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**RDECOM**



# Survivability Measures for Evaluation of Personnel in Military Systems

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**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

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## Outline

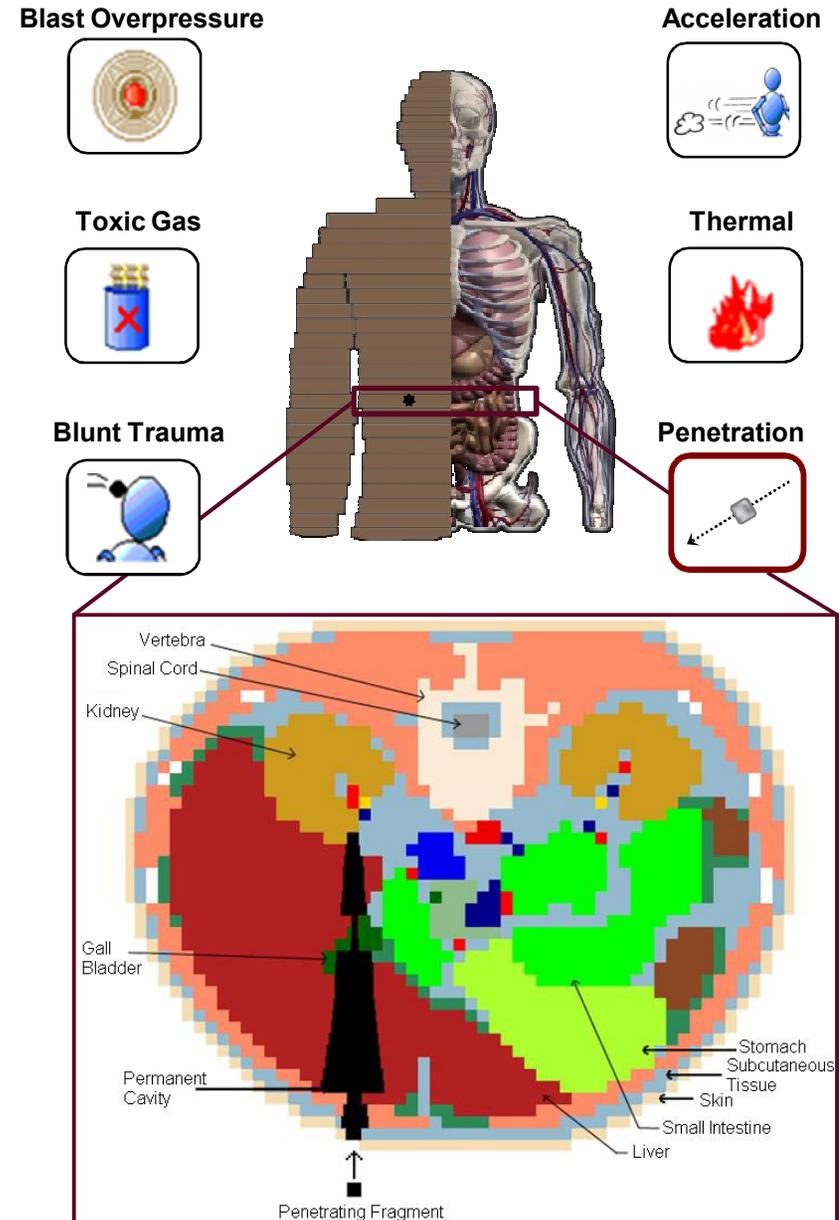


- “ ORCA overview
- “ Survivability and lethality discussion and metrics
- “ Crew casualty assessment
- “ Predictive personnel analysis of vehicle crew
- “ Sample analysis

