Joint Technical Coordinating Group for Munitions Effectiveness

JTCG/ME

Test Data Supporting Training and Combat Operations

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JMEMs

A SOLUTION TO THE WEAPONEERING PUZZLE

Presentation Overview

JTCG/ME

Introduction to the JTCG/ME

- *Charter and Mission*
- *Organization*
- *Weapons Effectiveness Estimation*
- *Products*
- *Users and User Requirements Generation*

JTCG/ME Testing and Training Initiatives

- *Integration Challenges*
- *A current initiative*
  - *Advanced Joint Effectiveness Model*
  - *Joint Live Fire Testing*
  - *Credible Training & Combat Ops Support*

Conclusion

- *Additional Challenges*
- *Responsiveness to Changing Warfare*

Charter and Mission

JTCG/ME

JTCG/ME CHARTER

DEPARTMENT OF THE ARMY
HQS US ARMY MATERIEL COMMAND
WASHINGTON DC, 20315

DEPARTMENT OF THE NAVY
HQS NAVAL MATERIEL COMMAND
WASHINGTON, DC, 20300

DEPARTMENT OF THE AIR FORCE
HQS AIR FORCE LOGISTICS COMMAND
WRIGHT-PATTERSON AFB, OHIO 43433

DEPARTMENT OF THE AIR FORCE
HQS AIR FORCE SYSTEMS COMMAND
ANDREWS AFB, WASHINGTON, DC, 20331

CHARTER
FOR
JOINT AMC/NMC/AFLC/AFSC
COMMANDERS
JTCG/ME

DATE: 10 Dec 1968

Reconcile Gaps and Inaccuracies in the Data Then Published by the Services on Air-to-Surface Non-nuclear Weapons

Joint Service Authenticated Products

Prepare and Publish Joint Munitions Effectiveness Manuals (JMEMs) for Fielded Systems

Develop, Maintain and Update Databases

- *Weapon Effectiveness*
- *Weapon Characteristics*
- *Delivery Accuracy*
- *Reliability*
- *Vulnerability*

Standardize Methodologies

Conduct Special Studies/Activities

- *Joint Live Fire (JLF)*
- *Data Collection Efforts from Operational Employment*
- *JMEM Seminars*

JTCG/ME

Organization

JTCG/ME

Director Operational Test & Evaluation

DOT&E/LFT&E

OSD Oversight and Funding

JTCG/ME Steering Committee

Program Office
APG, MD

JTCG/ME Steering Committee

Army Materiel Command	Mr. David Shaffer (Chair)
Air Force Materiel Command	Dr. Mike Caluda
Naval Materiel Establishment	Mr. Danny Brunson
J-8	Brig Gen Stephen M. Goldfein
U.S. Marine Corps	Dr. Alfred Brandstein
Defense Intelligence Agency	Mr. Jim Hempstead
Def Threat Reduction Agency	Dr. Leon Wittwer

Air-to-Surface
Eglin AFB, FL

Operational Users Working Group (OUWG)

Surface-to-Surface
APG, MD

OUWG

Anti-Air
China Lake, CA

OUWG

Vulnerability
Dahlgren, VA

Offices of Primary Responsibility

Army - MG J. R. Snider (AMC)

Navy - RADM D. G. Bowler (N70)

Air Force - Dr. Mike Caluda (AFMC)

Publication Management Office - Tinker AFB

JMEM Production Contractor - Oklahoma State University

Joint Technical Coordinating Group on Aircraft Survivability

SURVIAC — Survivability/ Vulnerability Information Analysis Center

Joint Live Fire (JLF) Munitions Effectiveness

Joint Munitions Effectiveness

JTCG/ME

JMEM Weapons Effects Process

Weapons Characteristics

- Warhead
- Guidance Methods
- Direct/Indirect Hits
- Fuze Functioning
- Reliability
- Precision/Ballistic Errors

Delivery Accuracy

- Aiming/MPI Error
- Target Location Error
- Precision/Ballistic Error
- Acquisition
- Effects of Threat Environment and Countermeasures

+

Target Vulnerability

Target Model Sensitivity To:

