Higher Fidelity Operational Metrics

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$$35 \neq 35$$

$$35 = ??$$

Small Arms CBA

Priority Findings

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

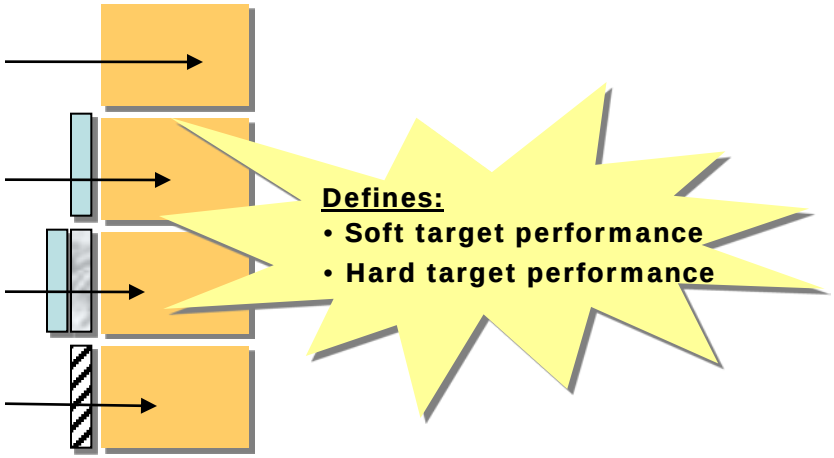
Individual Performance Assessment

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

Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range….

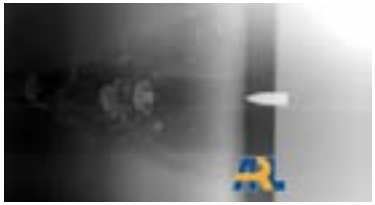


Static Dynamic Framework evaluates target performance based on system launch considering factors that influence terminal effect….

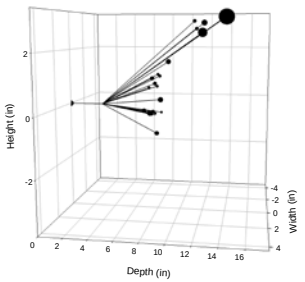
….and ORCA model translates shot location and damage into incapacitation of target based on ammo and weapon system used

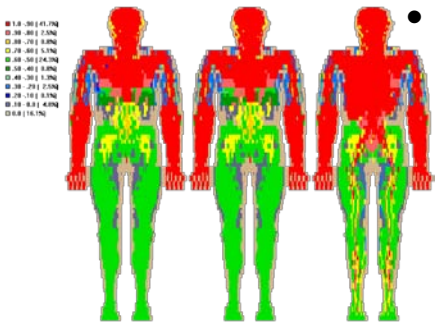
- ✓ Simple
- ✓ Measurable
- ✓ Repeatable