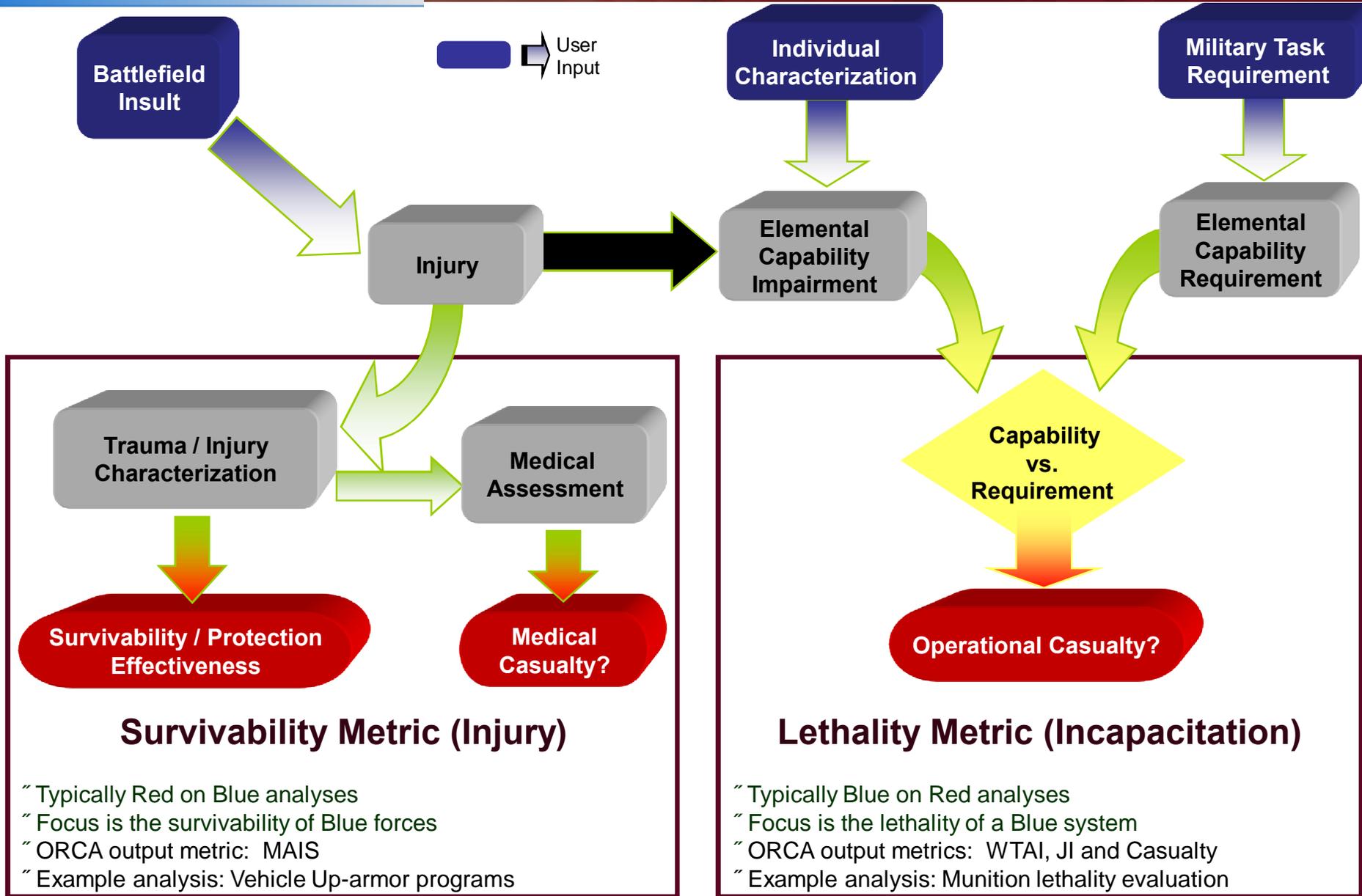
# Operational Requirement-based Casualty Assessment (ORCA)



- “ ORCA is a high-resolution computerized human vulnerability model that is used to assess the impact of various casualty-causing insults on personnel.
- “ ORCA calculates several injury severity trauma metrics that may be used to characterize both an individual injury as well as multiple injuries to a single person.
- “ ORCA is used to assess the impact of various casualty-causing mechanisms on the ability of military personnel to perform battlefield tasks.
  - “ It considers the operational tasks that personnel must perform, and determines the extent to which penetration and other battlefield insults degrade the ability to perform these tasks.
  - “ The model can be applied to personnel occupying any crew position and posture on any combat platform.
  - “ Based on a given insult or set of insults, ORCA assesses whether personnel becomes impaired to the extent that the personnel is incapacitated based on his specific job/military occupational specialty (MOS).



# ORCA Methodology



# ORCA Metrics



**SURVIVABILITY (Injury Metric):** ORCA utilizes the Abbreviated Injury Scale (AIS). AIS is an anatomically-based, consensus-derived, international severity scoring system that classifies each injury by body region according to its relative importance on a 6-point ordinal scale. AIS values provide information on the type, location, and severity of anatomical injuries. AIS scores each single injury.

“ **MAIS** . Maximum Abbreviated Injury Score (MAIS) is an anatomical measure of injury severity. This score classifies injury severity on the basis of the single injury having the greatest AIS severity value. The MAIS is between 0 and 6.

MAIS	Injury Level	Head Injury Example	Type of Injury
1	Minor	Minor laceration of scalp	Superficial
2	Moderate	Major laceration of scalp, blood loss < 20%	Reversible injuries; medical attention required
3	Serious	Fracture of skull, penetration < 2 cm	Reversible injuries; hospitalization required
4	Severe	Depressed skull fracture, penetration > 2 cm	Non-reversible injuries; not fully recoverable without care
5	Critical	Depressed skull fracture, laceration of spinal artery	Non-reversible injuries; not fully recoverable even with care
6	Maximal	Massive brain stem crush	Nearly Unsurvivable

**LETHALITY (Incapacitation Metric):** ORCA provides operational metrics derived from evaluating the impact of injuries from one or more insults on the capabilities that humans use to accomplish tasks for a particular set of operational requirements.

“ **WTAI** . Weighted Task Average Impairment metric provides an average characterization of an individual’s post-injury capability. ORCA examines the reduction in capability to perform individual tasks for a given job with respect to a minimum performance level. WTAI makes use of all task capability information by computing the average level of impairment over all of the task elements that constitute the job under consideration.

