Higher Fidelity Operational Metrics

LTC Tom Henthorn
Chief, Small Arms Branch
SRD, USAIC
35 ≠ 35

35 = ??
Requirements for improving small arms analyses

• Adopt an effects based standard (Probability of Incapacitation, $P_i$)

• Develop higher fidelity, operationally relevant metrics to enable effective analysis of the performance of specific current (and projected) non-materiel and materiel combinations

• Develop the modeling and simulation base that enables sensitivity analyses of Soldier and small unit performance to add quantitative and qualitative value to threshold and objective requirements
Effects Based Standard

• “Stopping” or “Knockdown” Power are ambiguous and not measurable
• Hits on a target do not guarantee an inability to shoot back
• A human target is complex and requires an understanding of
  – Where a hit occurs
  – What part of the body is impacted by bullet / fragment
  – How much damage is produced by the bullet / fragment
  – Whether the damage is relevant to the target’s task performance
  – When effect occurs or is realized
• Must consider both delivery and terminal performance
• Probability of Incapacitation facilitates evaluating Soldier System performance from bullet delivery through terminal effect

Soldier + Training + Weapon + Enablers (Optics) + Ammo = Effect
**Assessment / Evaluation Facilities**

- **Maneuver Battle Lab** (POC: Mr. Jerry Barricks, jerry.w.barricks@us.army.mil)
  - *US Army Infantry Center, Ft Benning, GA*
  - Weapon and Systems capabilities assessment
  - Weapon Assessments with Soldiers in an operational context

- **Gruntworks Facility** (Mr. Mark Richter, mark.richter@usmc.mil)
  - *US Marine Corps, Quantico, VA*
  - Provide configuration management of current Marine Rifle Squad equipment
  - Determine optimum integration of all Marine Rifle Squad equipment
  - Determine best areas to modernize the Marine Rifle Squad for the future

- **Asymmetric Battle Lab** (POC: Mr. Joe Vega, joe.vega@us.army.mil)
  - *Asymmetric Warfare Group, Ft Meade, MD*
  - Rapid Asymmetric Non-Materiel and Materiel Solution Development
Individual Performance Assessment

Soldier Weapon Evaluation and Test (SWEAT)
- Generate capability comparisons
- Any Soldier + Training + Weapon + Optic + Ammo combo
- Performance as a function of time and range
- Relevant operational framework

Support Requirements Generation

Not “Training”

Not “Testing”
Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range....

Defines:
- Soft target performance
- Hard target performance

Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect....

....and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

✓ Simple
✓ Measurable
✓ Repeatable
Small Caliber Evaluation

- Replaced outdated assessment methodologies
  - Energy deposit methodology
  - Gelatin block “damage” evaluation
  - Methods do not account for spatial damage

- New evaluation methodology
  - Joint ARL SLAD/WMRD effort
  - End to end look at weapon/bullet performance evaluation
  - Includes statistical variation in systems performance “fleet” yaw
  - Can be applied to body armor and other types of barrier evaluation

- First study performing comparative P(I) analysis for M855, MK262, and M80 (among others)
  - Assessments including yaw effects and other considerations
  - Incapacitation predictions produced by ORCA

- Currently being used for LFT&E of M855LFS (Green Bullet Program)

Slide courtesy of the U.S. Army Research Laboratory
Modeling and simulation in the Static/Dynamic Framework / Operational Requirement-based Casualty Assessment (ORCA) model used to generate:

Weighted Task Average Impairment (WTAI)

Probability of Incapacitation $P(I)$

$P(H) = f$ [Warfighter-weapon interface, aerodynamics, weapon & projectile design]

$P(I) = f$ [delivery, terminal effects, hit location and shot line, projectile/spall interaction with anatomical features, time]

Empirically Driven System Effectiveness Models
Soldier Weapon Evaluation and Test Course
SWEAT

Defines:
• Soft target performance
• Hard target performance

Understand terminal performance through barrier at range….

….develop incapacitation zones on targets that respond to the weapon and threat posture….

Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect….

….and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

✓ Simple
✓ Measurable
✓ Repeatable
Overview: Require targets that ‘understand’ adjustable quality of hit metrics and provide target feedback given differences in target posture, location of hit and caliber of round

- Adjustable target zones (size)
- Quality of hit scoring
- Variable time responses
- Real-time feedback to Soldier
- Multiple degrees of freedom for target response
- Adjustable software
- Wireless to 1200m (reduce digging on range)
- Thermal signature (O) for future use
- Durable to .50 cal
- Rapid target switch-out
- Moving targets
Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range....

Defines:
• Soft target performance
• Hard target performance

....develop incapacitation zones on targets that respond to the weapon and threat posture....

Soldier in the loop performance evaluates under operational conditions the weapon and ammunition influence

Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect...

....and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

 ✓ Simple
 ✓ Measurable
 ✓ Repeatable

<table>
<thead>
<tr>
<th>Soldier</th>
<th>Weapon</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<td>40</td>
<td>50</td>
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</table>
Course Layout: 1 of 22

- Position: 1
- Represents: Right handed engagements
- Firing position: standing
- Number of engagements: 5
- Number of target locations: Bldg 3, 5, 6 and 7
- Type of engagements: 2 window, 1 roof

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<tr>
<th>Range</th>
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<th>15m-50m</th>
<th>75m-200m</th>
<th>300m-600m</th>
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SWEAT Scoring Methodology

Produces two results

Overall Score for comparison of capability

Given a Soldier, Training, Weapon, Optic Ammo combination

Incapacitation Profile for comparison of standards

where score is a function of

- quality hits
- time burden
- rounds fired

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Comparison of System Performance

Soldier + Training + Weapon + Optic + Ammo = Effect

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<th>S</th>
<th>T</th>
<th>W</th>
<th>O</th>
<th>A</th>
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<th>50m 3sec</th>
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</table>

Relevant comparisons of capability based on Effect produced
Closing

- SGM Pete Gould

• Develop and maintain tools for improved capability evaluation
  • SWEAT (Individual)
  • SWEAT (Sniper)
  • SWEAT (Support by Fire)

• Share and leverage evaluation capability across Joint Services and Industry

• Develop understanding of Soldier System Effect…

….what is required?