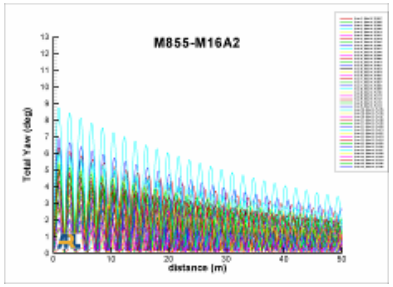
Small Caliber Evaluation



- **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)**

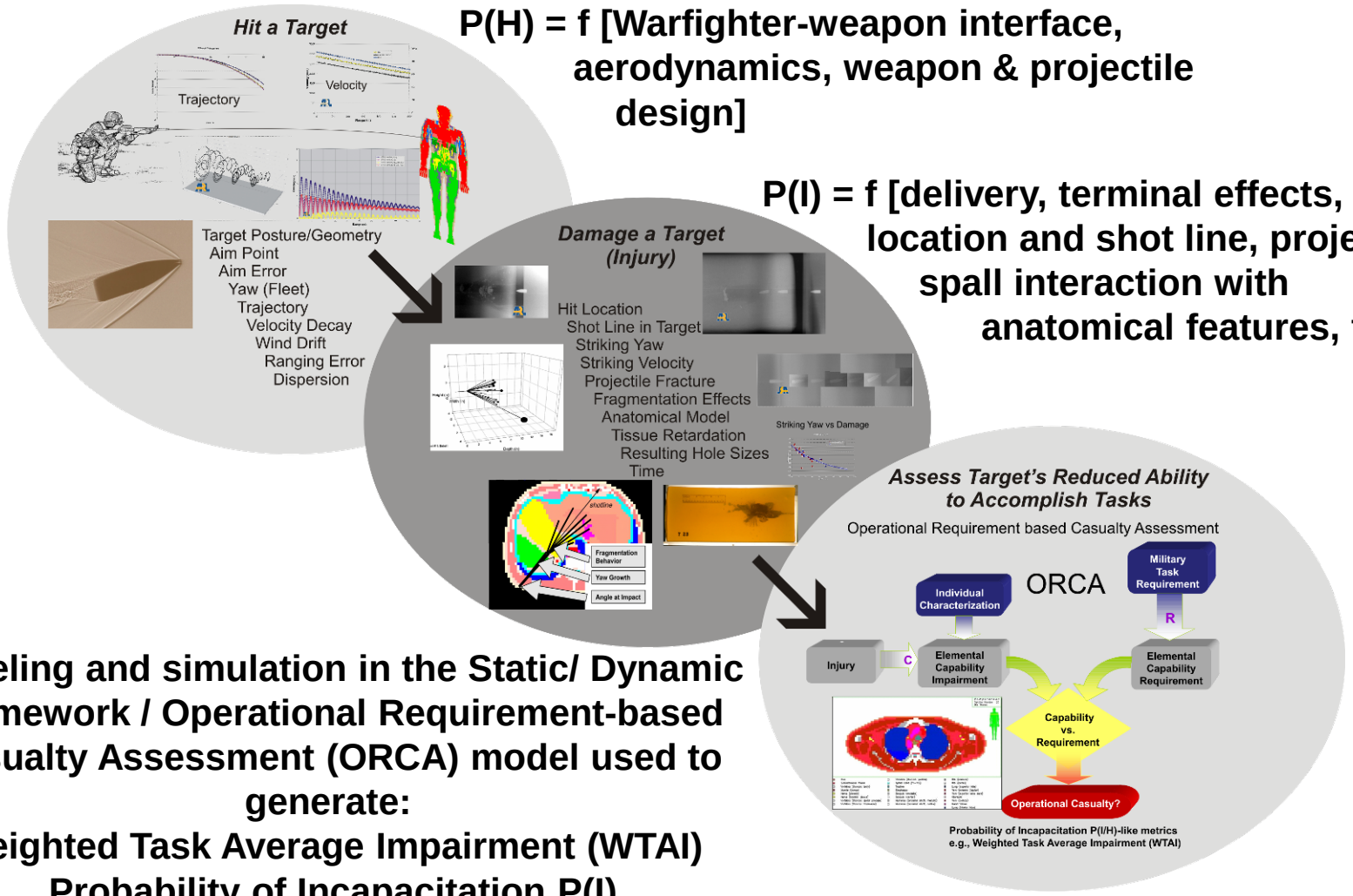






Slide courtesy of the U.S. Army Research Laboratory

Static/Dynamic Framework



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]