- Penetration
- Fragments
- Blast
- Fire and Explosion

Operational Encounter Conditions

Weapon Effectiveness

Target-Weapon Interaction Analysis

Paper Products → **Diskettes** → **CD-ROMs** → **WEB Based Products**

Joint Munitions Effectiveness

JMEM Development Process

JTCG/ME

~ 2 year process

Intelligence Collection/ Production

Command identified targets ~ 660

- *Ground*
- *Ship*
- *Aircraft*
- *Infrastructure*
- *Personnel*

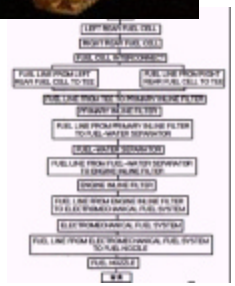
Colliseum

Support …

- *NGIC*
- *MSIC*
- *NAIC*
- *ONI*
- *DOT&E/TSO*

Target Geometric Model Development

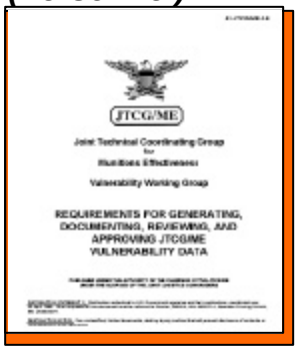
- *BRL-CAD (Ground targets)*
- *FASTGEN (Air targets)*
- *STMG (Infrastructure)*



- *FMECA*
- *Kill definition*
- *FALT trees*
- *Component data*

Vulnerability Data Development

- *AJEM or COVART (Air targets)*
- *AJEM MUVES S-2 (Surface Mobile)*
- *MEVA-GF (Ground fixed)*
- *ORCA (Personnel)*

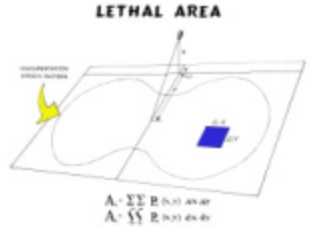


- *Fragmentation*
- *Blast*
- *Shaped Charge*
- *EFP*
- *Fire*

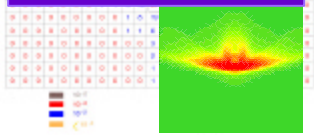
Effectiveness Indices or Lethal Areas Generation

Joint MAE

- *General Full Spray*
- *SWAMAE*



Weapon Characteristics and Delivery Accuracy



Specific weapon and Specific target Interaction

PD or EFD Calculation/ Estimation

- *WinJMEM/TARCOM*
- *ARTQUIK/SAMSITE*
- *BAM*
- *BAS*
- *CDM*

Effectiveness Program

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Delivery Accuracy

- *Aiming/MPI Error*
- *TLE*
- *Precision/Ballistic Error*
- *Acquisition*
- *Effects of Threat Environment and Countermeasures*

Joint Munitions Effectiveness

JTCG/ME Integrated CD-ROM Products

Joint Anti-Air Combat Effectiveness (J-ACE)

Air Superiority v2.0

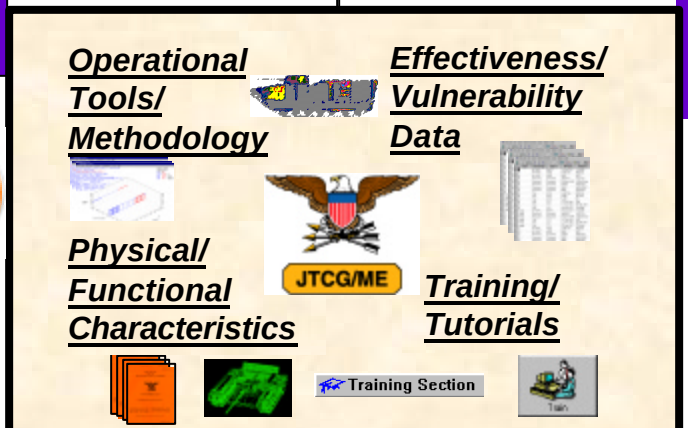
- Air-to-Air Weapons … Surface-to-Air Threat (Red-on-Blue v2.0)
- Interactive "Compute" Module
- Air-launched Missile Fly-out Simulation
- Probability of Kill Data

Air Defense v1.0

- Land-Based Surface-to-Air Weapons
- Interactive "Compute" Module
- Calculates Intercept Points for User-Selected Engagement Conditions
- Probability of Kill Data

