

Measures of Effectiveness for Non-Lethal Weapons: Aligning Test & Evaluation with Operational Success

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IDA | Non-Lethal Weapons

Non-Lethal Weapons (**NLWs**) are weapons, devices, and munitions that are “explicitly designed and primarily employed to **incapacitate targeted personnel** or materiel immediately, while **minimizing fatalities, permanent injury** to personnel, and undesired damage to property in the target area or environment.” – DOD Directive 3000.03E

Could this ...



Novel flash bang
developed by Sandia
National Labs in 2008

Taken from *Wired*

... stop this?



Iranian protestors storm
the US Embassy in
Tehran in 1979

Taken from *The Daily Telegraph*

IDA | MOPs vs. MOEs

To assess the technical maturity of a NLW, combat developers must compare the NLW's capabilities to **requirements**

**Measure of
Performance
(MOP):**

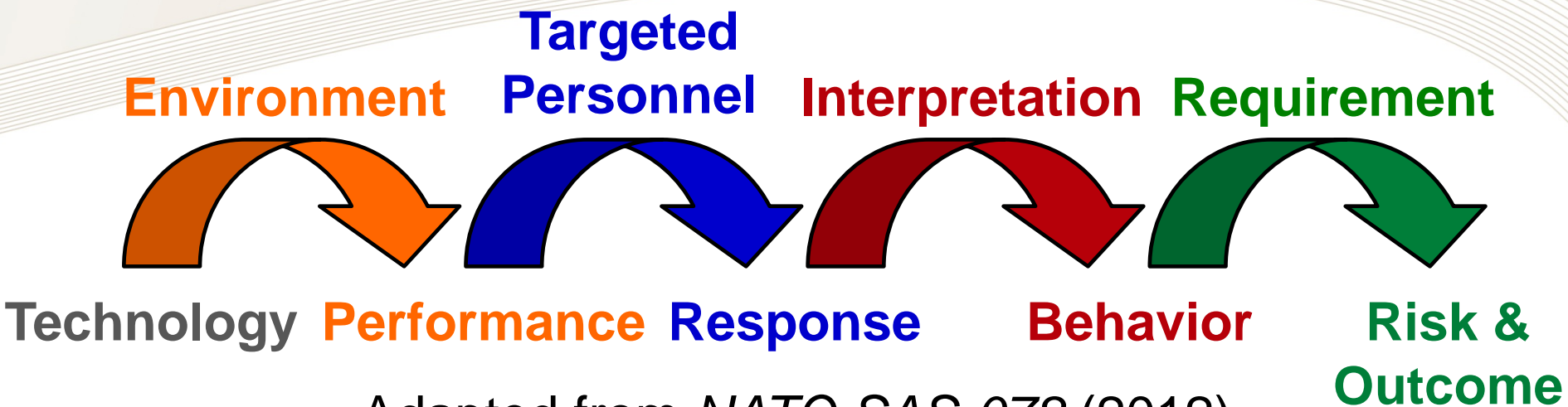
*Am I doing the
thing right?*

vs.

