Evaluating the "Prevention of Fatality" as a Force Protection Requirement

Problem Statement

- Legacy methodologies for determining fatality, especially with respect to shock and acceleration insults, are insufficient.

“….Prevention of Fatality….”

Outline

- Intro
- Purpose
- Historical Background
- MCOTEA Approach
  - Methodology Basis
  - Example
  - Methodology Pros/Cons
- Conclusion

Intro to MCOTEA

Planning → Testing → Reporting

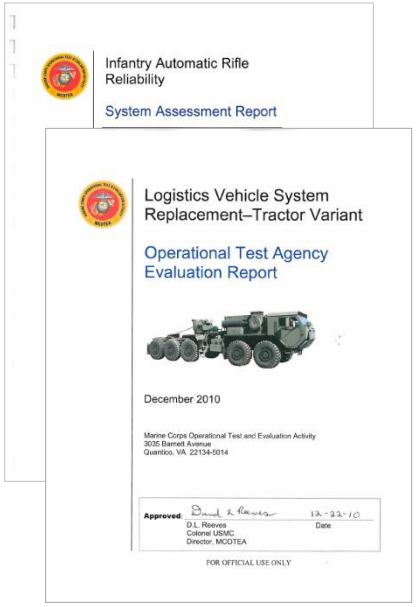
Evaluation Plans
Assessment Plans
Test Plans
Observation Plans

Combat Service Support Systems

Expeditionary, Naval, and Amphibious Systems

C4ISR & IT/Business Systems

Initial Operational Test
Follow-on Operational Test
Multi-service Test
Quick Reaction Test
Test Observations



Evaluation Reports
Assessment Reports
Test Data Reports
Observation Reports

Ground Combat Systems

Purpose

Engage the T&E community concerning the issues surrounding the evaluation of Fatality in ballistic survivability and Live Fire Test and Evaluation (LFT&E) and present the current MCOTEA approach to evaluate this requirement.

"Prevention of Fatality" is an emergent KPP requirement for Force Protection

Historical Background

- "…Prevention of Fatality…." emerged as a KPP in 2006.
- Legacy Evaluation Framework was inadequate:
  - Did not directly address "Fatality":
    - Previously Force Protection was only an Incapacitation Based Eval
    - The Effect of Multiple injuries was not considered
    - Shock and Acceleration injury mechanisms were not prevalent in the past
  - Validity of "Prevent Fatality" vs. "Incapacitation"
    - Users wanted to know if a Platform "Prevented Fatality"
    - Incapacitation was "secondary consideration"

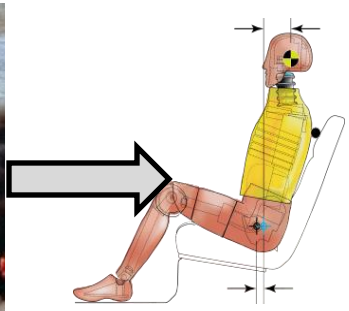
*****Solution*****

Utilize the Abbreviated Injury Scale (AIS) Scores provided by ARL/SLAD as part of the Crew Casualty Report for each event to develop a value model based evaluation methodology that can calculate the "Unacceptable Risk to Fatality".

Developed by MCOTEA in 2008; Implemented in 2009

Process Overview

LF Event Planning

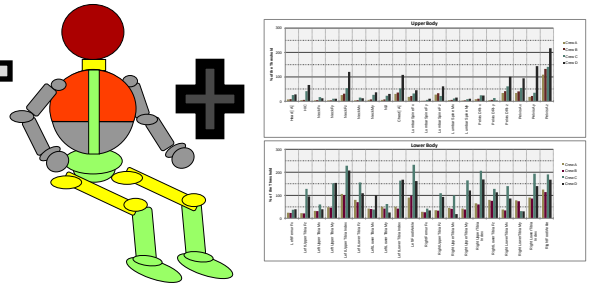


Data Collection

(ATC)

Data Assessment

(ARL Crew Casualty Report)