JMEM/AS Weaponeering System (JAWS) v2.2.1

- Air-to-Surface Weapon Systems
- Pre-calculated data and Embedded Methodologies
- Operational Tools … Bridges and Buildings
- Vulnerability Data, Effectiveness Indices and Pre-calculated Single Shot Probability of Damage



Special Operations Target Vulnerability and Weaponeering Manual v2.0

- Special Operations Mission Planners and Operators
- Single Shot PK and Number of Rounds Required to Achieve Desired Kill Level

JMEM/SS Weapons Effectiveness System (JWES) v2.0

Indirect Fire Systems

- Pre-calculated Effectiveness Data and Operational Tools … Red-on-Blue … Navy Ship-to-Shore
- Number of Rounds Required to Achieve Desired Damage Level

Direct Fire Systems

- Pre-calculated Effectiveness Data and Operational Tools … Red-on-Blue
- Vulnerability Data, Probability of Kill, Probability of Hit, and Number of Rounds Required to Achieve Desired Damage Level

Joint Munitions Effectiveness

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JMEM/AIR-TO-SURFACE WEAPONEERING SYSTEM (JAWS)

JAWS FEATURES

- Interactive Browser
  - Weapons Characteristics
  - Target Vulnerability
  - Risk Estimates for Friendly Troops
  - Target Acquisition
  - Weaponeering Guide
  - Delivery Accuracy
- Weaponeering
  - Lookups
  - Programs
- Interactive Training

JAWS is a single source for air-to-surface weaponeering and target vulnerability

EMBEDDED MODULES AND TOOLS

- Windows Automated Weaponeering Program (WINJMEM)
- Target Complex (TARCOM) Computer Program
- Target Vulnerability Data Access Program (TVDAP)
- Penetration and Cratering (PC-EFFECTS)
- Joint Smart Weapons Module (JSWM)
- Bridge Analysis System (BAS)
- Paveway Munitions Planning Tool (PMPT)
- Collateral Damage Module (CDM)
- Building Analysis Module (BAM)
- GAU-8 Gun Method

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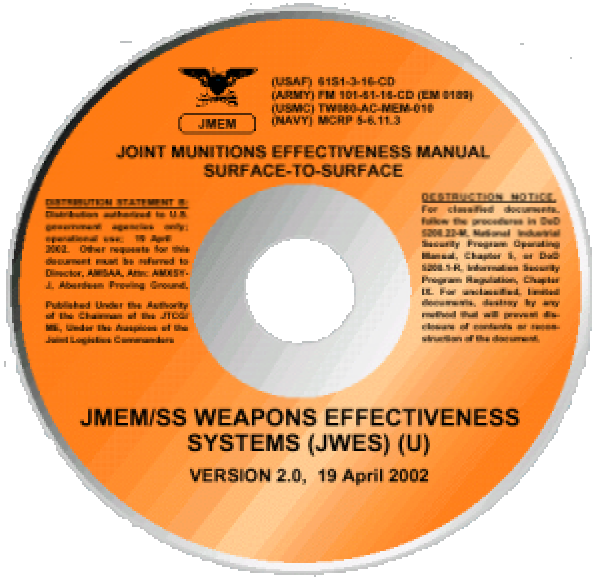
JMEM/SURFACE-TO-SURFACE WEAPONS EFFECTIVENESS SYSTEMS (JWES)

JWES is a single source for surface-to-surface weaponeering and target vulnerability

JWES FEATURES

- *Interactive Browser*
  - *Military Operations in Urban Terrain (MOUT)*
- *Weaponeering*
  - *World Artillery and Mortar Systems (WAMS) – Indirect Fire*
  - *World Infantry and Tank Systems (WITS) – Direct Fire*



EMBEDDED MODULES AND TOOLS

- *Effectiveness Guide*
- *Surface to Air Missile Site (SAMSITE)*
- *Simplified Artillery Projectile Effectiveness Model (ARTQUIK)*
- *Fraction of Target Incapacitation (FBAR)*
- *Passive Vehicle Target Model (PVTM)*

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JOINT ANTIAIR COMBAT EFFECTIVENESS: AIR SUPERIORITY (J-ACE: AS) & AIR DEFENSE (J-ACE: AD)

J-ACE:AS and J-ACE:AD are sources of information on antiair and air defense weapon effectiveness against air targets