**Measure of
Effectiveness
(MOE):**

*Am I doing the
right thing?*

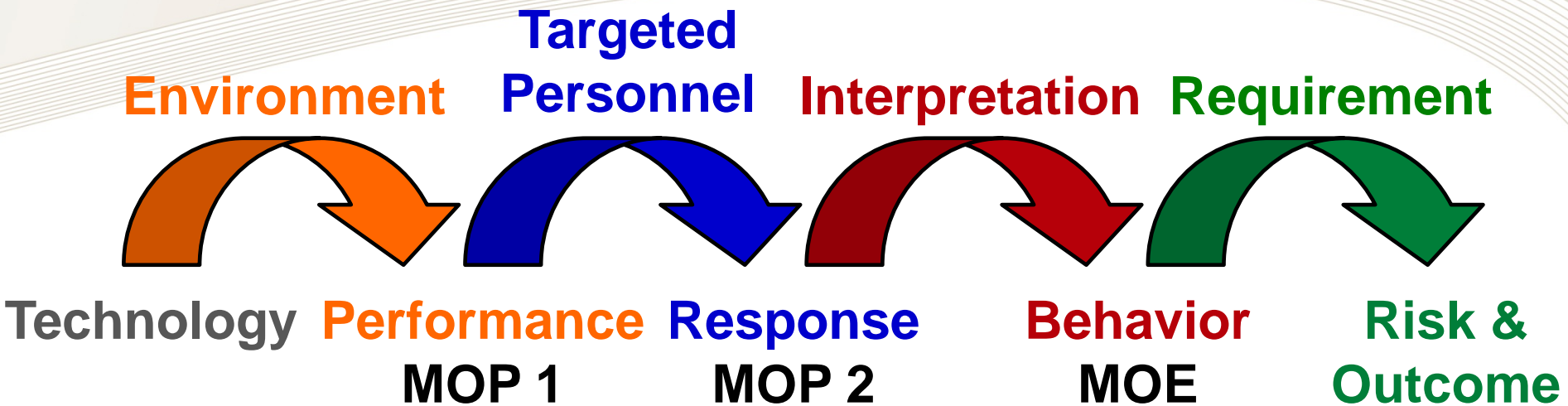
IDA | Framework for NLW Effectiveness



Adapted from *NATO SAS-078* (2012)

- NATO created a framework for NLW effectiveness in the 2000s
- Several DOD groups contributed to this framework

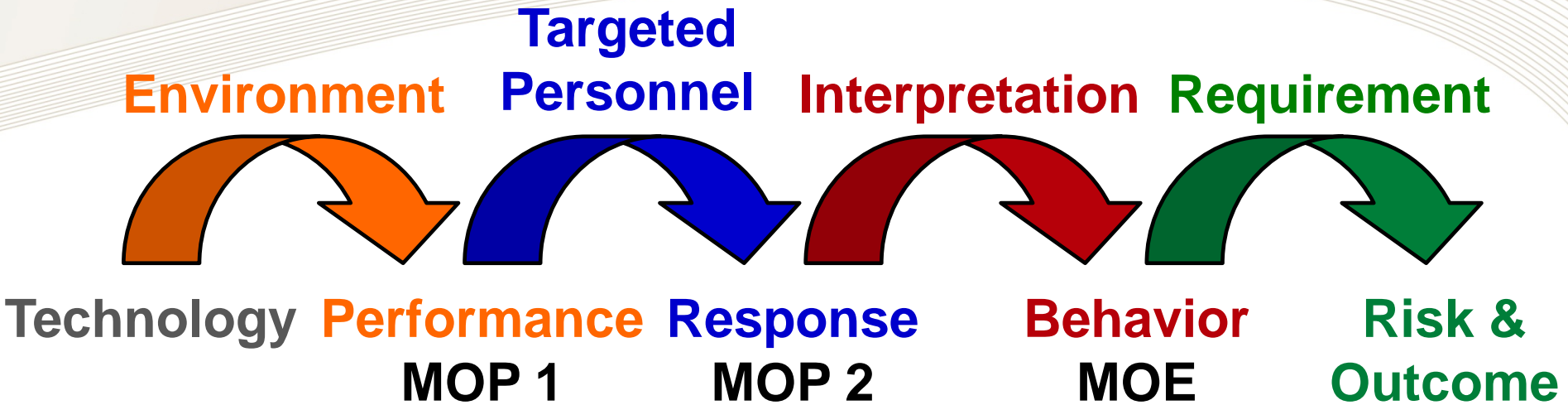
IDA | NLW Requirements



Assess the **physical performance** of the NLW (e.g., brightness, loudness)

- *Pro:* Straightforward to measure in lab
- *Con:* Does not assess how the NLW will affect the targeted personnel