Evaluation

MCOTEA
Injury Eval
Process

LFT&E
Reporting

FP KPP Met/Not Met

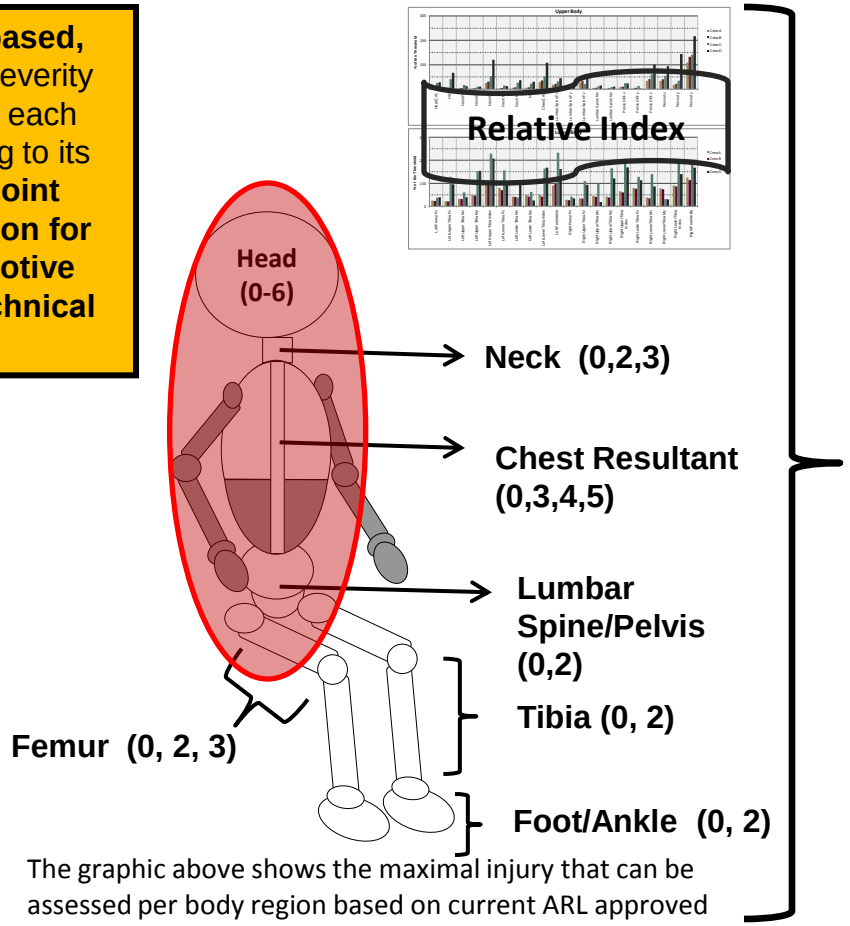
Methodology Basis:

MCOTEA Weighting of ARL Provided Abbreviated Injury Scale Scores

ARL/SLAD, trusted technical agent, calculates and publishes the AIS scores and associated Relative Index for each event in the Crew Casualty Report.

The AIS is an **anatomically-based, consensus-derived, global** severity scoring system that classifies each injury by body region according to its relative importance on a **6-point ordinal scale. The Association for the Advancement of Automotive Medicine (AAAM) is the "technical authority" for AIS**

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



The graphic above shows the maximal injury that can be assessed per body region based on current ARL approved injury criteria.

MCOTEA Weighting

- Core injuries are considered more severe than leg injuries and thus core injuries are weighted more by squaring the assessed AIS value
- Leg injuries in general are considered not as severe (severe bleeding can be treated with tourniquet) and thus are scored the actual AIS value
- Lumbar spine/pelvis, and leg injuries can only be assessed an AIS 0 or 2 and thus the Relative Index (RI) is used to score an additional point based on the recorded acceleration relative to the threshold. A RI of 100% over the AIS 2 threshold results in a "3" score.

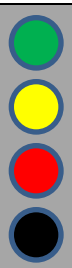
Hybrid II/III ATD Response Parameter	AIS Values/Injury Output	Crew Locations - AIS/MAIS Scores										Qualitative Weighting Methodology	Crew Locations - Weighted Score									
		1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
ACCELERATION - CORE																						
Head	AIS 0, AIS 1, AIS 2, AIS 3, AIS 4, AIS 5, or AIS 6											$(AIS)^2$										
Neck	AIS 0, AIS 2, or AIS 3											$(AIS)^2$										
Chest Resultant Acceleration	AIS 0, AIS 3, AIS 4, or AIS 5											$(AIS)^2$										
Lumbar Spine, Pelvis	***AIS 0 or AIS 2***											(AIS + 1 if threshold exceeded by 100%)^2										
Left Femur	AIS 0, AIS 2, or AIS 3											$(AIS)^2$										
Right Femur	AIS 0, AIS 2, or AIS 3											$(AIS)^2$										
ACCELERATION - LOWER LEGS																						
Right Tibia	***AIS 0 or AIS 2***											AIS + 1 if threshold exceeded by 100%										
Left Tibia	***AIS 0 or AIS 2***											AIS + 1 if threshold exceeded by 100%										
Right Foot/Ankle	***AIS 0 or AIS 2***											AIS + 1 if threshold exceeded by 100%										
Left Foot/Ankle	***AIS 0 or AIS 2***											AIS + 1 if threshold exceeded by 100%										
												Total										