J-ACE:AS and J-ACE:AD FEATURES

- *Interactive Browser (Both)*
  - *Weapon and Target Characteristics*
- *Weaponeering*
  - *Antiair Missile System Effectiveness (J-ACE: AS)*
  - *Antiair Gun Weapon System Effectiveness (J-ACE: AS)*
  - *Air Defense Weapon System Effectiveness (J-ACE: AD)*

EMBEDDED MODELS

- *Joint Antiair Model (JAAM) – J-ACE: AS*
- *Gun Computer-Aided Joint Munitions Effectiveness Manual (GunCAJ) – J-ACE: AS*
- *Joint Services Endgame Model (JSEM) – J-ACE: AD*

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SPECIAL OPERATIONS TARGET VULNERABILITY AND WEAPONEERING MANUAL (SOM)

SOM is used for special operations forces in planning attacks against selected targets

SOM FEATURES

- *Critical Target Elements*
- *Weapons Effectiveness Information*

EMBEDDED FEATURES

- *Pre-calculated values - document is browsable in html*

JTCG/ME Products

JTCG/ME

Models

- Advanced Joint Effectiveness Model (AJEM)
- Joint Services Endgame Model (JSEM)
- ORCA
- COVART/FASTGEN
- BEAMS
- PENCRV3D
- Matrix Evaluator
- Fortran Stickbomb
- GFSM/GFSP
- Complex Target
- Bridge
- Attack Assess Comp Program

Service/Agency Owned Models

- Surface Mobile Target Methodology (PDAM, MUVES/S2,COVART)
- FATEPEN
- GENESIS
- Advanced Survivability Assess Program (ASAP)
- Munitions Effectiveness Assessment (MEA)
- MEVA-GF/MEVA-MOUT
- SURFAC
- SUBVEM

CD-ROMs

- JAWS
- JACE-AS
- JACE-AD
- JWES
- Special Operations

Databases

- JPIAS
- CVAA
- Air Target Geometry
- Ground Target Geometry
- Visualization Tool
- Ground Target Acquisition
- Data Review
- Data Generation
- TVDMS

Operational Tools

- WINJMEM
- Target Complex (TARCOM)
- PC-Effects
- Bridge Analysis System (BAS)
- Building Analysis Method (BAM)
- Joint Anti-Air Model (JAAM)
- Joint Smart Weapons Module (JSWM)
- Collateral Damage Module (CDM)
- Hard Target Analysis
- Paveway Munitions Planning Tools (PMPT)

Service/Agency Owned Operational Tools

- Fraction of Target Incapacitation (FBAR)
- ARTQUIK
- Passive Vehicle Target Model (PVTM)
- Surface-to-Air Missile Site (SAMSITE)

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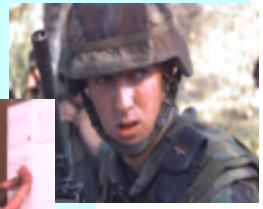
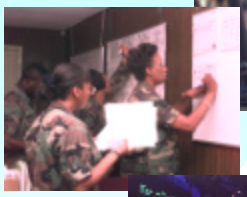
JMEM Users

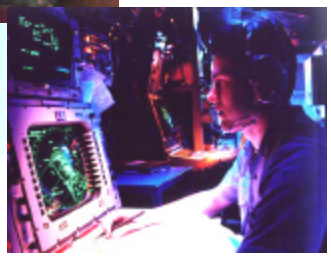
Warfighters	DoD/Joint/Service Planners	Service Acquisition Communities
• Operational Weaponeering • Mission Planning • Tactics Development • War Gaming/Training	• Mission Area Analysis • Requirement Studies • Procurement Planning (Ammunition/Equipment)	• Performance Assessment • Analysis of Alternatives (AOA) • Improved/Enhanced Design • Survivability Enhancement
Unified Combatant Commands, Army/ Navy/Air Force/USMC Operators/Units and Weaponeers, Service Schools	Joint Staff (J8/J2), OSD, JWAC, BMDO, DTRA, DIA, Service Major Commands and Agencies	PEO/SPO/PMs, Analytical Organizations, Service T&E Commands/Agencies, Service Labs/RDECs, Academia, DoD Contractors

