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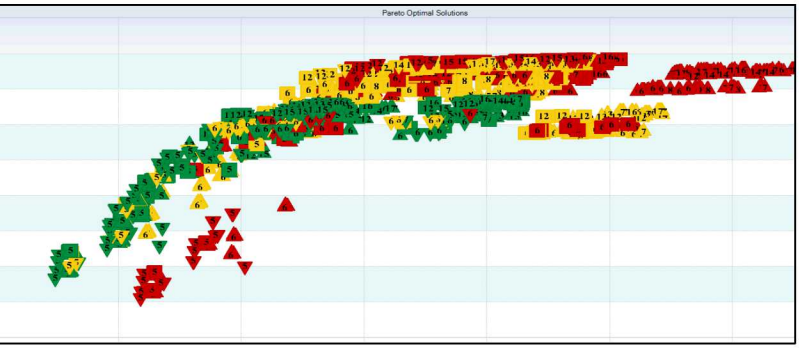

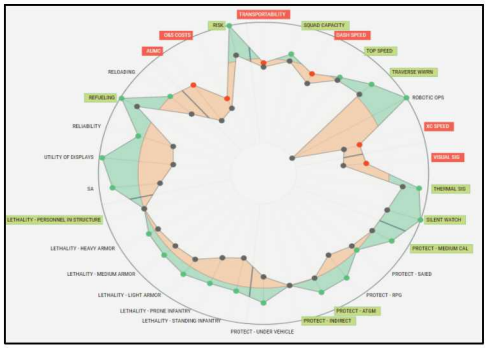

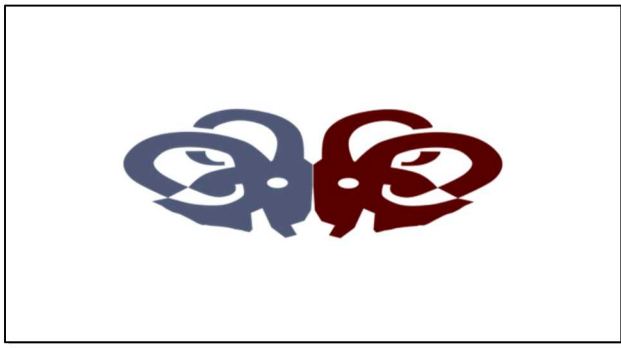

Advanced Requirements Integration & Exploration System (ARIES) for Acquisition Programs

Alex Dessanti, Rachel Agusti, Dennis Anderson, Stephen Henry, Jack Gauthier, Matthew Hoffman, Adam Pierson, Yang Ho, Michael Zabat

88th MORS Symposium

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Overview

- Problem Space
- When is ARIES Used
- What is ARIES
- Capability Walkthrough
- ARIES Benefits
- Path Forward

ARIES Problem Space

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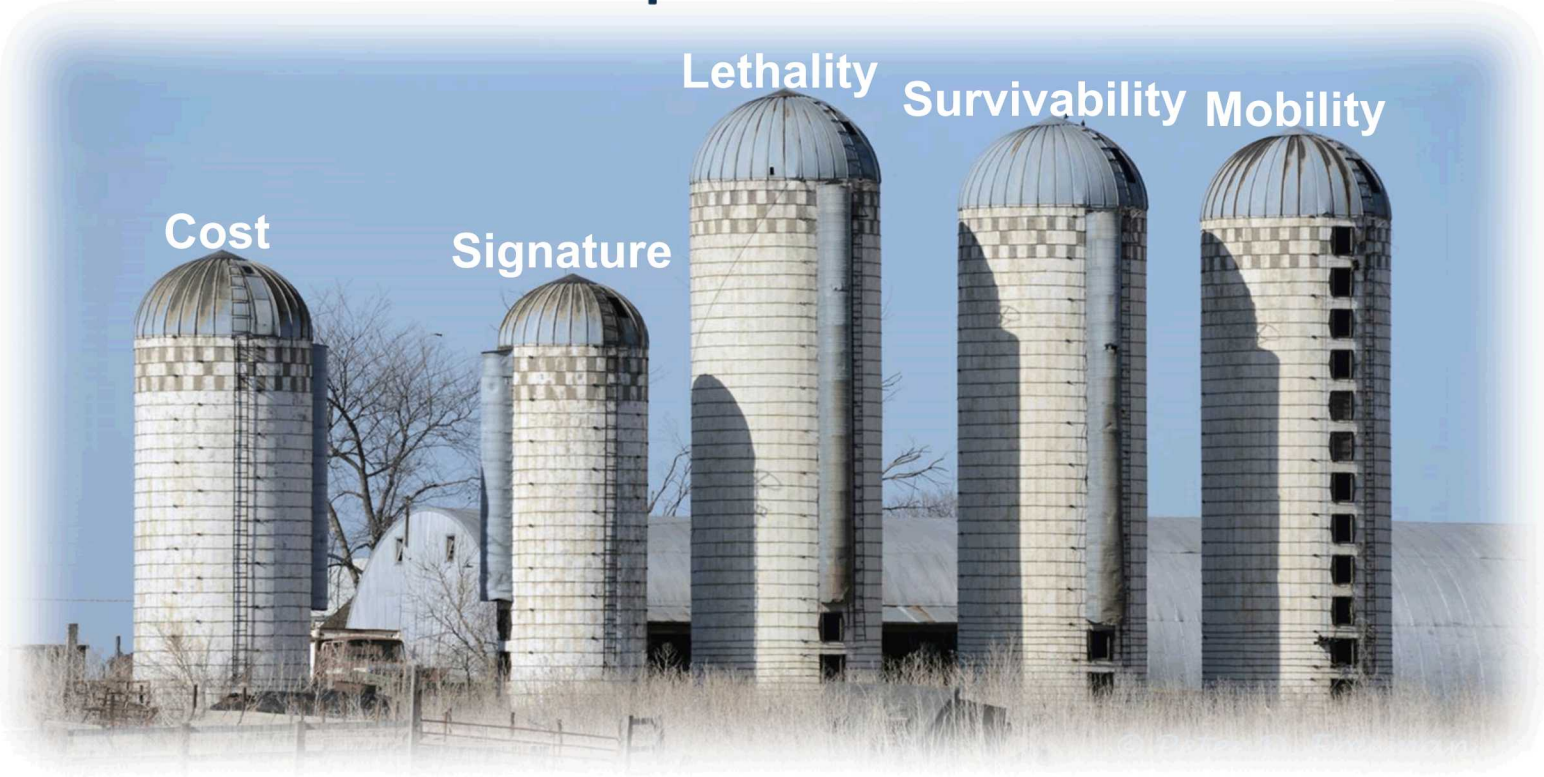
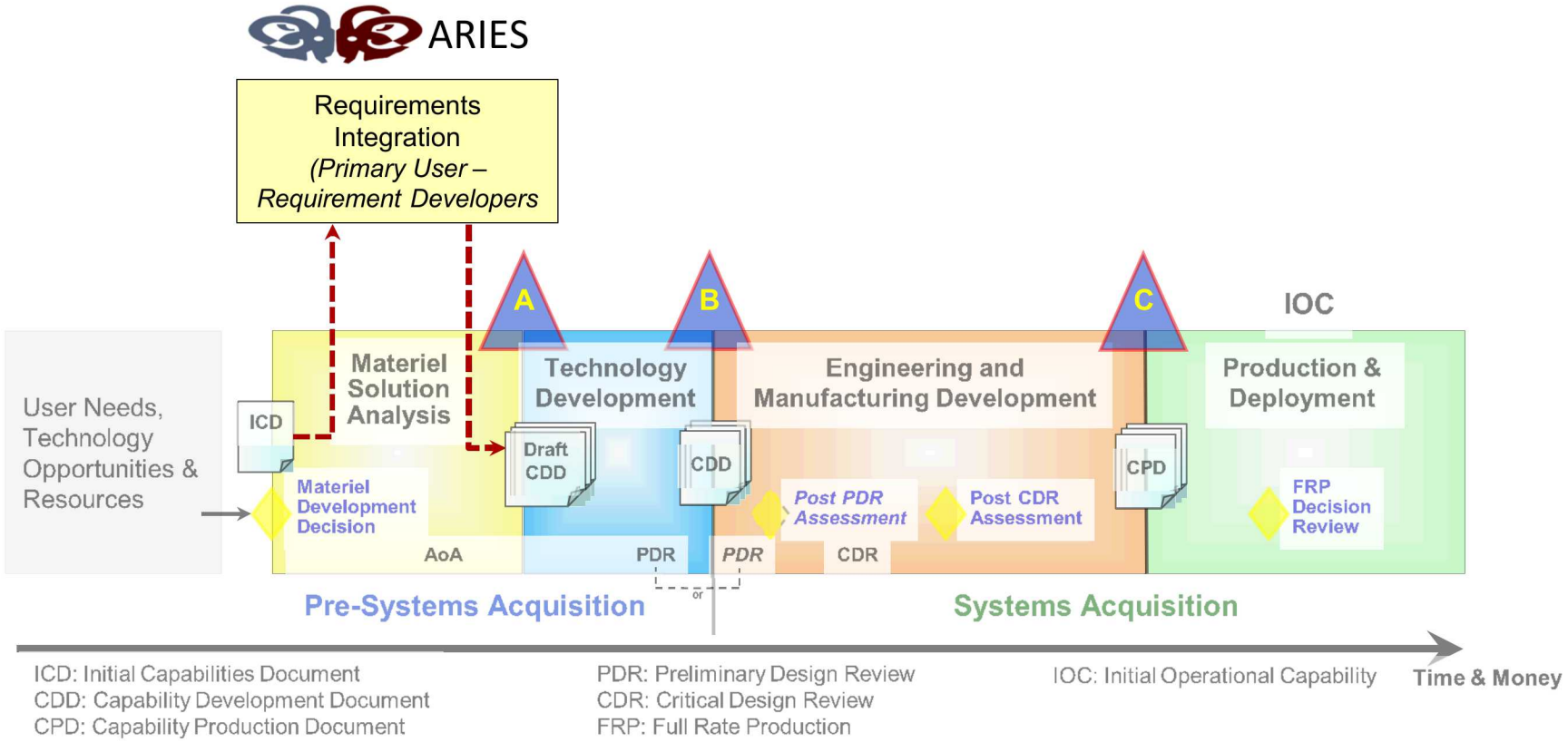


