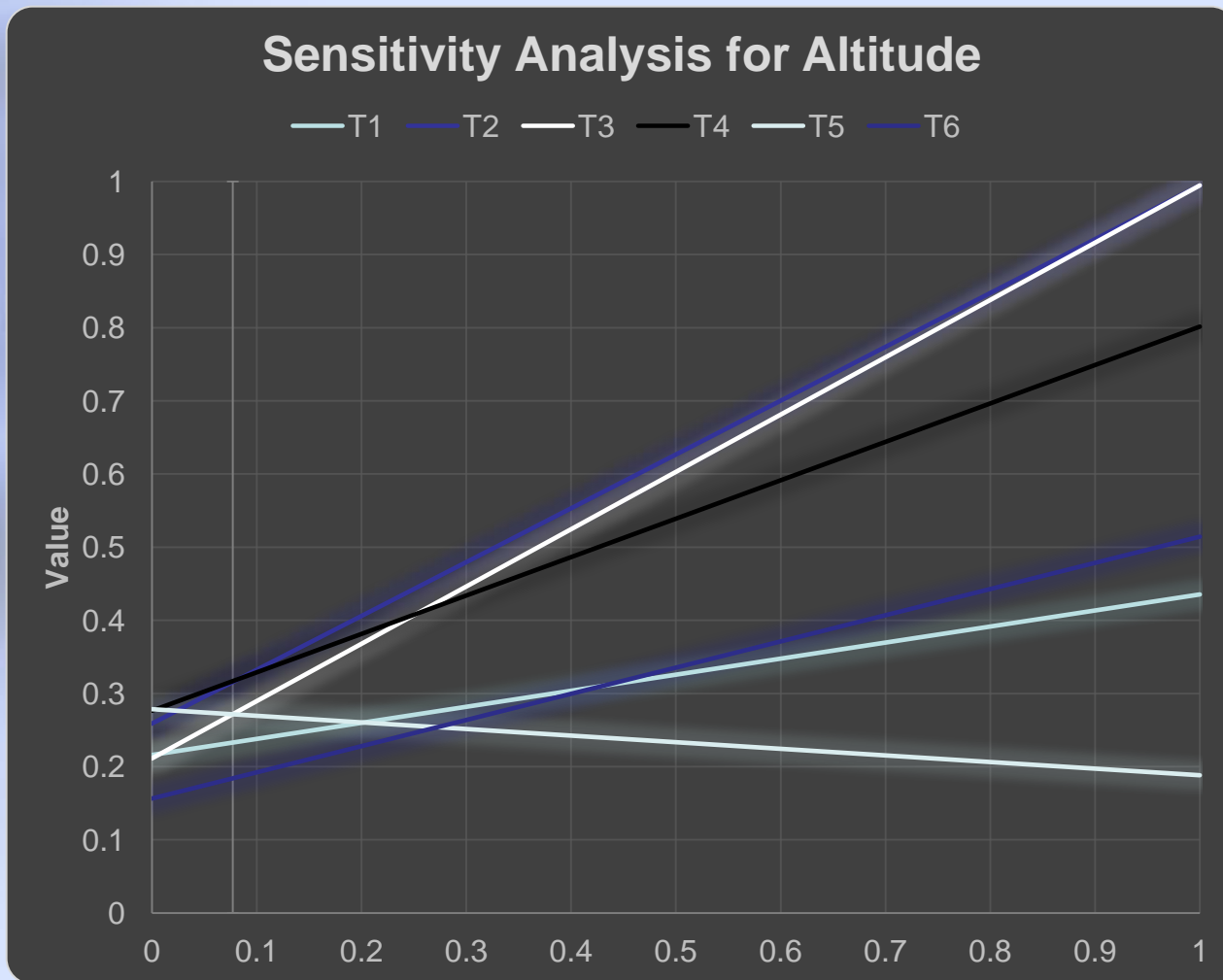
Step 9

- Sensitivity Analysis

Step 10

- Conclusions & Recommendations

Sensitivity Analysis



Threat Analysis