JAWS v2.2 (Attack) was released in support of Operation Enduring Freedom

- Weaponeering/Target List Development (KAOC, CAOC)
- Collateral Damage Assessment (JWAC)
- Battle Damage Assessment (DIA)
- Mission Planning Support (AFATDS, CMSA ...)
- Capabilities-Based Munitions Requirements (DoD)
- Muntions Effectiveness Assessment (DTRA)
- Air Force/Navy/Joint Targeting Schools
- JEFX/NTC FTX
- Performance Assessments (JSOW, SFW, BAT ...)
- Counterproliferation ATD







Broad User Base … Supports Critical Warfighting Needs

Requirements Generation Process

JTCG/ME

Institutionalize integrated requirements build process (Combatant Commands, Services, and Operational Users Working Groups (OUWGs))

- *Living Documentation*
- *Continuously update and validate requirements … top down/bottom up*
- *Visible and accessible to support program build and monitor progress*

Joint Staff (J-8)

Annual Requirements Data Call

Combatant Commands and Services

- *Generate/Modify Top Down Requirements*
- *Review and validate priorities*

J-8, J-2, Users and Program Office Requirements Integration

- *Establish 1 to N list*

WGs and OUWGs

- *Semi-Annual*
- *Generate/Modify Bottom Up Requirements*

Program Office, WGs and OSU Requirements Assessment

- *Determine resource requirements/timeline*

Program Build

Project Data Sheet Development

User Feedback

Drives Program Build Process

Living Requirements Document

Joint Munitions Effectiveness

JTCG/ME

Integration Challenges…

- DOT&E supports decisions on weapon system ***Acquisition*** (to SECDEF, USD (AT&L), Congress)
- JTCG/ME supports decision on weapon system ***Application*** (to warfighters in planning, training and combat operations)

- ***Application*** support must be throughout the weapon life cycle and must account for changes in:
  - Weapon Capability
  - Threat
  - Application Objectives
- JMEM must be distributed to & in convenient format for the warfighter

Can a Testing and Training task help to meet this challenge???

- JMEM developed using models
- Credibility is that of the models
- Model "testing" is required (expensive, complex, slow)
- Part of a Verification, Validation and Accreditation (VV&A) process

- The test community does not focus on modeling
- The modeling community does not focus on testing
- Both need to better focus on warfighter support through JMEM

Advanced Joint Effectiveness Model (AJEM)

JTCG/ME

JTCG/AS

JTCG/ME

Credibility of JTCG Models is Key to Continued Warfighter Support!

- Provides a *single* DoD standard tool for evaluating:
  - ✓ Vulnerability of aircraft, missiles & ground-mobile targets
  - ✓ Lethality and Effectiveness of munitions
- Facilitates Coordinated Joint Service Vulnerability and Lethality Methodology:
  - ✓ Research and Development
  - ✓ Verification, Validation and Accreditation (VV&A)
  - ✓ Estimates

www.ajem.com

Joint Munitions Effectiveness

JTCG/ME

Joint Live Fire

JLF established objectives …

1. Gather empirical data on the vulnerability of front-line U. S. systems to foreign weapons and the lethality of U. S. weapons against foreign systems,

2. Provide insight into design changes necessary to reduce vulnerabilities and improve lethalities of U. S. weapons systems,

3. Enhance the database available for battle damage assessment and repair,

4. ***Validate current vulnerability and lethality methodologies.***

JLF Future Emphasis …

V/L Methodology Validation
(JMEM Oriented Projects)

Support Acquisition Upgrades

Other previously established objectives…

JTCG/ME

JTCG, AJEM, JLF and Warfighter Support

- Credible V/L methodology is the bridge between JTCG and JLF
- Ensure V/L models predict actual results
- Restructure JLF testing to support V/L model validation
  - Pre-shot predictions and post-shot analysis
  - Component tests may be required
  - RED-on-BLUE and BLUE-on-RED
- Use credible models to develop credible JMEM
- Accreditation will be an ongoing effort
  - Broader application
  - Higher resolution/confidence

Integration Supports Life Cycle Weapon System Evaluation for the Warfighter

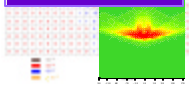
The key to <u>good testing</u> is a close tie between a test and the development of a method used in a model, improvement to a model, or validation between a model prediction and the test results