1 – 8: Minor Injury (Green)

9 – 12: Serious Injury (Yellow)

13 – 35: Critical/Severe Injury (Red)

36+: Unacceptable risk of fatal injury (Black)

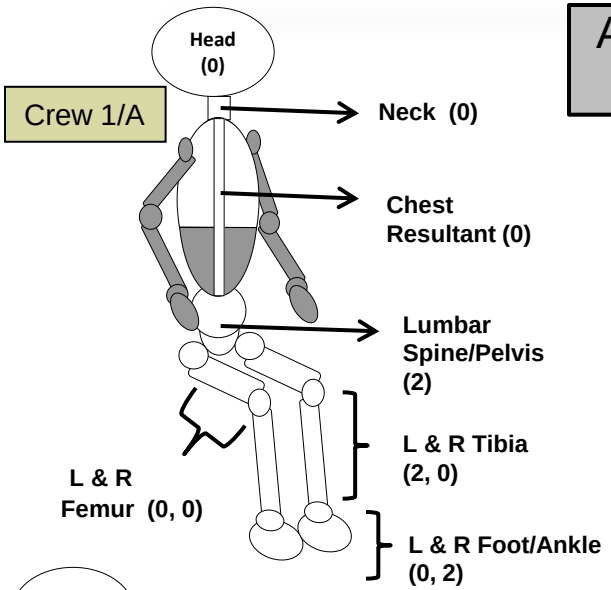


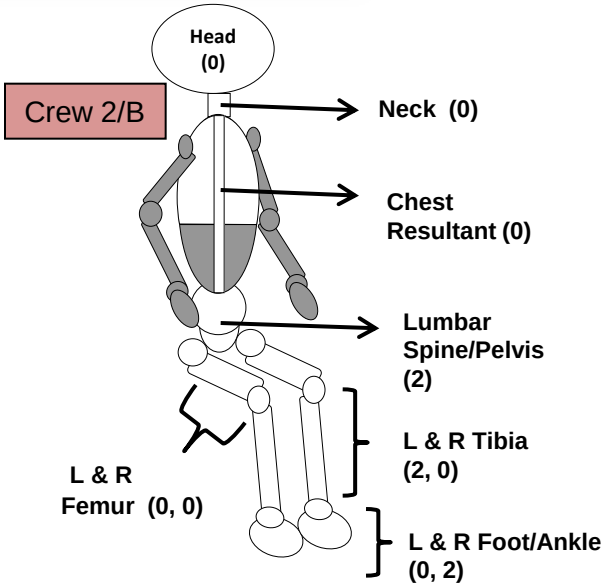
An Aggregate Score of zero "0" is considered – NO INJURY

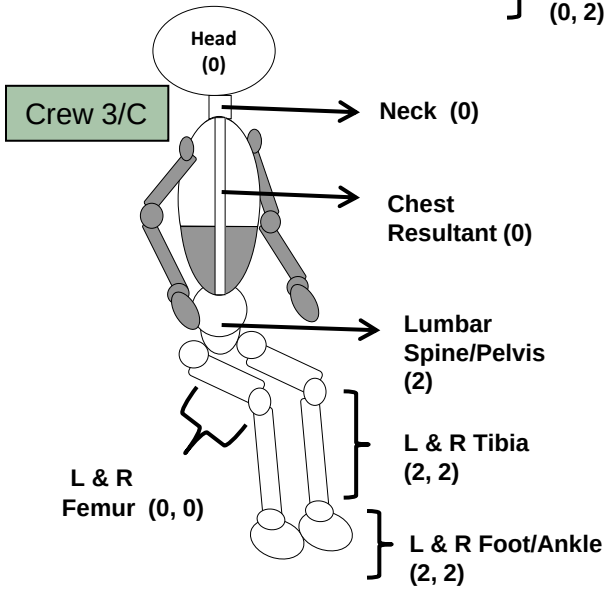
Totals are added to any additional AIS scores from other Injury Mechanisms; such as Fragmentation, Heat, Toxic Fumes, and Blast Over Pressure (BOP)

