Presented to:

Annual International Test & Evaluation Symposium

AMRDEC Techniques and Methodologies for Predictive Signature and Damage Modeling of Unmanned Aerial Systems

IAW DoD Directive 5230.24, Distribution A

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Overview

- Process Overview
- UAS Modeling for Predictive Signature Modeling
- UAS Testing and Modeling for Predictive Lethality from Blast and Fragmentation
- Surrogate Target Creation Process
- Verification, Validation & Accreditation

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Background

AMRDEC

- Virtual Targets Center signature design process

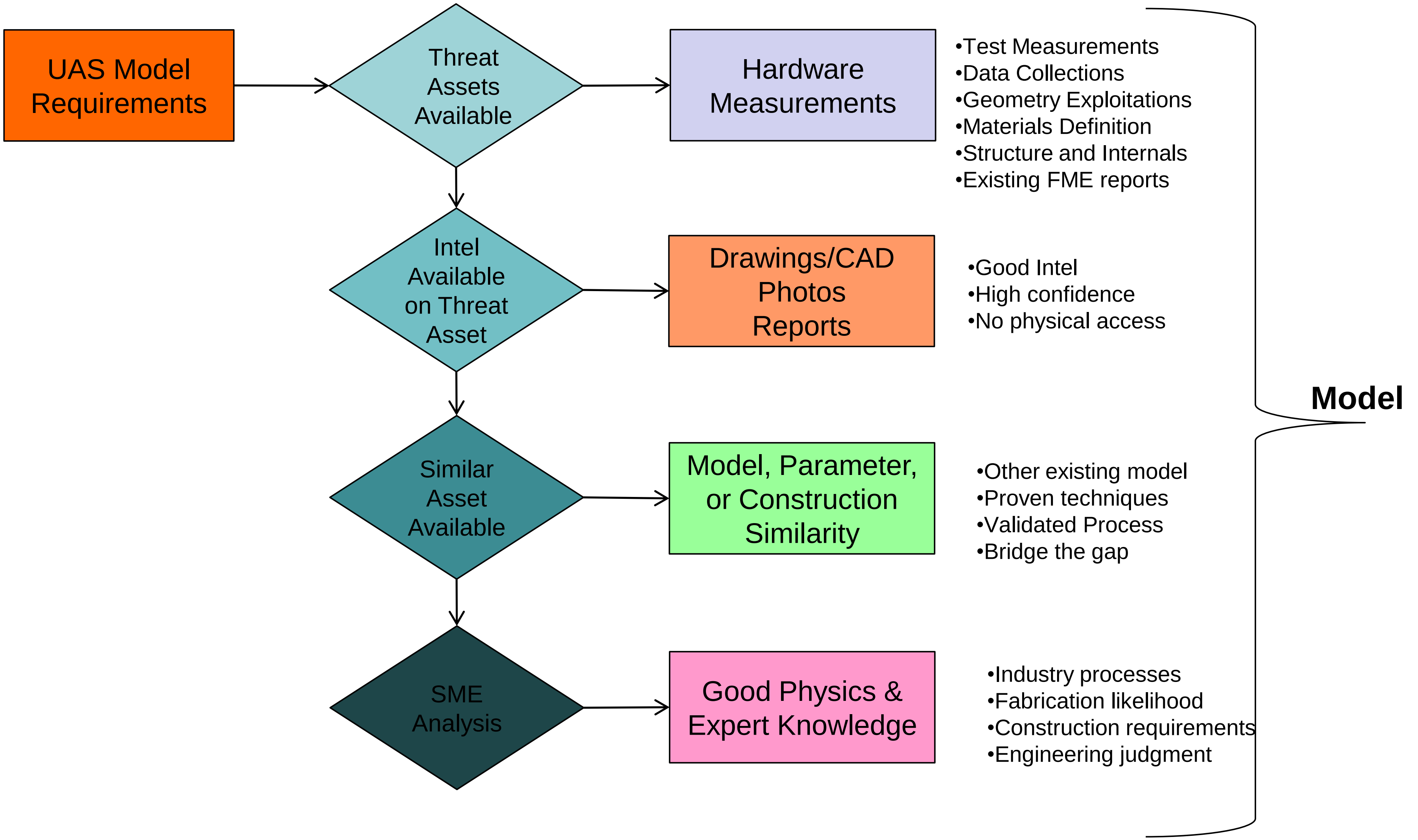
- Methodology used to model Unmanned Aerial Systems (UAS) Targets
  - Simulation models
  - Surrogate objects (hardware)
  - Includes limited or unavailable data cases

- VTC model validation process is proven and accepted by ATEC
  - Demonstrated with multiple radar and infrared models
    - Approximately 28 virtual target validations
  - Demonstrated with multiple hardware surrogate programs
    - 8 approved validation reports