# Crew Casualty Assessment



## Survivability Assessment

- “ Injury/Medical metrics:
  - . Severity of Injuries
  - . Are the injuries treatable?
  - . Are there medical casualties?
  - . Trauma scoring metrics
- “ Operational Metrics (secondary questions):
  - . Are there operational casualties?
  - . Is our mission intact?

Example:

Effectiveness of Added Vehicle Protection

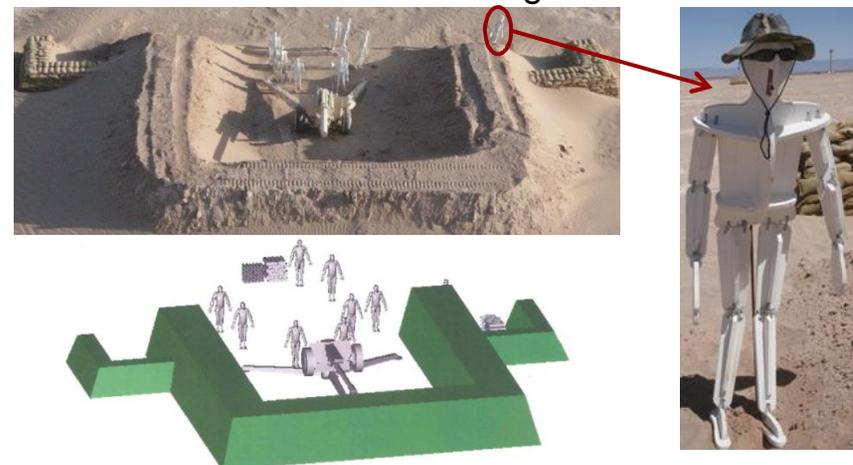


## Lethality Assessment

- “ Operational Metrics:
  - . Quantitative measure of weapon performance
  - . Can soldier perform certain military tasks?
    - » Dependent on soldier's tactical role and time after wounding
  - . Has the threat been neutralized?
  - . Is the enemy's mission intact?

Example:

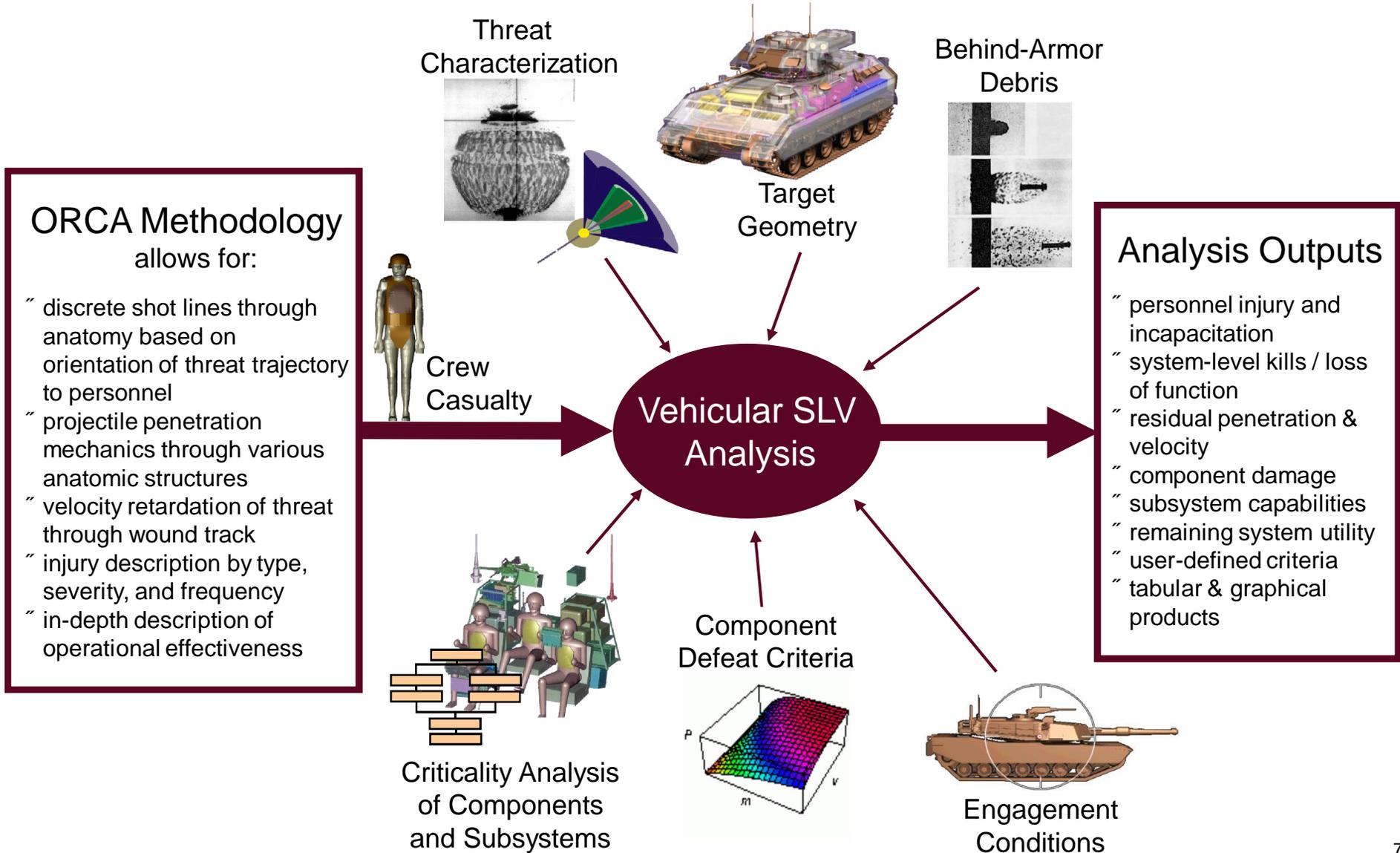
Effectiveness of an Air-bursting Munition