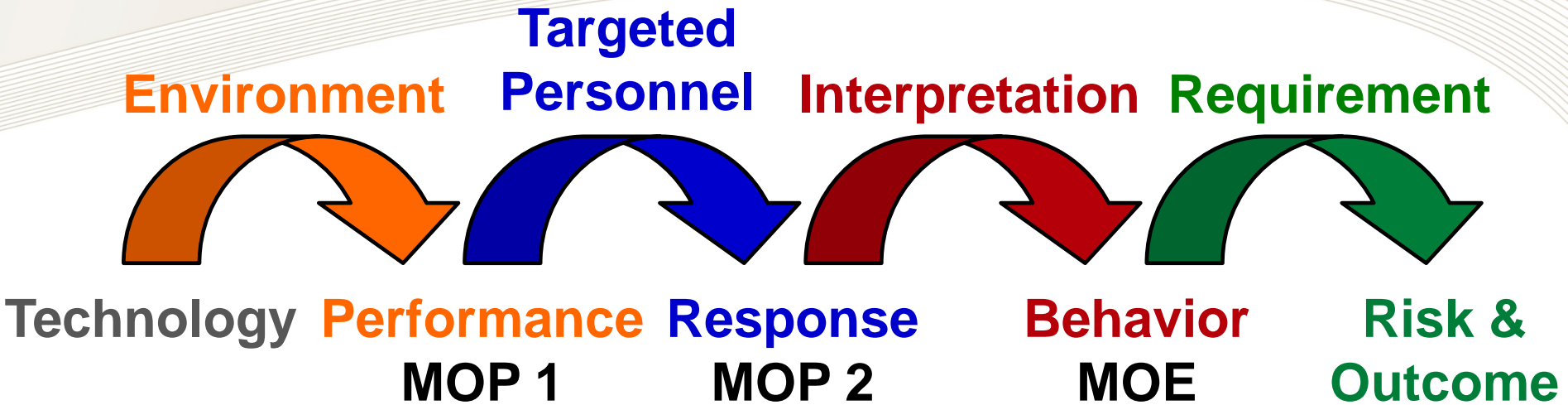
IDA | NLW Requirements



Assess the **physiological response** of the **targeted personnel** to the **NLW** (e.g., vision obscured, hearing threshold shift)

- *Pro:* Begins to assess effect on target
- *Con:* Does not assess how target will behave

IDA | NLW Requirements



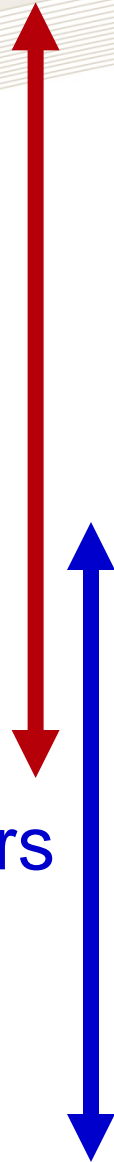
Assess the **behavior** of the targeted personnel after deployment of the NLW (e.g., keep throwing rocks, stop climbing fence)

- *Pro:* Assesses behavior of target
- *Con:* Difficult to measure in lab



IDA | IDA Effectiveness Framework

Military
Operators



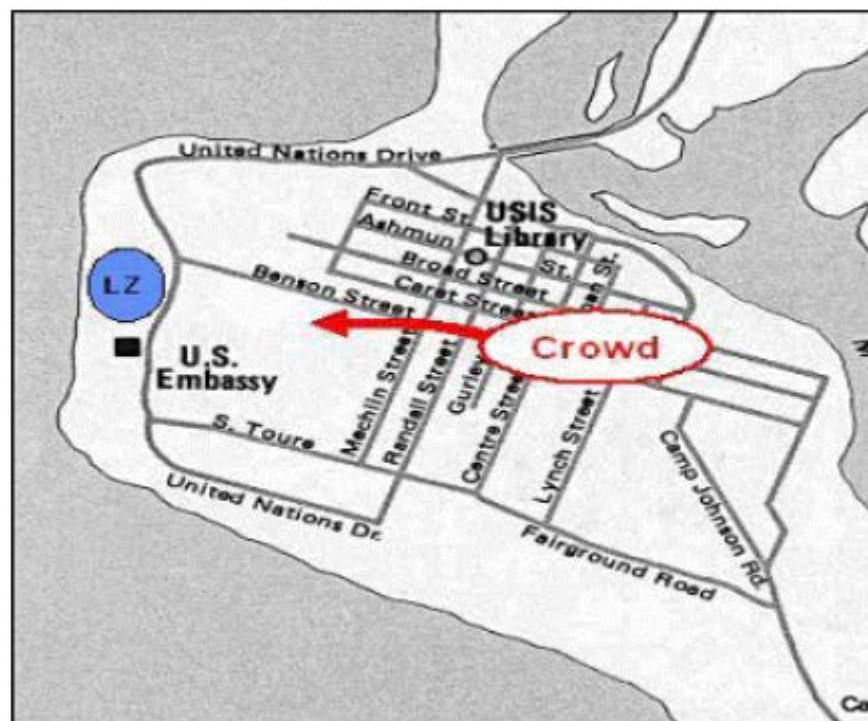
1. What is the **scenario**?
2. What are the **constraints** of the scenario?
3. What **actions** could individuals take that are **relevant** to the scenario?
4. What **metrics (MOEs)** describe whether a weapon can suitably influence those actions?
5. What **experiments** must be done to acquire those metrics?
6. What **field data** are available to estimate those metrics?