- Early in defense acquisition programs, an increasingly complex set of requirements is developed
- Each individual requirement possesses solid rationale and analytical backing
- However, different groups of requirements (lethality, mobility, etc.) are sometimes incompatible or unachievable when programmatic constraints are applied

ARIES provides unique analytic capability to foster communication and compromise across potential requirements silos, resulting in a simultaneously achievable set of requirements

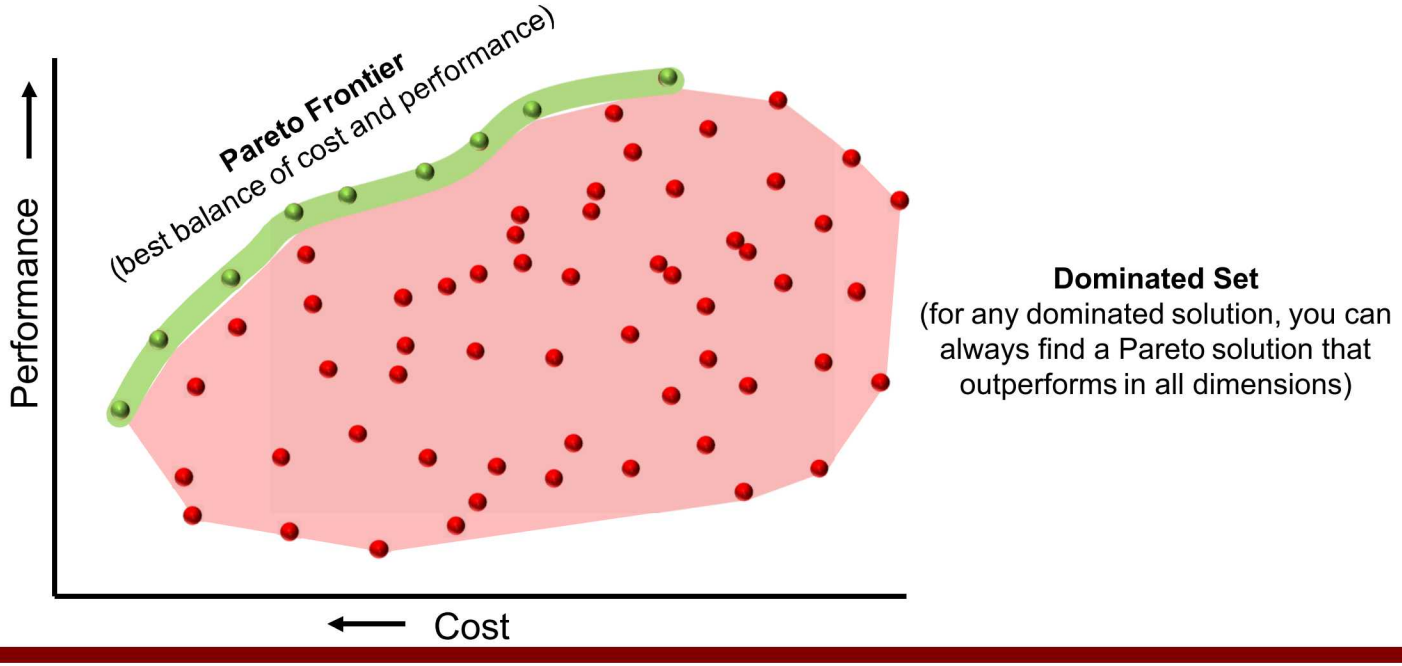
When is ARIES Used?



ARIES is used to help establish an achievable set of integrated requirements early in a program

What is ARIES?

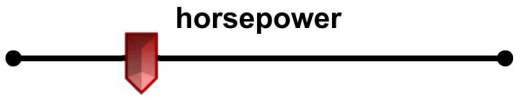
- ARIES is a decision support tool
- Uses a custom multi-objective Genetic Algorithm to explore the ***requirements trade space***
  - Does not provide just one best answer, but instead a **set of best answers** that balance competing objectives in different ways
    - Enables decision makers to examine and understand tradeoffs
  - ARIES is designed to capture this optimal trade space (Pareto Frontier)



Generating Solutions from Technologies

ARIES generates solutions via combinations of discrete subsystems (with inherent properties) rather than by directly setting system parameters

"Choose the part" **vs.** **"Choose the parameter"**



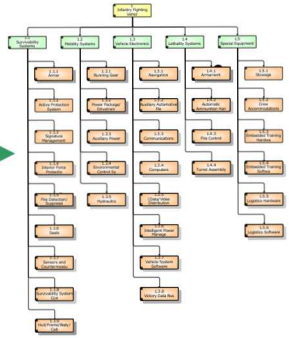
- Advantages of this technology way of thinking
  - Helps ensure analytic insights are grounded in reality
    - Tied to existing or envisioned technologies, their attributes, and interactions
    - Naturally avoids selecting impractical parameter combinations
      - Example – will not consider a very light and powerful alternative that does not exist/cannot be created
  - Easy to define system design constraints
    - Example – designing a vehicle, suspension has maximum weight it can support, can sum all selected component weights and compare to limit for selected suspension
  - Easy to capture technology compatibilities
    - Example – not all engines are compatible with all transmissions for a vehicle (not necessarily tied to specific parameter values)
  - Easy to talk about what a solution means (collection of parts vs. collection of parameters)

ARIES Methodology

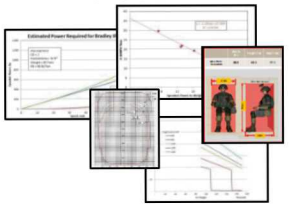
Develop Metrics

Safely and rapidly transport infantry to decisive locations and provide direct fire support

Establish Product Structure



Define Metric Evaluations



Identify Technology Options

Trade Space Analysis

ARIES

Explore Results & Reach Consensus

Understand Needs/Desired Capabilities

ICD

What is an ARIES solution?