- Process also supports threat representation accreditation

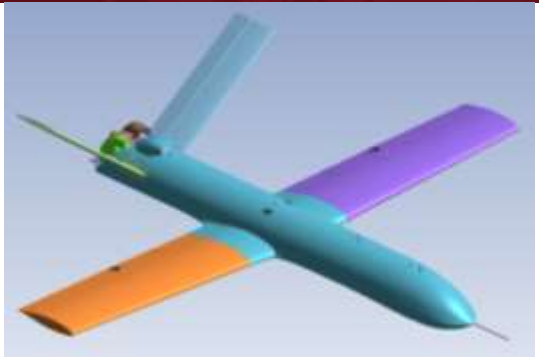
- Satisfies AR 5-11 and 73-1

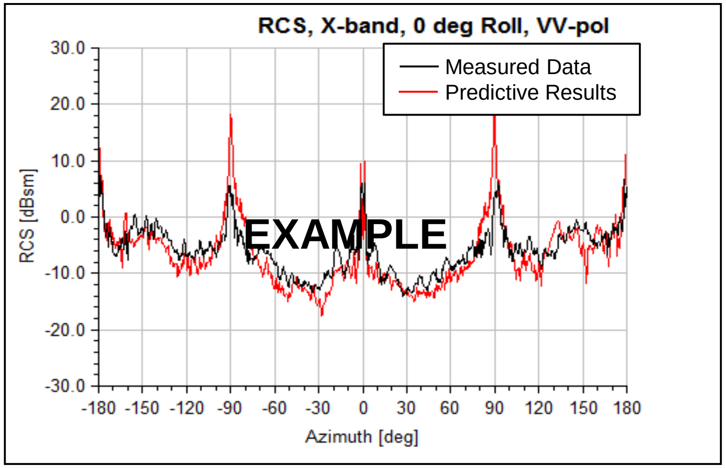
UAS Modeling Design Flow

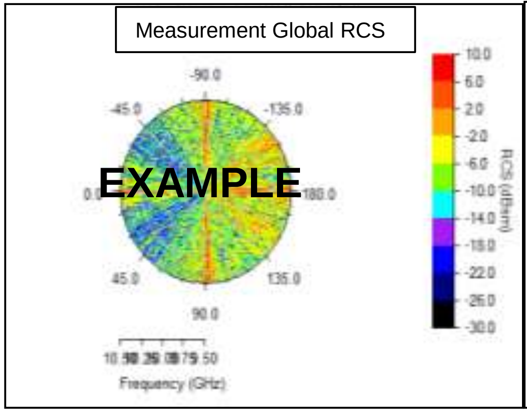


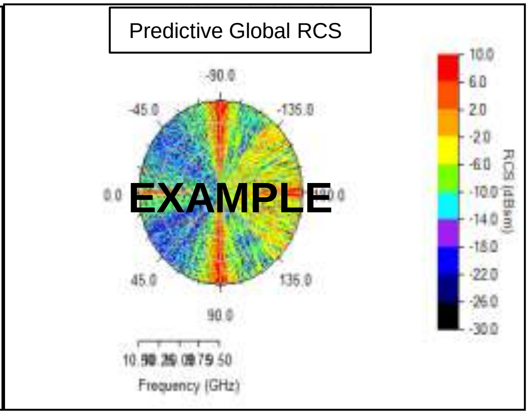
RCS Example for Similar Asset Development

- **RCS signatures needed for threat UAS**
  - Physical assets unavailable
  - Intel limited to basic line drawings
- **Solution**
  - Collect measurements on UAS
  - Build predictive model UAS
  - Validate predictive model of UAS against collected data
  - Utilize the same process, level of detail, and modeling strategy on the unavailable threat using Intel inputs
- **Result**
  - High confidence RCS signature model