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- Deterministic Analysis

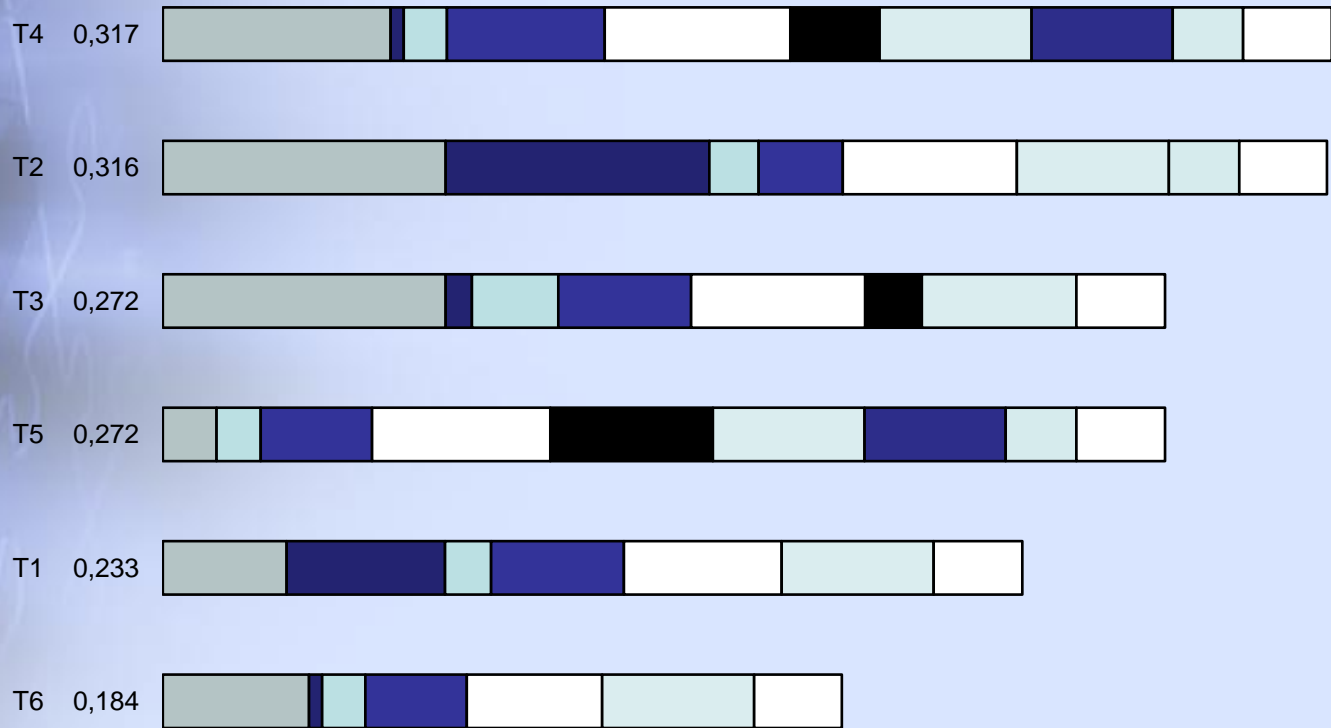
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- Sensitivity Analysis