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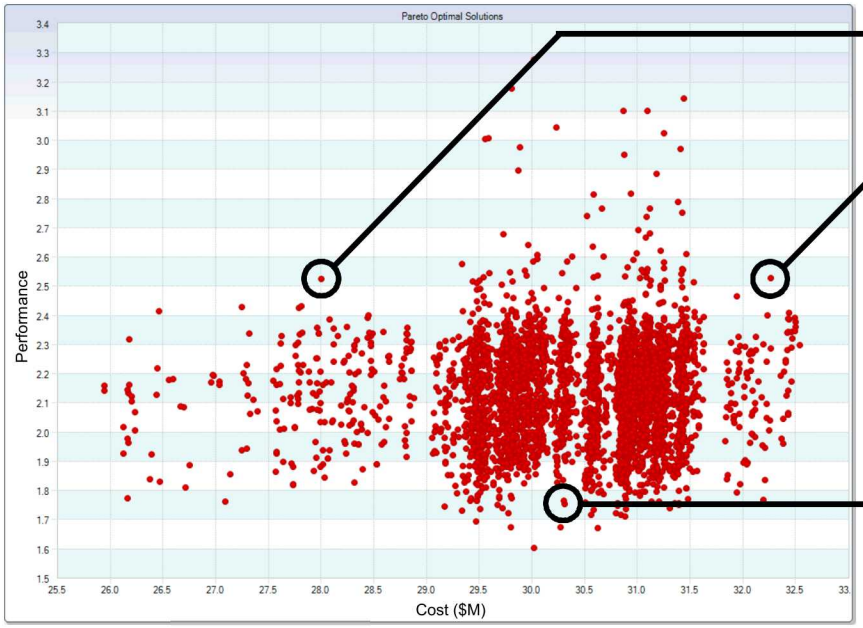
ARIES Solutions



Each ARIES solution is a unique **system design concept**

Each design concept has associated **performance metrics**

These performance metrics provide **optimized, simultaneously achievable** potential values for **requirement thresholds**

Thus, it is equivalent to think of ARIES solutions either as **optimal system concepts** or **optimal requirement thresholds**

ARIES Analytic Process

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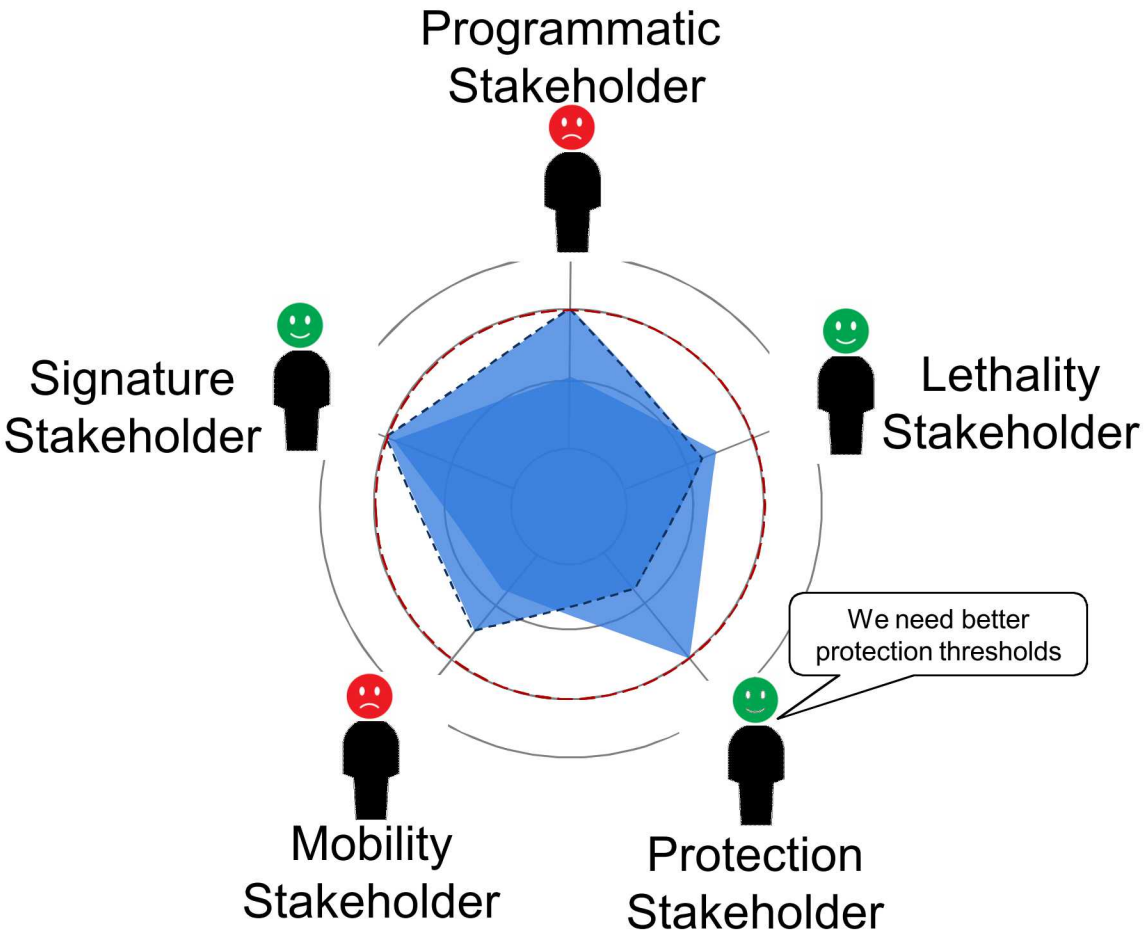
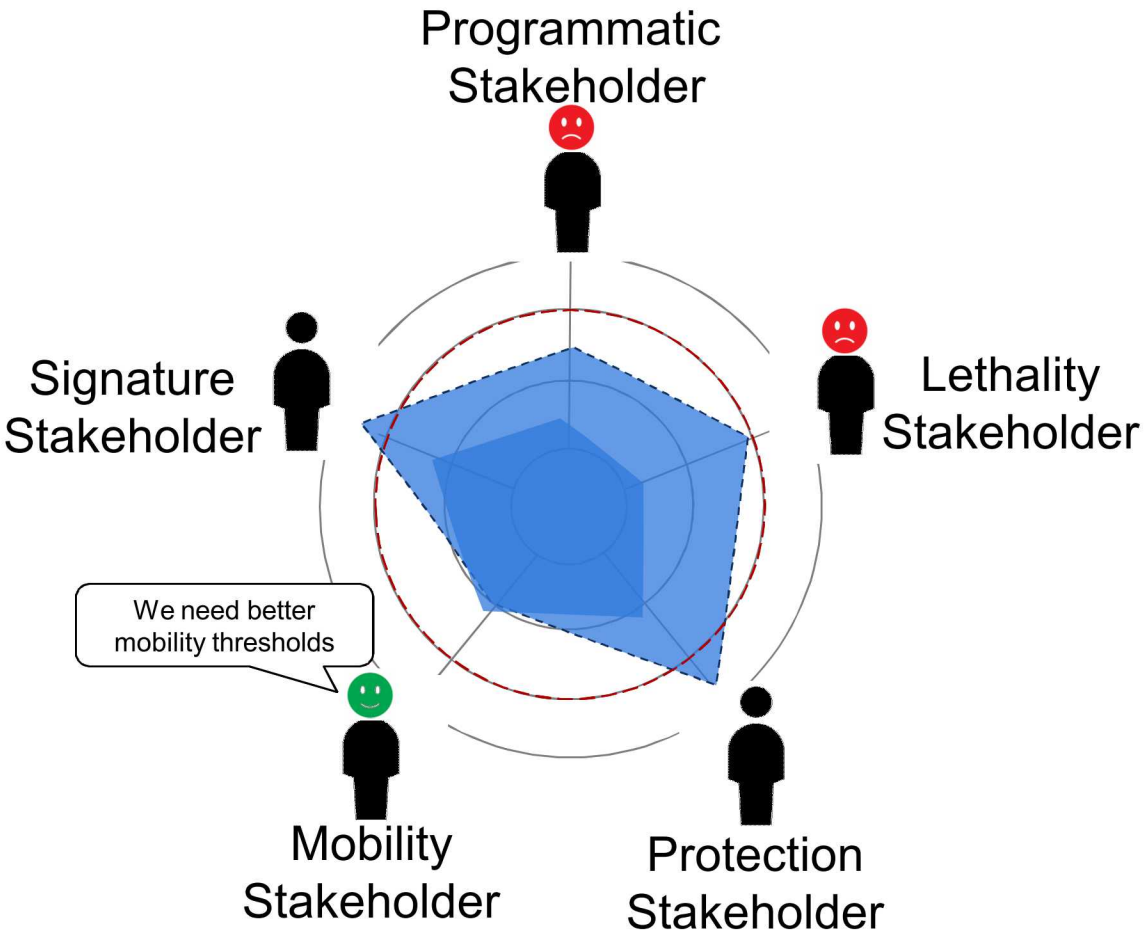
- Intended to be a real-time, **interactive process involving stakeholders** for the program – a negotiation between dozens of requirements competing to simultaneously achieve their goals
- Improving one requirement threshold often comes at expense of one or more competing requirements – ARIES **shows** these **interactions in real time**
- ARIES **facilitates** analytically-backed **exploration and compromise** to develop an integrated set of threshold values that are feasible with respect to all requirements and constraints (budgetary, technological, etc.)