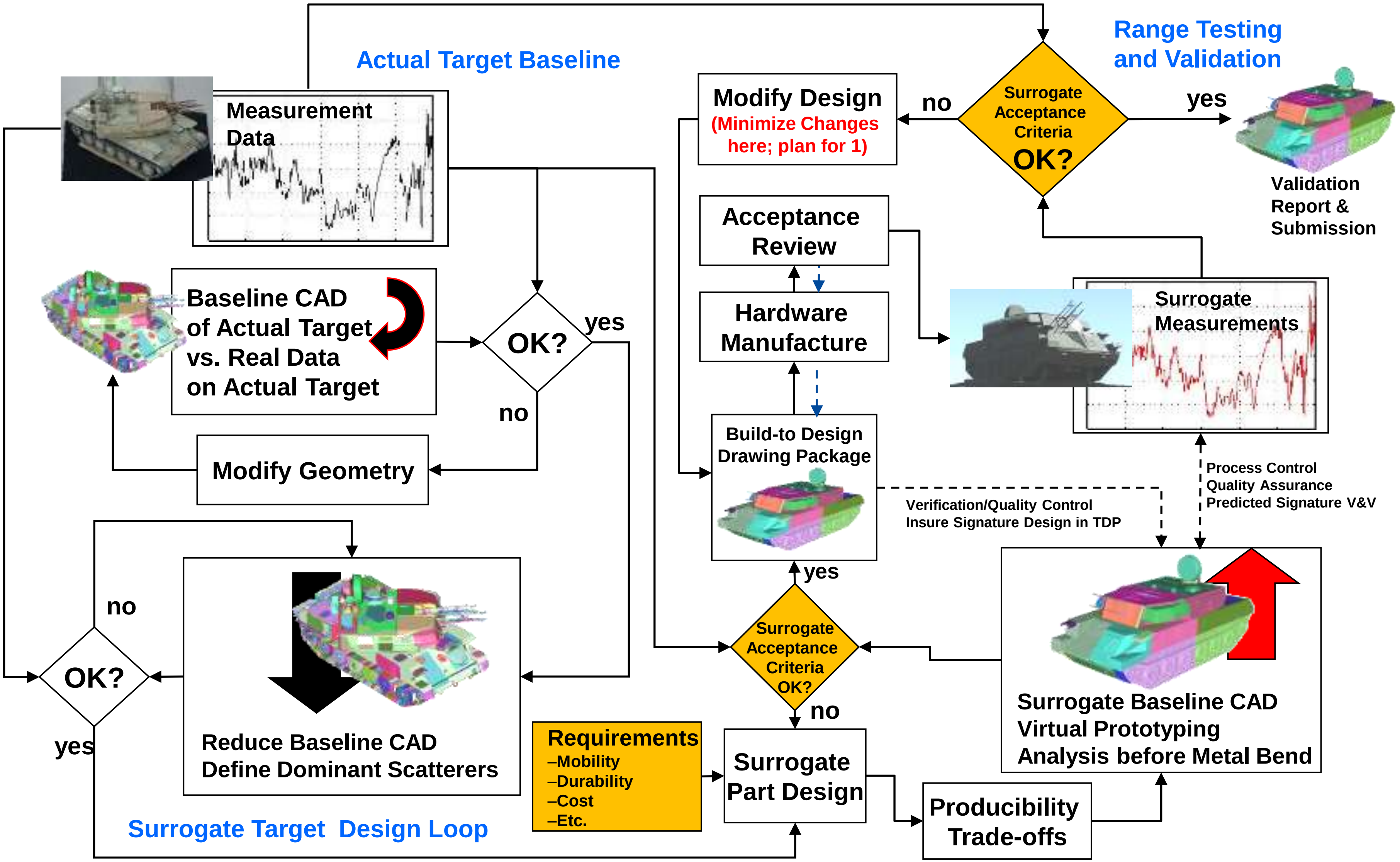






RCS Surrogate Design Process

Virtual Prototyping and Manufacturing Interface



UAV Vulnerability Characterization S&T Program

Purpose:

Determine the vulnerability of UAVs to fragment impact and blast effects; develop a lethality model to be used in assessing lethality against UAVs

Results:

- Test data for fragment impacts and blast effects on UAV targets
- Database of composite material lethality
- Predictive lethality model for UAV targets (composite structures)

Payoff:

- Determine effectiveness of air defense warheads against UAVs
- Determine safe separation distance of armed U.S. UAVs

Transitions (Area/System(s)):

- Applicable to several tech-base programs and AMRDEC customers – keeps us from overdesigning counter UAS weapons.

Test Facilities and Data Collection









Model Process and Design from a Validation Perspective

Validation is the process of determining the degree to which "validation objects" and their associated data are accurate representations of the real world from the perspective of the intended use(s). [2]

The key points of validation are:

•*Process*. Validation entails a formal and documented process.

•*Degree*. Validation quantifies degree of accuracy with respect to a real-world referent. Validation does not guarantee goodness, soundness, or applicability.

•*Intended Use*. Validation always has to consider intended use. An object is validated in context of an intended use. Validation does not imply universal use.

•One-to-one validation with empirical data is desired and "nice"

•Otherwise, one must use another authoritative reference set [1]:

1. Subject Matter Experts (SME) assessments to support credibility of results
2. Other similar referent data sets
3. Other similar validated results (M&S and empirical)

VTC modeling and design processes intrinsically utilize validation concepts

[1] DON M&S VV&A Implementation Handbook, 30 March 2004, Navy Modeling and Simulation Modeling Office.
[2] Department of Defense Standard Practice, Documentation of Verification, Validation, and Accreditation (VV&A) for Models and Simulations, MIL-STD-3022, dated 28 January 2008.

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CAD Hierarchy and Pedigree

AMRDEC

- No single CAD instantiation solves or supports all problems
- Many different aspects of model and design
  - RCS (Surface/Facet)
  - Mechanical/Fabrication (Surface/Solids models)
  - Blast Analysis (Step)
  - Fragmentation Analysis (BRL)
- Different formats and styles of CAD over technical regimes
- Develop common source CAD models
  - Ensure commonality, co-registration, and multi-use
  - Export formats and share geometry as appropriate and possible
    - Can require post processing
  - Create additional or specific CAD as warranted
    - For example- higher level of detail internals needed for RCS but not for Lethality
- Example
  - High fidelity RCS model as Source
  - Export parts for use in BRL-CAD and Frag Analysis
  - Export .step files to support Blast Analysis

Questions/Comments

Questions?

Comments?