# MUVES-S2 and ORCA



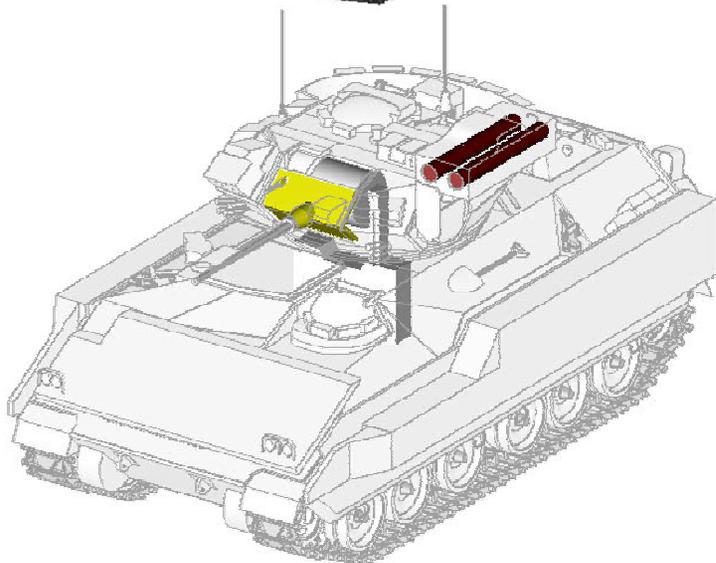
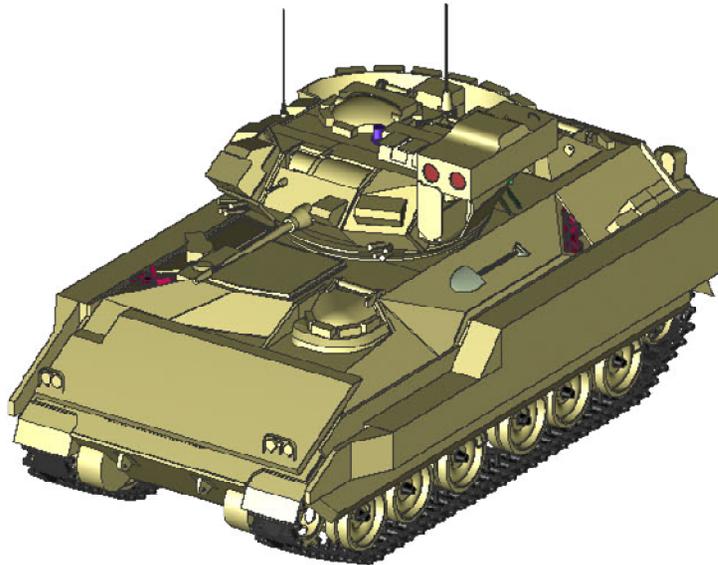
A Survivability/Lethality/Vulnerability (SLV) computer model capable of analyzing the effects of one or more munitions against aircraft or ground-mobile targets.