Real-Time Stakeholder Collaboration



Real-Time Stakeholder Collaboration



ARIES Radar Chart

- Each spoke represents a system requirement
- The orange/green ring represents the **desired** threshold for each requirement
- The grey dot represents the current filter setting for each requirement

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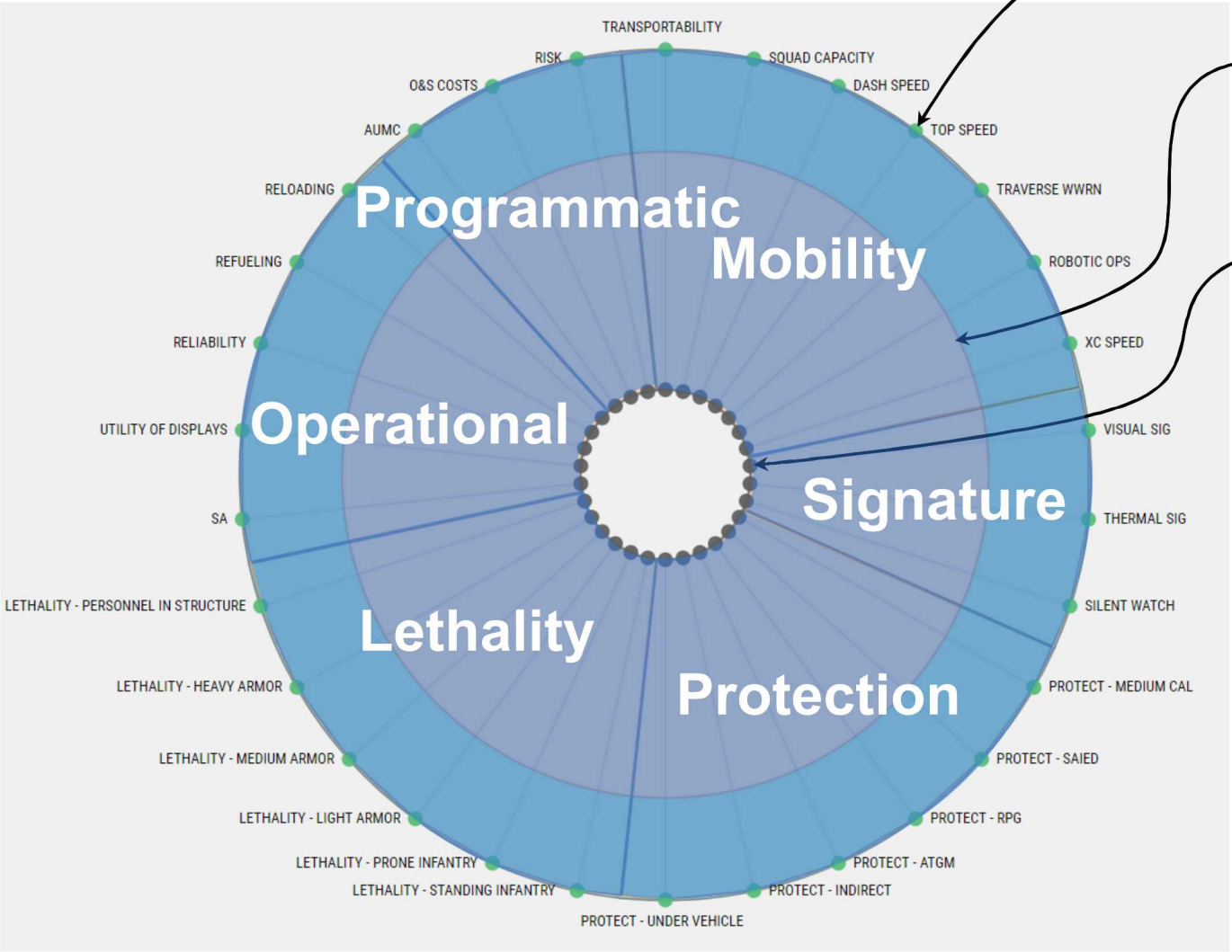