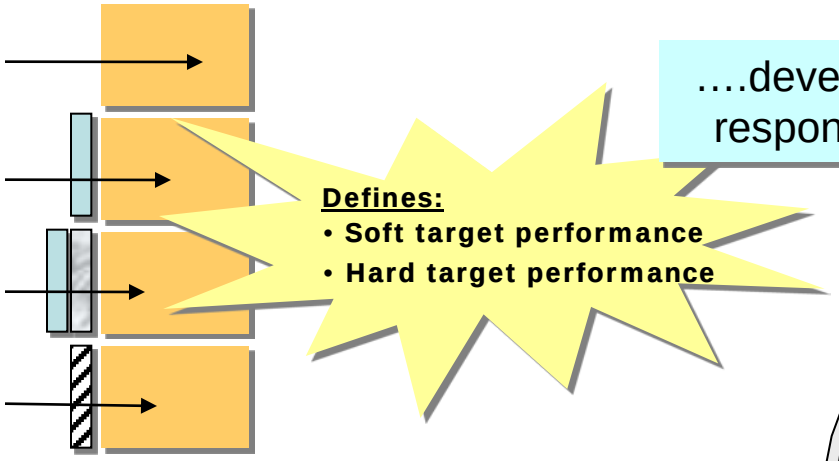
Modeling and simulation in the Static/ Dynamic Framework / Operational Requirement-based Casualty Assessment (ORCA) model used to generate:
Weighted Task Average Impairment (WTAI)
Probability of Incapacitation P(I)

Empirically Driven System Effectiveness Models

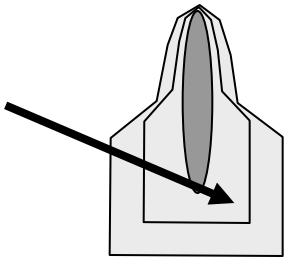
Slide courtesy of the U.S. Army Research Laboratory

Soldier Weapon Evaluation and Test Course
SWEAT

Understand terminal performance through barrier at range….



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



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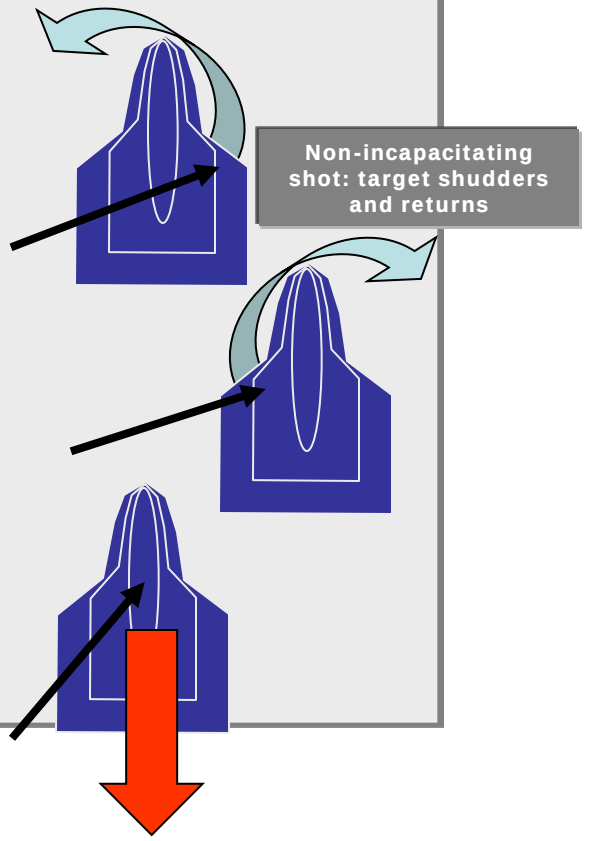
Target Response

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 feed-back 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