Researchers

IDA | IDA Effectiveness Framework

1. What is the **scenario**?

For
example:



Non-combatant Evacuation Operation (NEO)

Taken from *MPM-NLWS CONOPS* (2011)

2. What are the **constraints** of the scenario?
 - A. What is the **goal** of the mission?
 - B. What are the **Rules of Engagement**?

Rules of Engagement (**ROE**) are “directives issued by competent military authority that delineate the **circumstances and limitations** under which US forces will **initiate and/or continue combat engagement** with other forces encountered.”

– *DOD Dictionary of Military and Associated Terms*

3. What **actions** could individuals take that are **relevant** to the scenario?

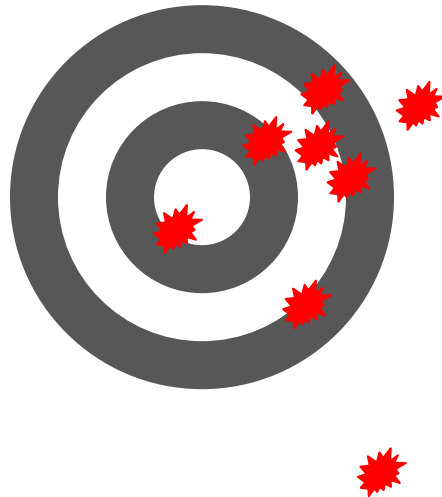
Relevant actions must

- A. Potentially **thwart the goal** of the mission *and*
- B. Be within the **window-of-opportunity** of the weapon

IDA | IDA Effectiveness Framework

4. What **metrics (MOEs)** describe whether a weapon can suitably influence those actions?

For
example:



Rock Throwing Behavior:

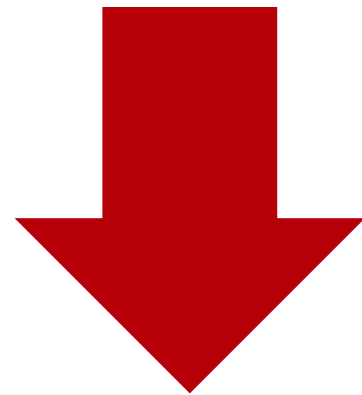
- Miss distance?
- Binary hit or miss?
- Number of hits?
- Time to first hit?

5. What **experiments** must be done to acquire those metrics?

Internal Validity

Fewer Uncontrolled Factors

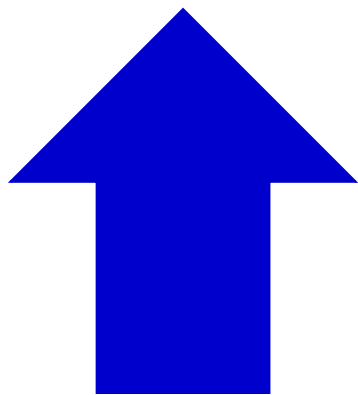
May Not Generalize Well to Real World



External Validity

More Uncontrolled Factors

Generalizes Well to Real World



Taken from Grier, *MORS Test & Analysis Techniques* (2013)

6. What **field data** are available to estimate those metrics?

- Analysis of similar operational situations
- Effects of similar weapons that have been fielded



Flash bang thrown during
2005 Camp Bucca riot
Taken from Rey, *YouTube* (2007)

IDA | Limitations & Opportunities

- Behavioral experiments and field data collections can be resource-constrained
- DOD Instruction 5000.02 supports **modeling & simulation** as a cost-effective approach to test & evaluation
- The IDA Effectiveness Framework could also include questions to guide modeling & simulation of NLW systems

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