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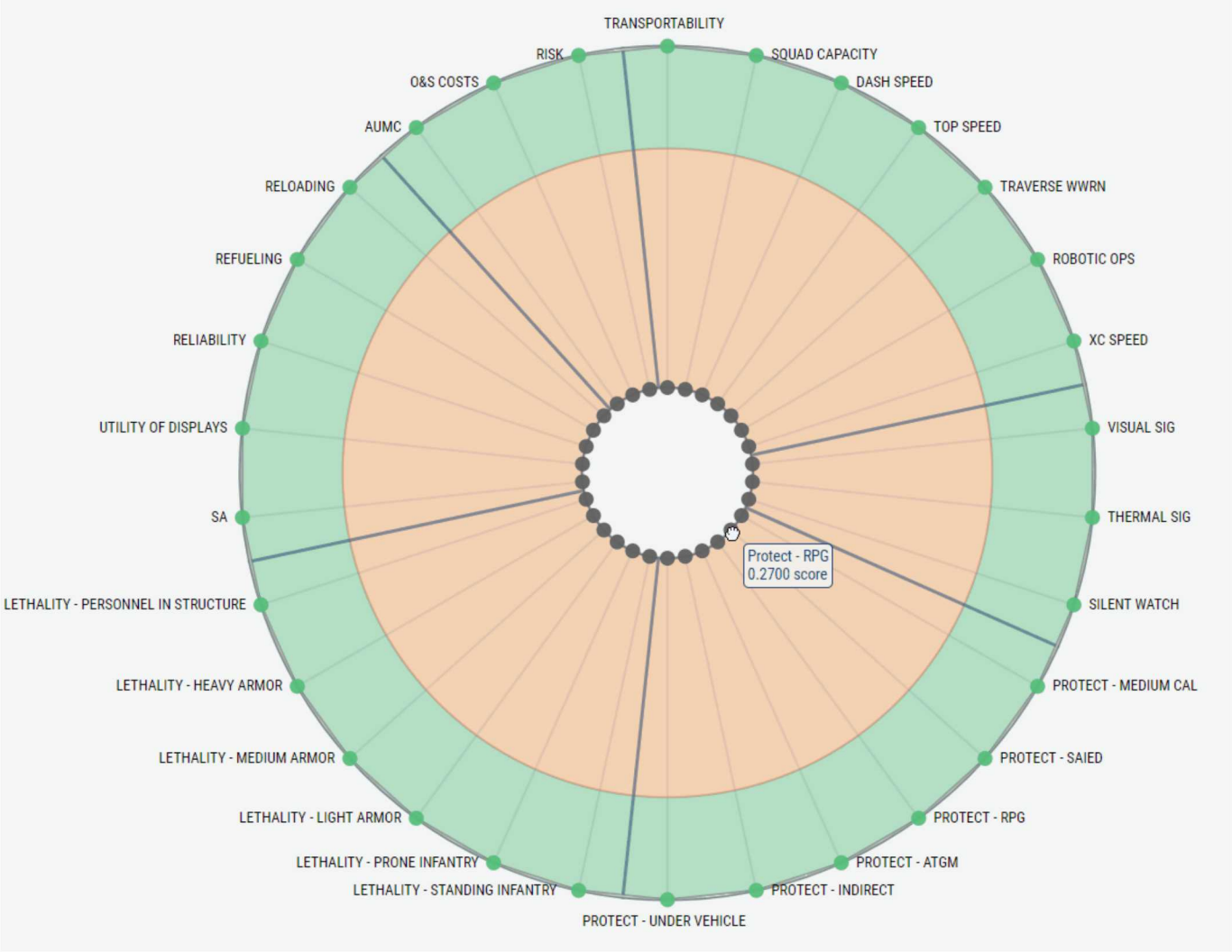

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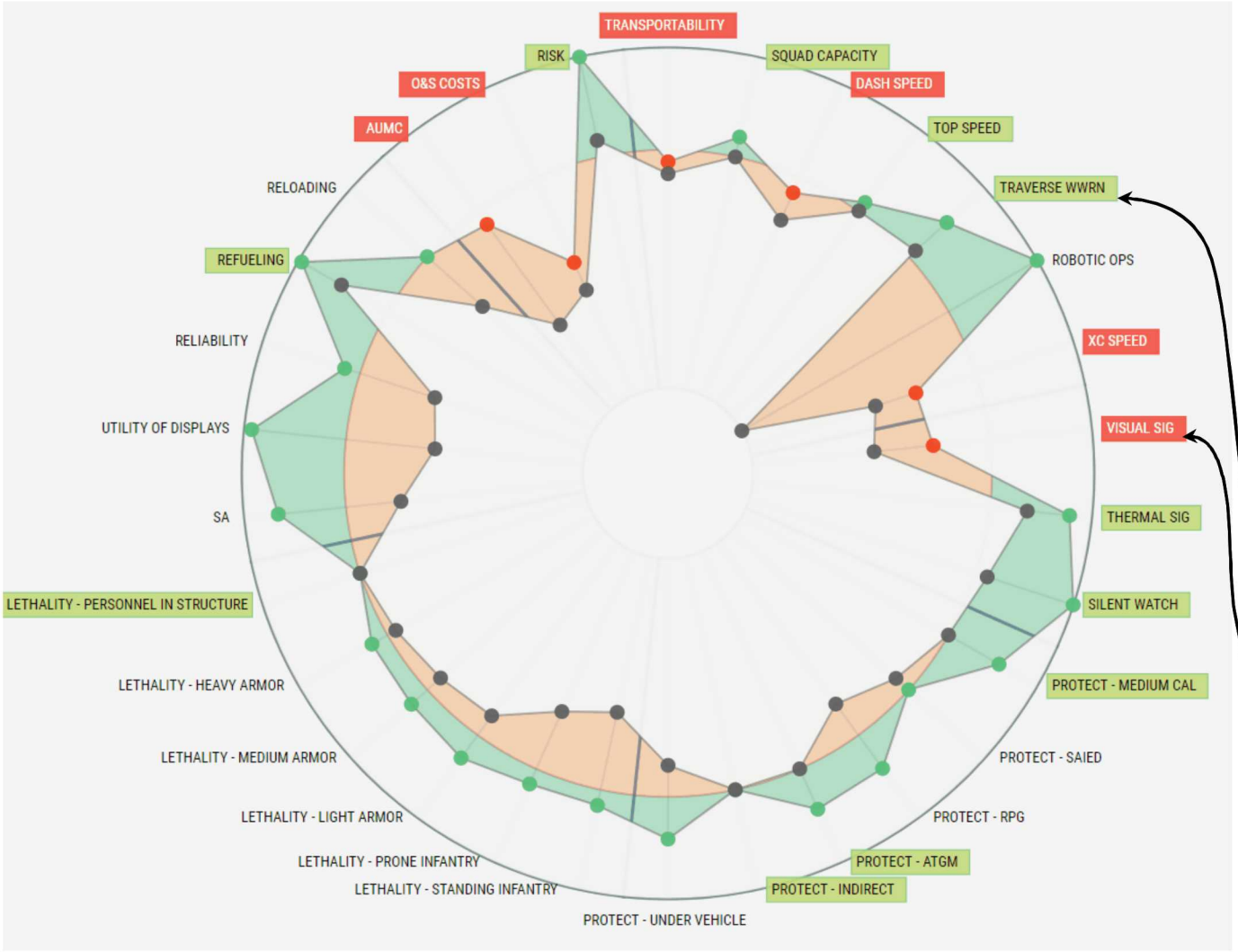

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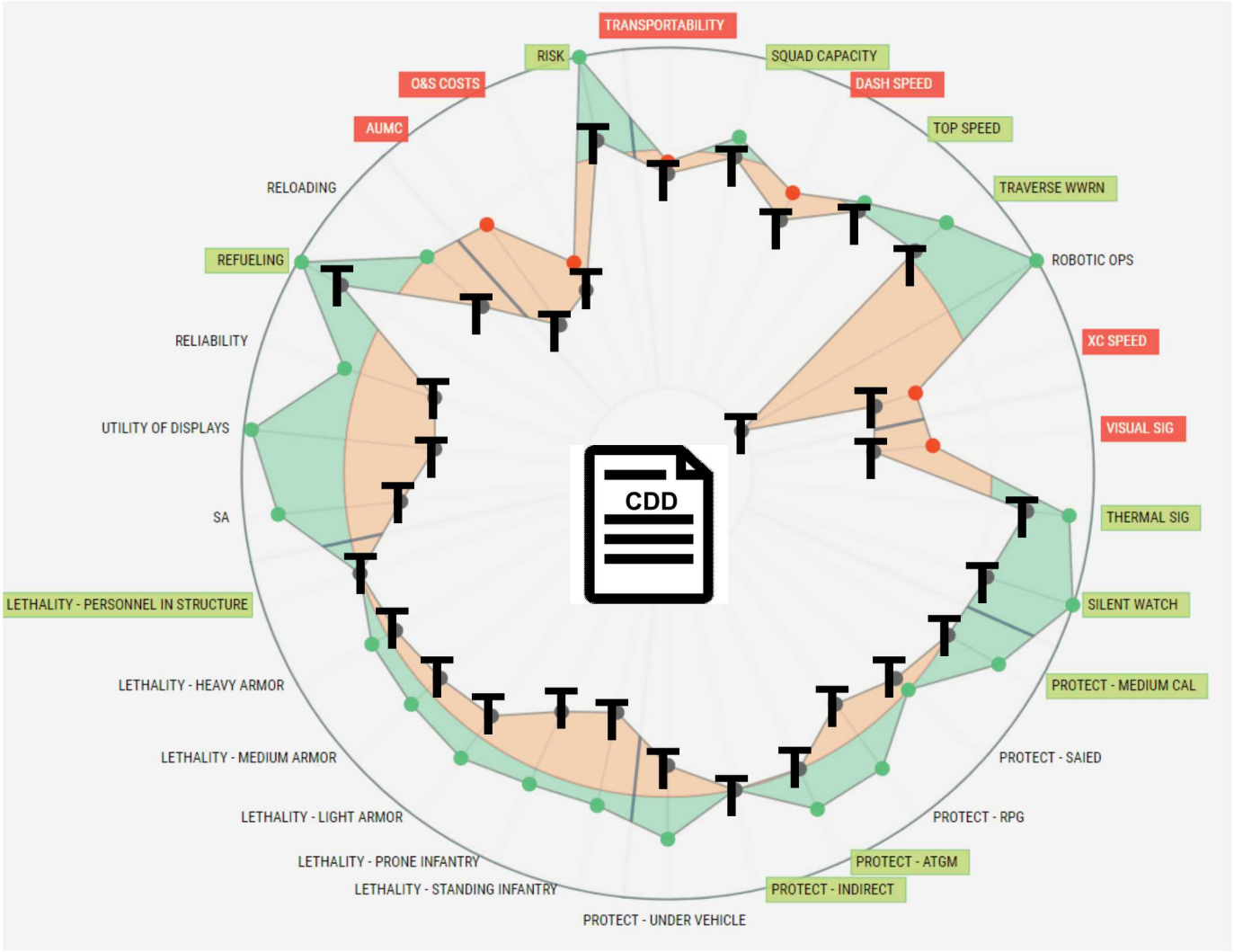