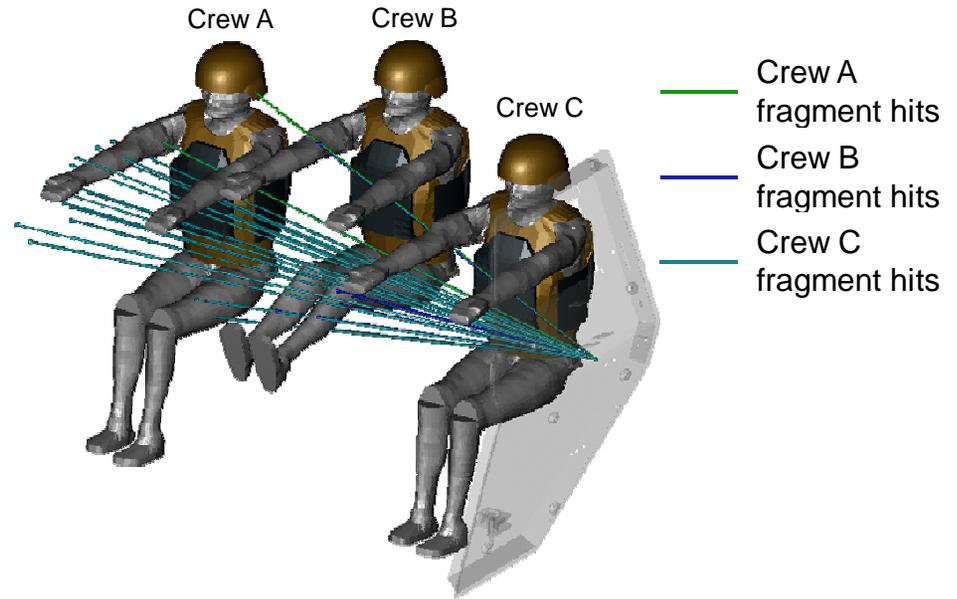
# Target and Threat Characterizations



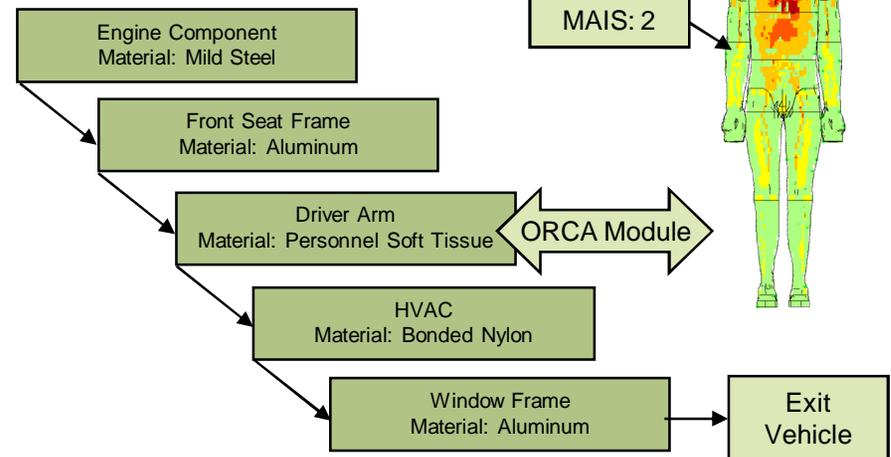
## Target Description