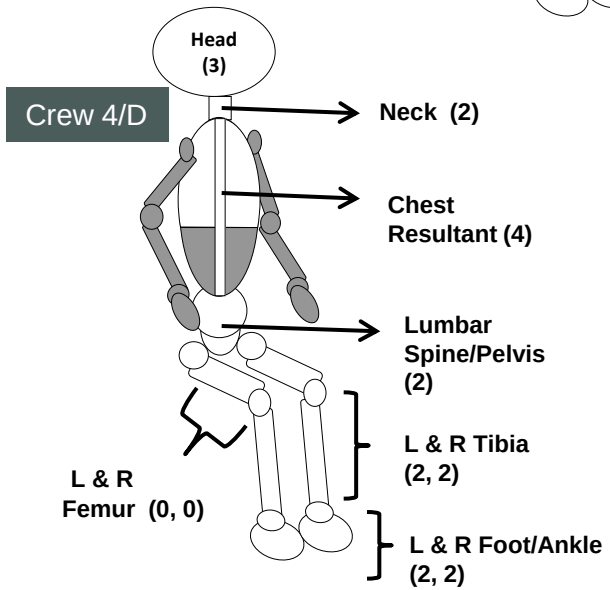
MCOTEA Injury Eval Process
Example

ARL Crew Casualty Report Output





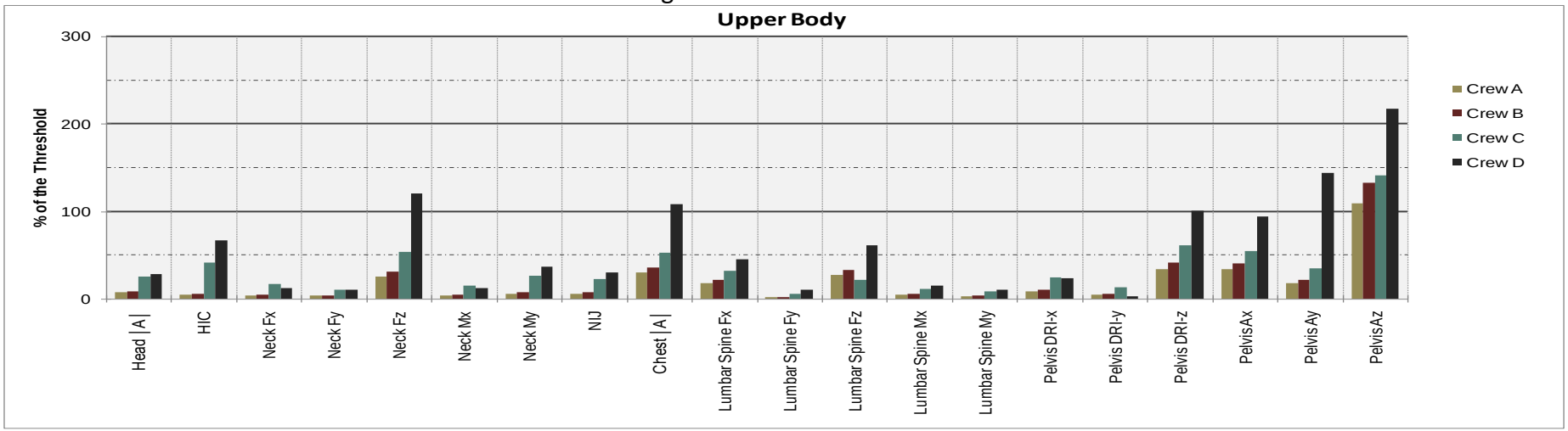


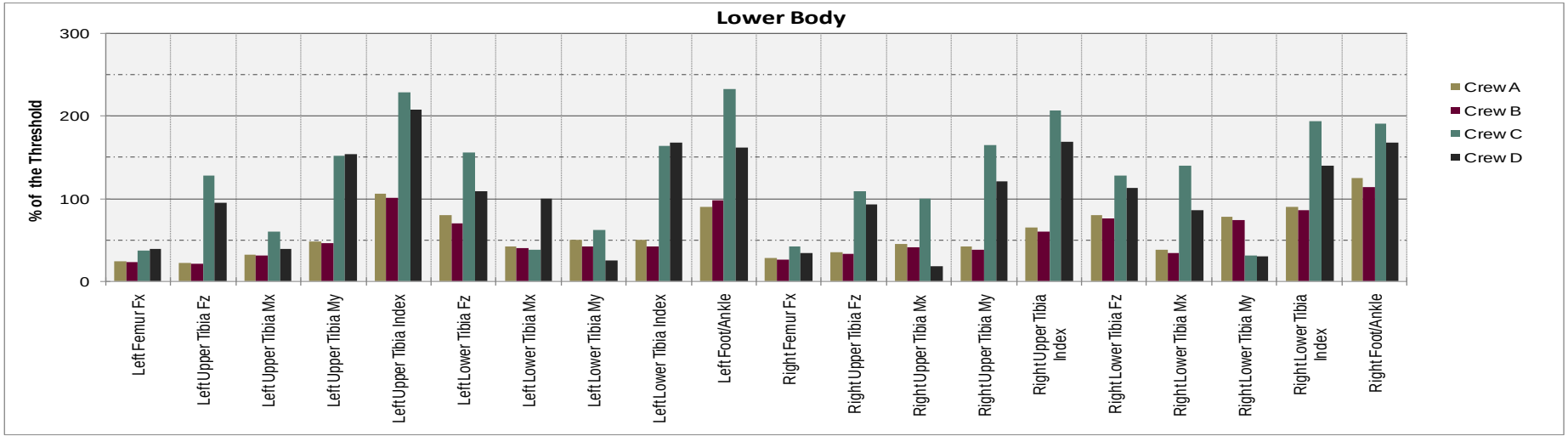


Relative Index (RI)

ARL reports RI for each body region and is used to increase injury score in the aggregation methodology based on the acceleration recorded relative to the threshold value for injury

- RI is the percent relative to the threshold value
- RI takes into account duration and magnitude





EXAMPLE COMPLETED WORKSHEET

Hybrid II/III ATD Response Parameter	AIS Values/Injury Output	Crew Locations - AIS/MAIS Scores										Qualitative Weighting Methodology	Crew Locations - Weighted Score									
		1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
ACCELERATION - CORE																						
Head	AIS 0, AIS 1, AIS 2, AIS 3, AIS 4, AIS 5, or AIS 6	0	0	0	**3**	N/A	N/A	N/A	N/A	N/A	N/A	$(AIS)^2$	0	0	0	9	N/A	N/A	N/A	N/A	N/A	N/A
Neck	AIS 0, AIS 2, or AIS 3	0	0	0	**2**	N/A	N/A	N/A	N/A	N/A	N/A	$(AIS)^2$	0	0	0	4	N/A	N/A	N/A	N/A	N/A	N/A
Chest Resultant Acceleration	AIS 0, AIS 3, AIS 4, or AIS 5	0	0	0	**4**	N/A	N/A	N/A	N/A	N/A	N/A	$(AIS)^2$	0	0	0	16	N/A	N/A	N/A	N/A	N/A	N/A