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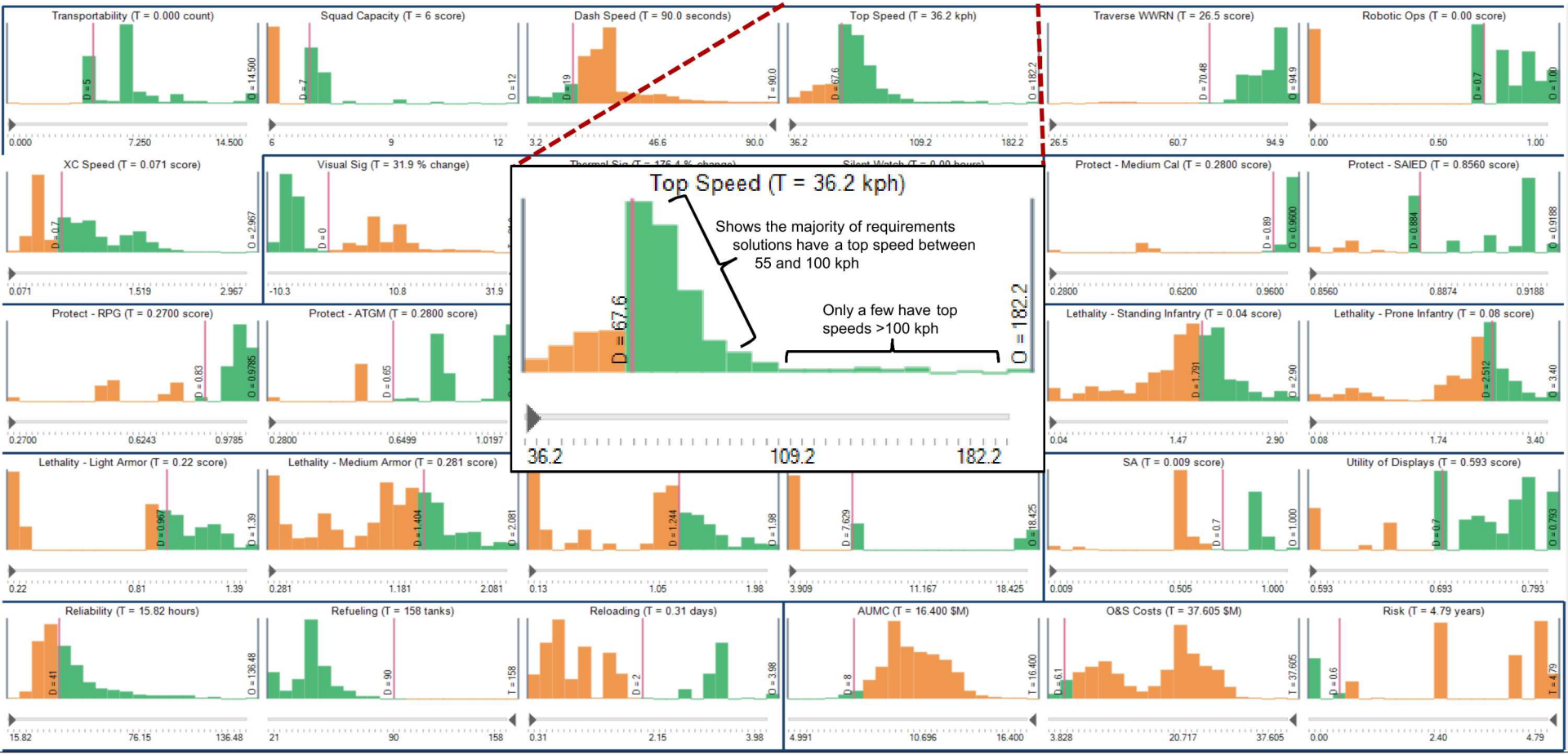
ARIES Result – insights and a complete set of achievable requirement values

ARIES Grid

- ARIES grid displays each system requirement, using the trade space optimization to generate a histogram of that requirement's optimal potential threshold values
- Related requirements are grouped within a border
- Each graph is laid out relative to **desired** and **possible** threshold levels for that requirement



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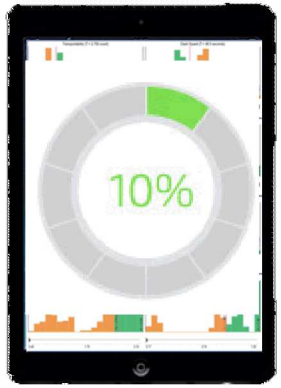
Long Term Interface Vision

Future versions of the UI plan to build upon the collaborative requirements discussion space, including the ability for individual users to customize their own views and see progress towards their desired threshold levels

Master Requirements Grid

SME 1



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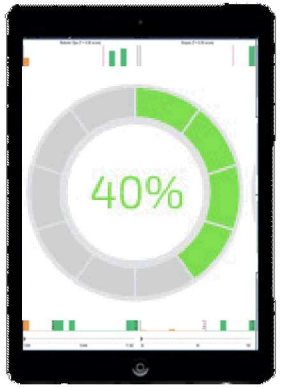
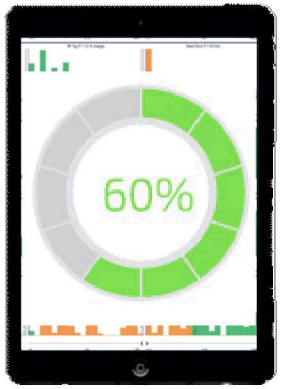


SME 3



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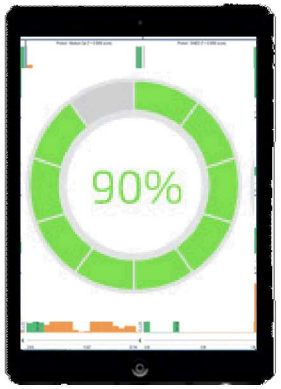

ARIES Benefits

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- ARIES process facilitates stakeholders identifying a **feasible set of values** for all requirements
  - Facilitates real-time **collaboration**
  - Enables **interactive exploration** of alternatives to reach consensus
- Outcome based on compromises, programmatic, and technological constraints
- Helps determine **achievable,** yet challenging **requirement values early** in a program **to inform a CDD**
  - **Minimizes** program **risk**
  - **Increases** chances of **program success**