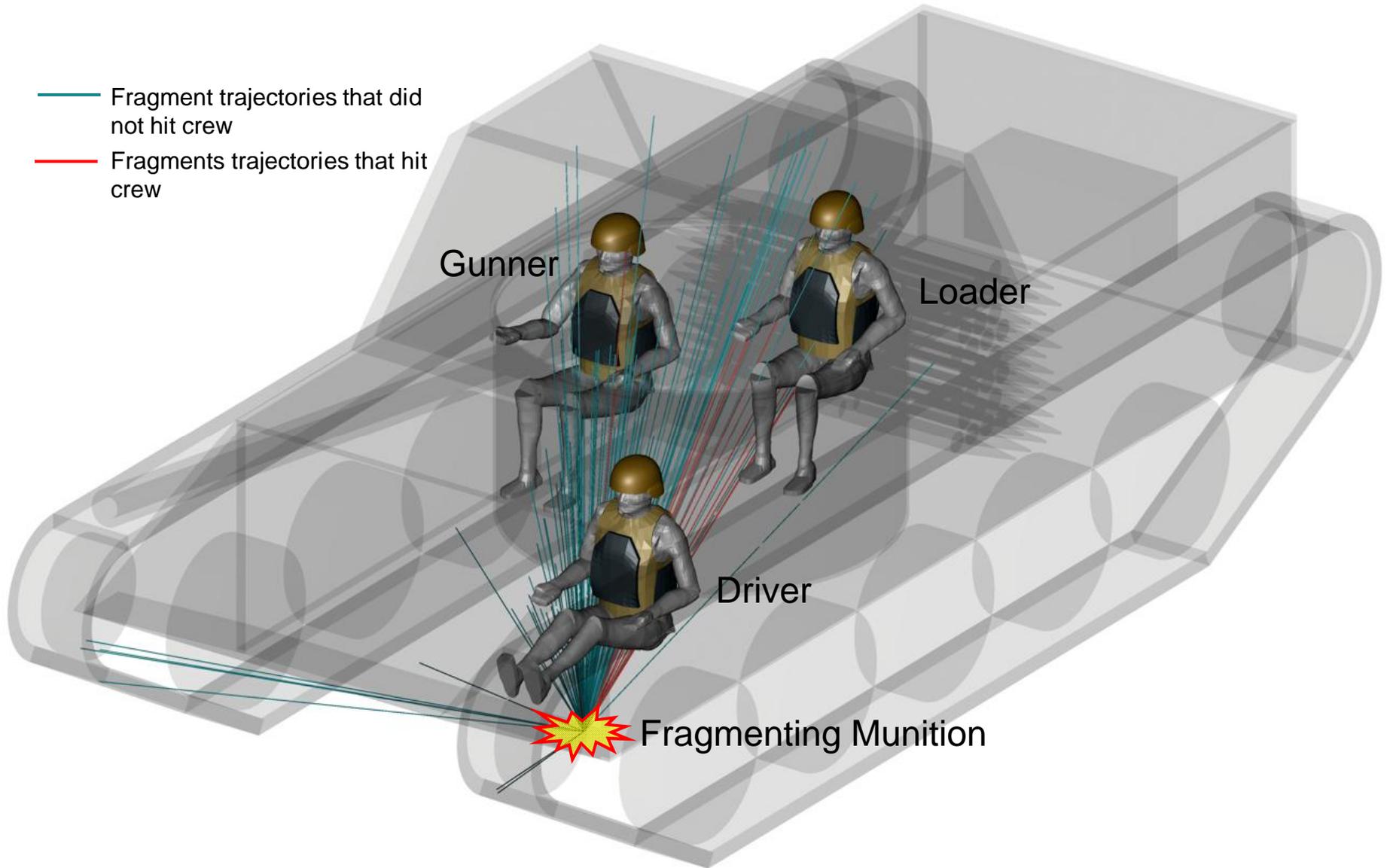
## Threat Interaction



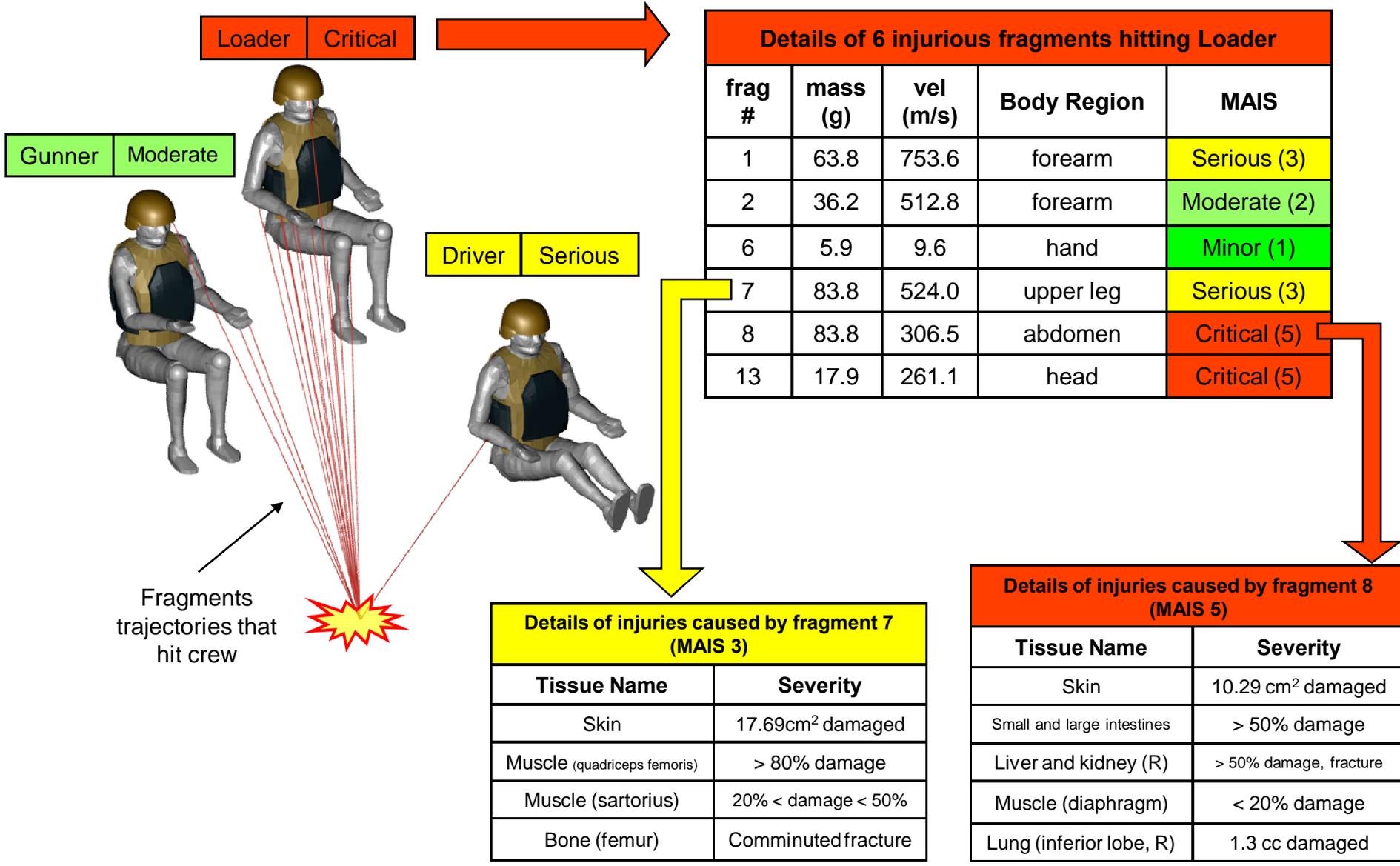
Copper Fragment Threat vs. Modeled Vehicle