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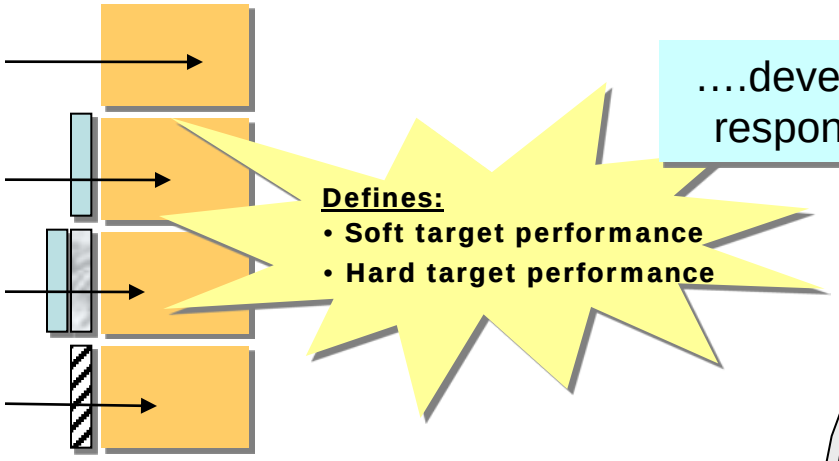
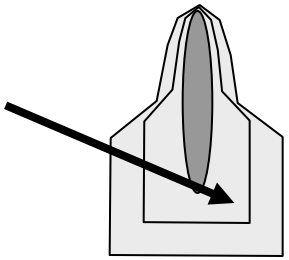


….develop incapacitation zones on targets that respond to the weapon and threat posture….

….evaluate Soldier performance in an operationally realistic environment driven by system influence and target response



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Weapon

Soldier	A	B	C	D
1	10	15	25	15
2	50	60	75	50
3	55	55	70	60
4	30	40	50	35

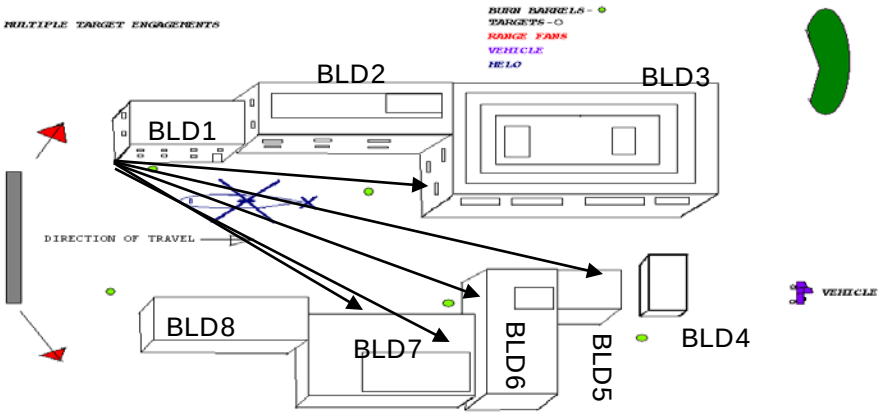
- ✓ Simple
- ✓ Measurable
- ✓ Repeatable

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

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

Range	CQB-3-10m	15m-50m	75m-200m	300m-600m	800-1000m
Time	1.2 sec	3 sec	4 sec	10 sec	15 sec
P(i)	0	5	0	0	0



SWEAT Scoring Methodology

Produces two results

Overall Score
for comparison of capability

741

where score is a function of

- **quality hits**
- **time burden**
- **rounds fired**

Given a Soldier, Training, Weapon, Optic Ammo combination

Range	CQB	50m	200m	600m	1000m
Time	1 sec	2 sec	4 sec	7 sec	10 sec
Raw Score	12/15	10/15	6/15	2/12	0/10
P(i)	80	67	40	17	0

Incapacitation Profile
for comparison of standards

Comparison of System Performance

Soldier + Training + Weapon + Optic + Ammo = Effect

S	T	W	O	A	CQB 2sec	50m 3sec	200m 5sec	600m 8sec	1000m 10sec
11B	SS	M4	Iron	M855					
11B	SS	M4	CCO	M855					
11B	SS	M4	RCO	M855					
92Y	SS	M4	Iron	M855					
11B	B4	M110	x10	**118LR**					
11B	B4	M24	x10	**118LR**					

Relevant comparisons of capability based on Effect produced

Closing

Excellent. More Fact. Less Opinion.

- 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?