Path Forward

- Sandia and CCDC GVSC have collaborated over the past year to advance ARIES to a production-ready analysis capability
- Initial capability demonstration and applications have focused on supporting the U.S. Army's Next Generation Combat Vehicles (NGCV) Program

- Future Improvements
  - Refine User Interface to improve usability/robustness
  - Refine analytic process
  - Automated Analytics
    - More quickly explain insights
    - Identify causes of requirement conflicts
    - Technology Option insights

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QUESTIONS

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BACKUP

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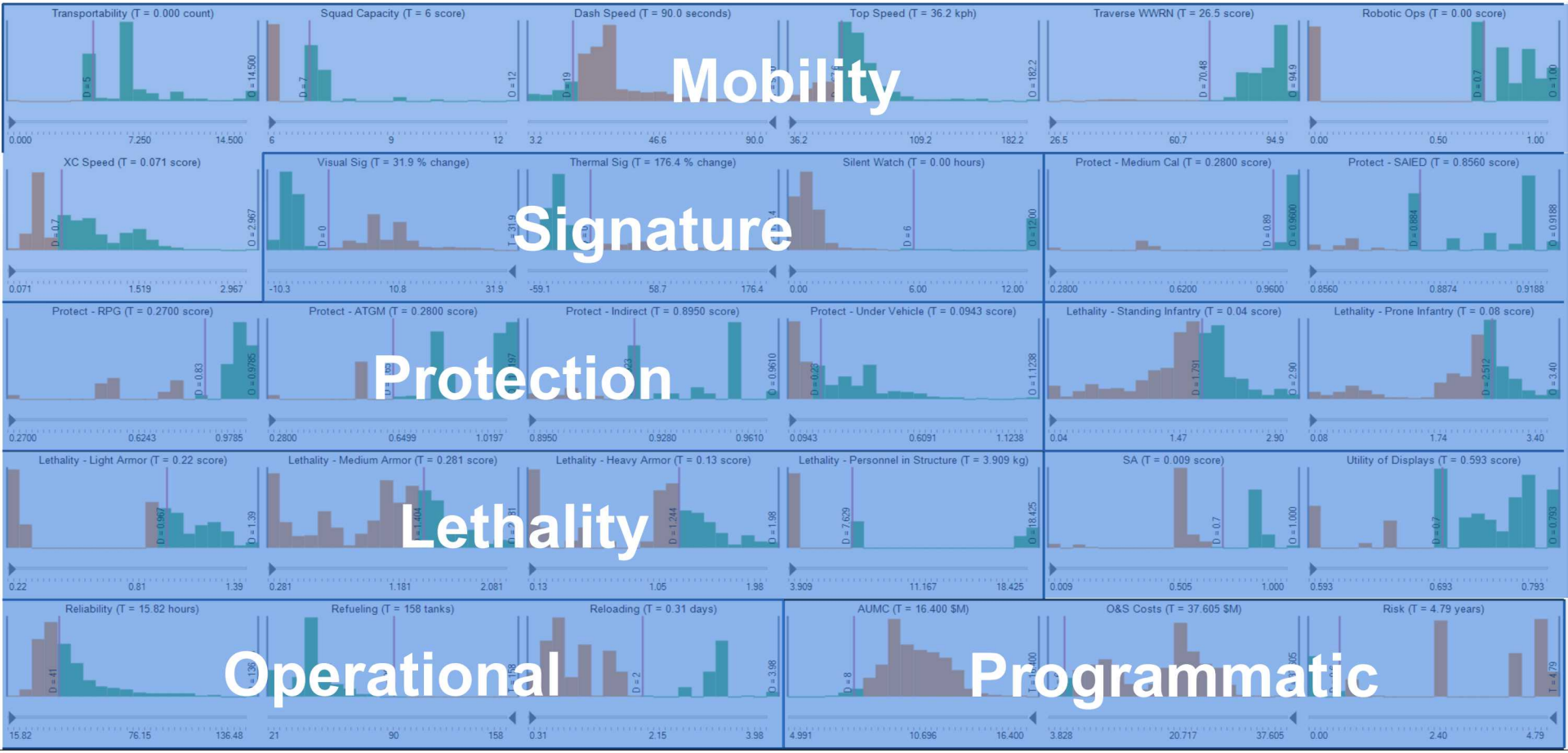

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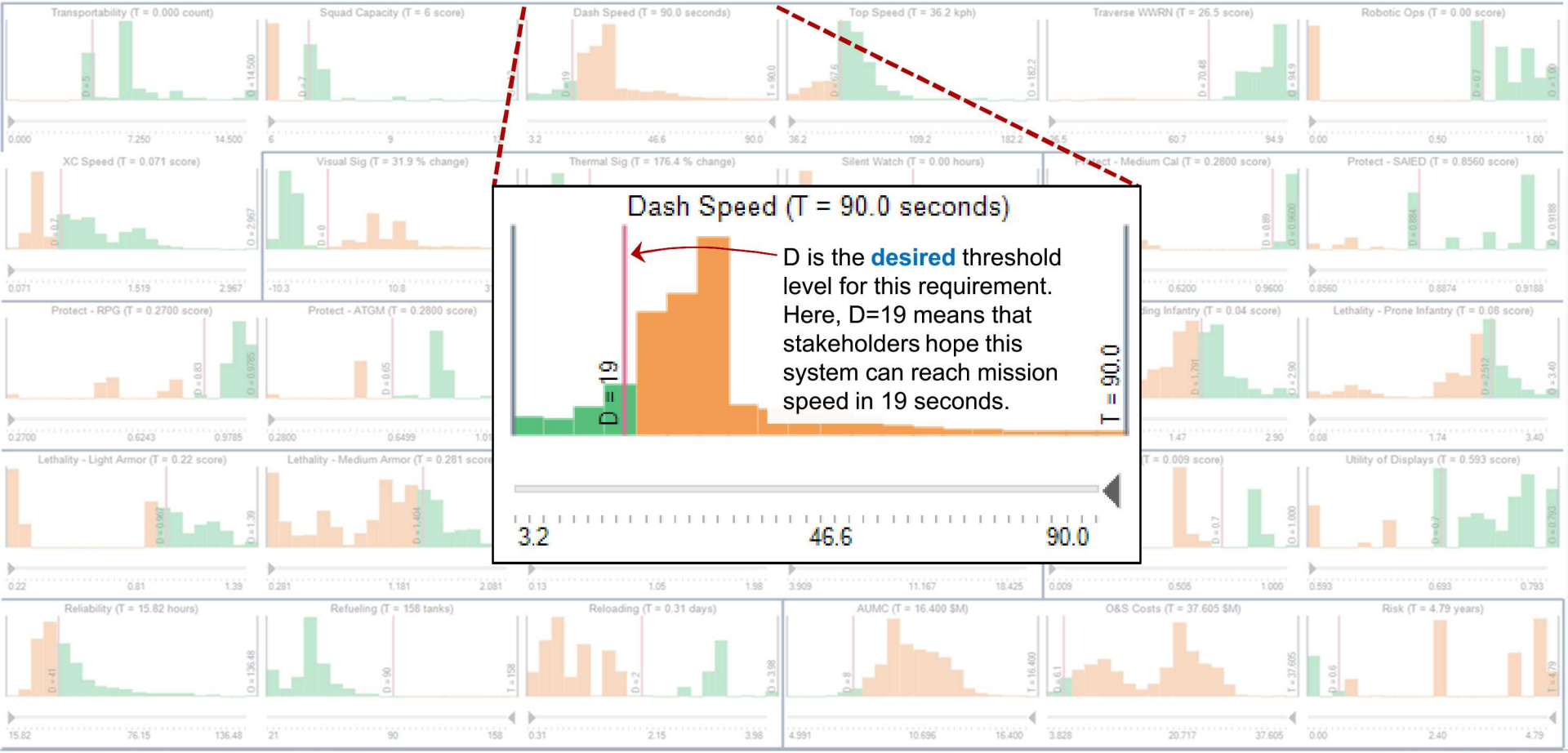