JTCG/ME

Integration Supporting Warfighter Training and Combat Operations

JMEM Development Process

~ 2 year process

Intelligence Collection/ Production	Target Geometric Model Development	Vulnerability Data Development	Effectiveness Indices or Lethal Areas Generation	PD or EFD Calculation/ Estimation
Command identified targets ~ 660 • Ground • Ship • Aircraft • Infrastructure • Personnel Gallisellin Support … • NGIC • MSIC • NAIC • ONI • DOT&E/TSO	• BRL-CAD (Ground targets) • FASTGEN (Air targets) • STMG (Infrastructure)   • FMECA • Kill definition • FALT trees • Component data	• AJEM or COVART (Air targets) • AJEM MUVES S-2 (Surface Mobile) • MEVA-GF (Ground fixed) • ORCA (Personnel)  • Fragmentation • Blast • Shaped Charge • EFP • Fire	Joint MAE • General Full Spray • SWAMAE  Weapon Characteristics and Delivery Accuracy  Specific weapon and Specific target Interaction	• WinJMEM/TARCOM • ARTQUIK/SAMSITE • BAM • BAS • CDM Effectiveness Program JTCG/ME Delivery Accuracy • Aiming/MPI Error • TLE • Precision/Ballistic Error • Acquisition • Effects of Threat Environment and Countermeasures

Joint Munitions Effectiveness

18

JLF Test Results → Model VV&A → Credible Joint V/L Model → Credible Data for Training, Planning and Combat Operations

Joint Munitions Effectiveness

JTCG/ME Program Challenges

JTCG/ME

Data Generation and Documentation

- *Data Shortfalls for Critical Weapon/Target Pairings*
- *DoD 5000.2R … Require JMEM production at IOC … Methodology coordinated with JTCG/ME … Impact on Developmental Systems?*
- *Acquisition reforms impact on leveraging Service data*
- *Strategy to capture data below ACAT 1*

Methodology and Tool Standardization

- *Collateral Damage Assessment*
- *Bridge Analysis System*
- *Building Analysis Module*
- *Hardened Target Module*
- *Smart Weapons*
- *Target Acquisition*
- *V/L and Endgame Model*
- *Target Oriented JMEMs*

Product Configuration Management & Maintenance

- *Services Shifting Responsibility*
- *Increasing percent of budget … less discretionary funds*
- *Making Significant Progress … "Procedures for Accreditation of Software by the JTCG/ME"*
- *Focusing on Most Critical Areas*

Product Generation and Distribution

JTCG/ME Product and Information Access System

- *Consistent with JV2020 Goals*
- *Key to Responsiveness*
- *Technology Provides Opportunity*

JPIAS

Emerging User Requirements

- *Training*
- *Developmental Systems*
- *Data for Joint Studies*
- *Counter Proliferation*
- *Non-lethal Weapons*
- *Information Operations*
- *Directed Energy Weapons*

Growing requirements continue to exceed available resources

JTCG/ME

JMEM Responsive to Changing Warfare Environment

Increased Weapon Systems Complexity

- Precision Guided Munitions – in ODS 9%, Kosovo 35%, Afghanistan ~70% of expended munitions by Combatant Commands
- Available inventory constrains operational use … each item critical
- All weather capability needed … increased use of GPS … multi-mode terminal seekers
- Non-kinetic capabilities increasingly employed … DE, IO, etc.

Requires methodology/data for newly fielded and developmental systems

Integrated Planning for Joint/ Coalition Operations

- Coalition Operations becoming the norm … no longer US only
- Must have buy-in and participation of all nations
- Strengthening the exercise program is key to success

Requires availability of tools to planning cells … integration into Mission Planning Systems

Demanding Operational Environment ...

- 24 hour, all weather, precision engagement, restricted air-space, great distances from launch point to target, extraordinary concerns for collateral damage and loss of life
- Reduced planning timelines … shortened targeting cycle
- Information flow is critical

Methodology requires … shorter product cycle times ... WEB based distribution

Evolving Target Set

- Hard and Deeply Buried
- WMD
- MOUT
- Physical Infrastructure
- Networks … Information Systems
- … functional & physical effects

Requires accurate methodologies … effects based capability

Current Operations

Significant cost to replace expended inventory

Timely, accurate and complete JMEMs are critical … Small Investment ⇨ High Payoff

Joint Munitions Effectiveness