# Fragmenting Munition vs. Tank Crew (1 of 4)



# Injury Details (2 of 4)

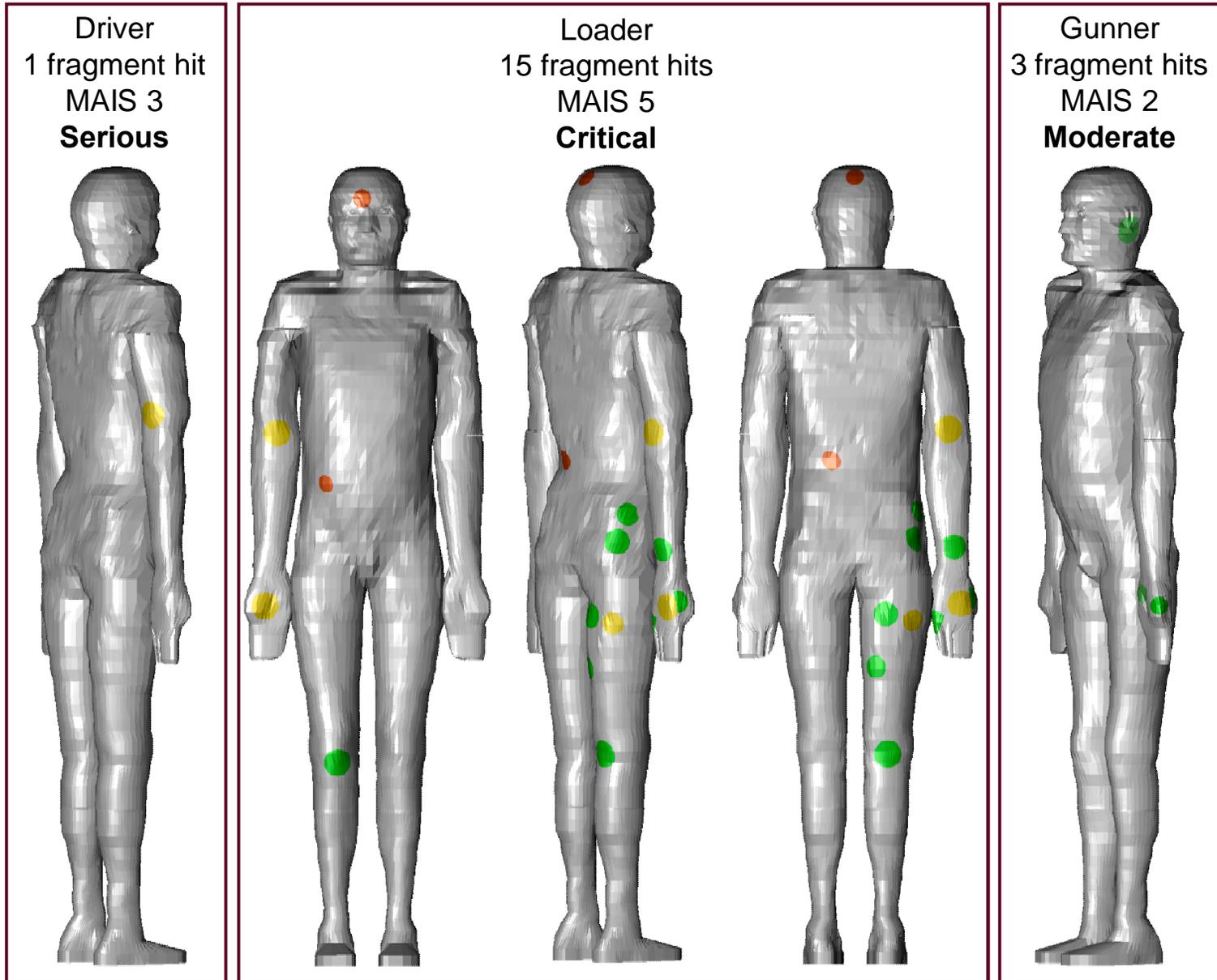


# Surface Injury Mapping (3 of 4)



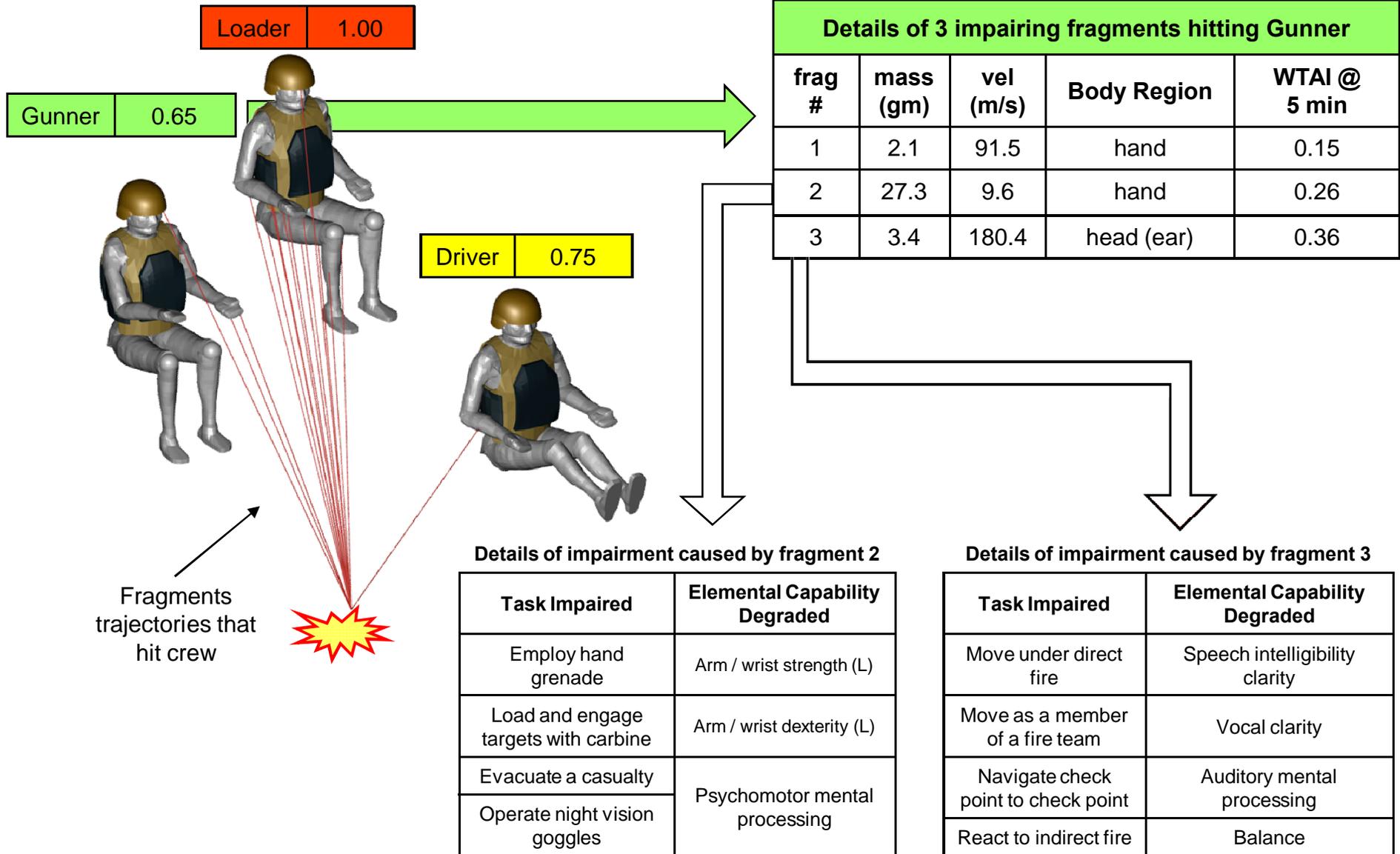
MAIS	Injury Level
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximal

Size of the surface damage reflects the size of damaged skin tissue and the color indicates the severity of the wound track.



# Impairment Details (4 of 4)

capacitation For a Given Tactical Role and Time Period



## Conclusion



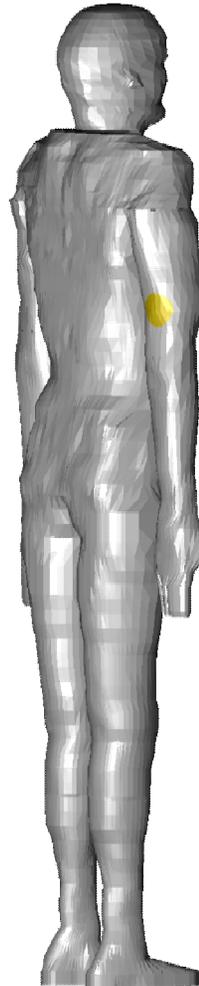
- “ MUVES-S2 with ORCA improves personnel casualty assessment for SLV analysis of combat systems.
- “ ORCA provides improvements for all phases of the casualty assessment process from operational casualty assessment needed to address lethality questions to survivability-based metrics.