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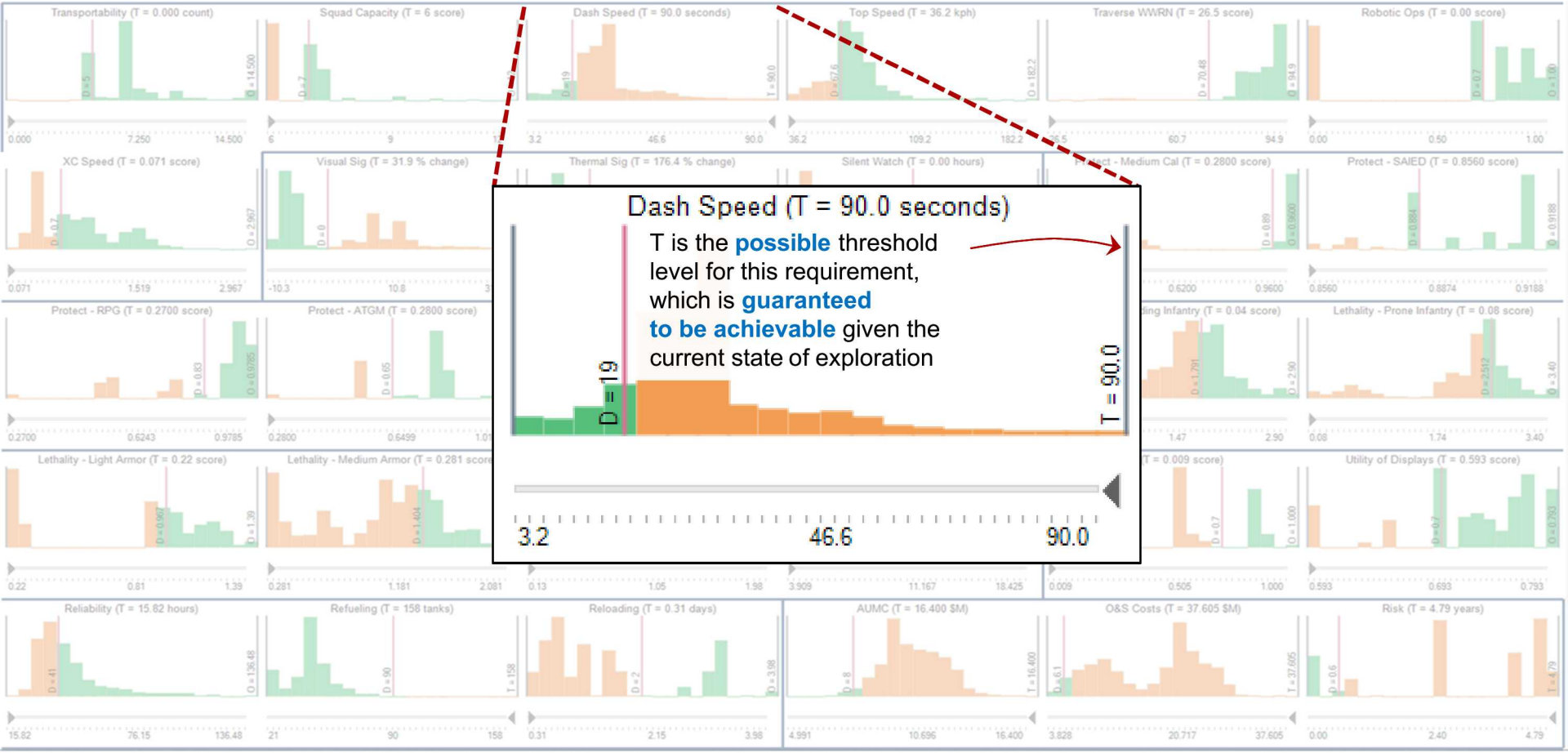

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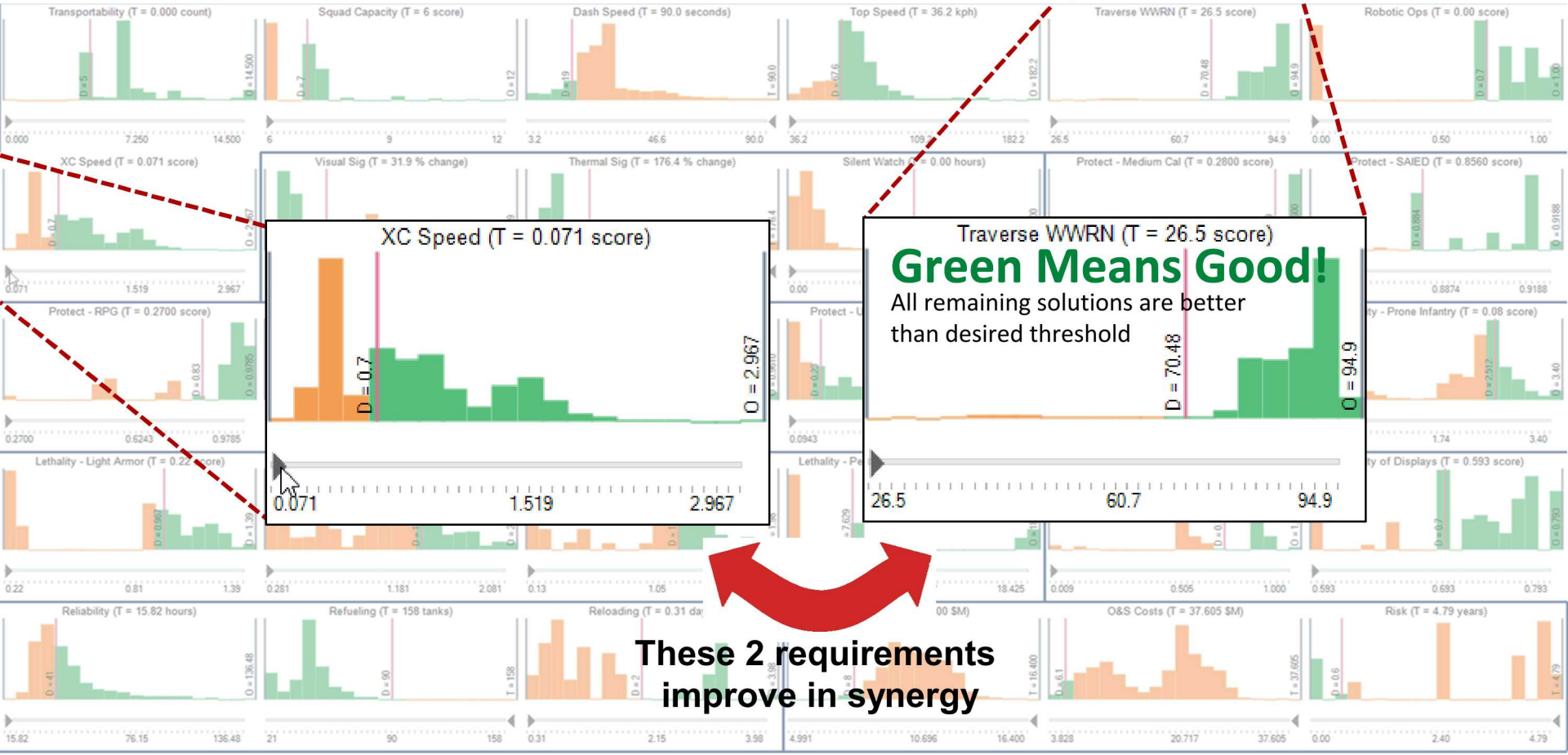

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