Step 10

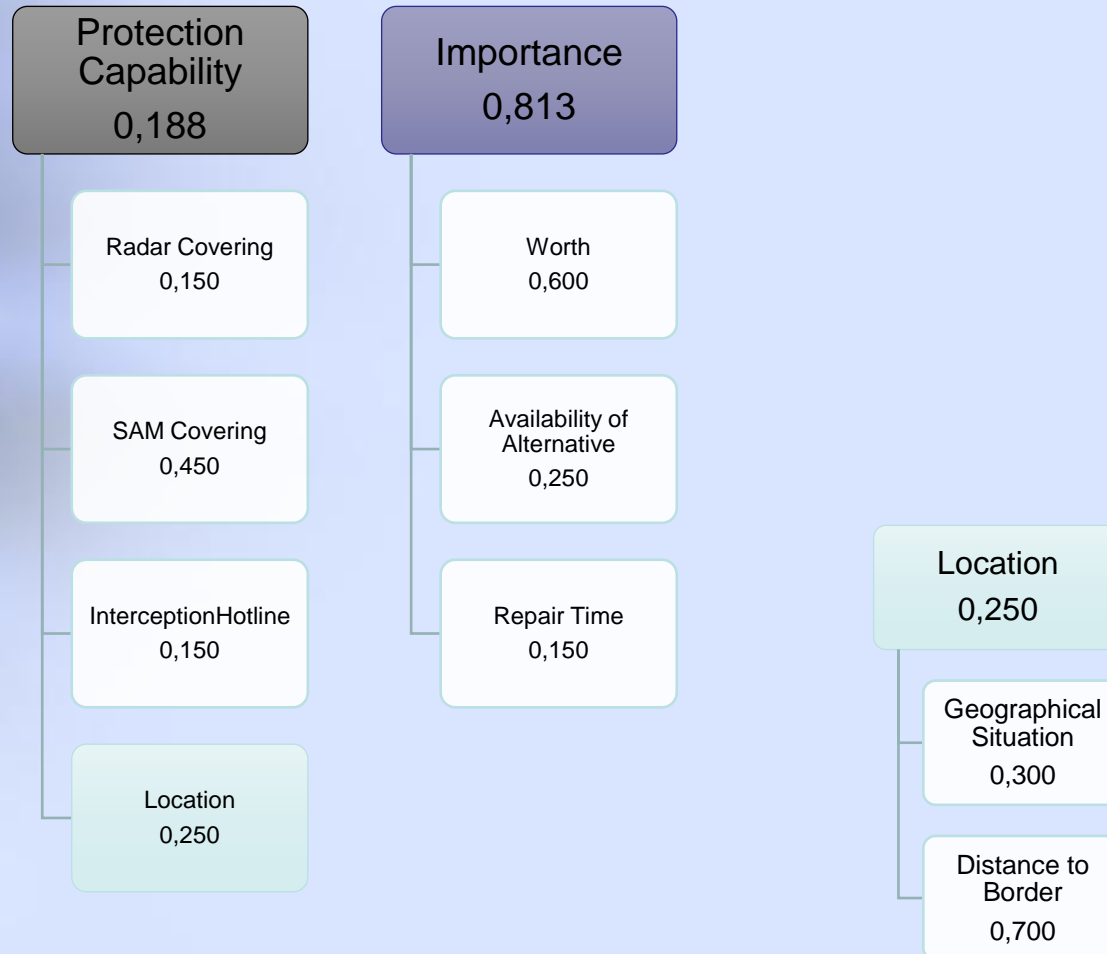
- Conclusions & Recommendations

Conclusions & Recommendations

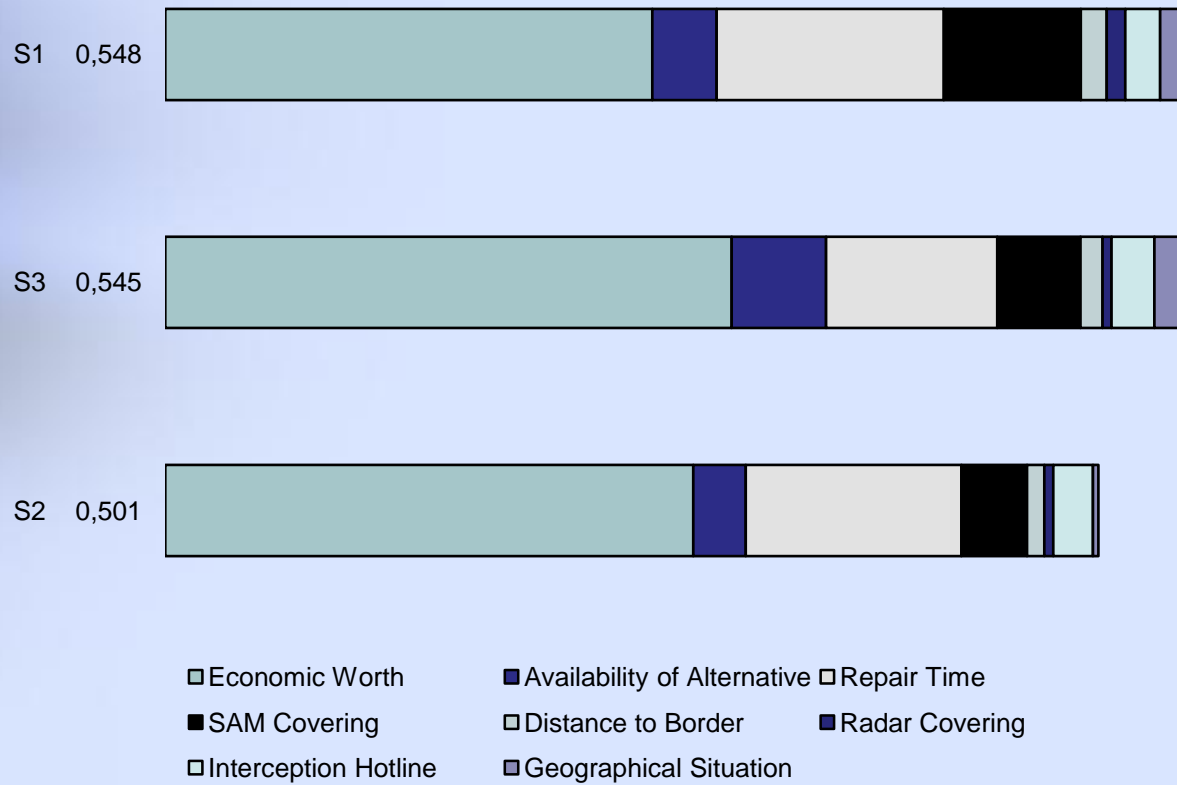


- EW Capability
- Stealth
- Intel
- IFF
- Altitude
- Origin
- Speed
- Distance
- CPA
- Weapon Envelope
- Time to CPA
- Support Existance
- Number of Support
- Type
- Time to Target

Value Analysis



Value Analysis



Value Analysis

		S1	S2	S3	S1	S2	S3	Total
Threat	TA Value	0,55	0,50	0,55				
T1	0,23	45	80	90	7,03	2,33	1,27	10,63
T2	0,32	48	72	75	9,08	4,51	4,30	17,89
T3	0,27	48	60	60	7,82	5,45	5,92	19,19
T4	0,32	55	53	45	7,82	7,54	9,50	24,86
T5	0,27	80	74	56	2,98	3,61	6,52	13,10
T6	0,18	94	80	56	0,66	1,84	4,42	6,92

Weapon Assignment

- Minimize the threat's survival value,
- Minimize the defended asset's damages,
- Maximize the all survivability of assets.

$$\textit{Minimum Cost} = \sum_{i=1}^T \left[C_i \prod_{k=1}^A \varepsilon_{ik} \prod_{j=1}^w (1 - P_{ij})^{X_{ij}} + \sum_{j=1}^w C_w X_{ij} \right]$$

Discussion and Results

- TE: A model was created and it is seen that process is much faster than classical methods. It is detected that a thousand threat data can be evaluated in 148 milliseconds.
- WA: If heuristic algorithms aren't used there are 4^{14} (268.435.456) possibilities at solution model. It takes 58 hours to solve this process with a computer.

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- A blue-tinted background image showing a person climbing a rope ladder. The person is positioned on the left side of the frame, and the ladder extends vertically. The background is a light blue gradient with some faint, abstract patterns.
- Questions