- “ These new survivability metrics provide injury type and severity leading to higher resolution outputs to better serve survivability assessments.
- “ This new and unique capability in MUVES-S2 allows careful analysis and design of vehicle and body armor systems and configurations.

# Surface Injury Mapping (3 of 4)

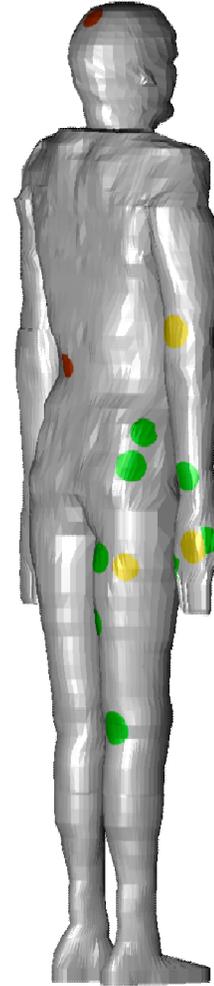


MAIS	Injury Level
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximal

Driver  
1 fragment hit  
MAIS 3  
**Serious**



Crew 1  
15 fragment hits  
MAIS 5  
**Critical**



Crew 2  
3 fragment hits  
MAIS 2  
**Moderate**



Size of the surface damage reflects the size of damaged skin tissue and the color indicates the severity of the wound track.