Lumbar Spine, Pelvis	***AIS 0 or AIS 2***	2	2	2	**2***	N/A	N/A	N/A	N/A	N/A	N/A	(*AIS + 1 if threshold exceeded by 100%)^2	4	4	4	9	N/A	N/A	N/A	N/A	N/A	N/A
Left Femur	AIS 0, AIS 2, or AIS 3	0	0	0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	$(AIS)^2$	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Right Femur	AIS 0, AIS 2, or AIS 3	0	0	0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	$(AIS)^2$	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
ACCELERATION - LOWER LEGS																						
Right Tibia	***AIS 0 or AIS 2***	0	0	2	**2**	N/A	N/A	N/A	N/A	N/A	N/A	*AIS + 1 if threshold exceeded by 100%	0	2	2	2	N/A	N/A	N/A	N/A	N/A	N/A
Left Tibia	***AIS 0 or AIS 2***	2	2	2*	**2***	N/A	N/A	N/A	N/A	N/A	N/A	*AIS + 1 if threshold exceeded by 100%	2	2	3	3	N/A	N/A	N/A	N/A	N/A	N/A
Right Foot/Ankle	***AIS 0 or AIS 2***	2	2	2*	**2**	N/A	N/A	N/A	N/A	N/A	N/A	*AIS + 1 if threshold exceeded by 100%	2	0	3	2	N/A	N/A	N/A	N/A	N/A	N/A
Left Foot/Ankle	***AIS 0 or AIS 2***	0	0	2*	**2**	N/A	N/A	N/A	N/A	N/A	N/A	*AIS + 1 if threshold exceeded by 100%	0	0	3	2	N/A	N/A	N/A	N/A	N/A	N/A
												Total	**8**	**8**	**15**	**47**	N/A	N/A	N/A	N/A	N/A	N/A

1 – 8: Minor Injury (Green)

9 – 12: Serious Injury (Yellow)

13 – 35: Critical/Severe Injury (Red)

36+: Unacceptable risk of fatal injury (Black)

No other injury mechanisms present from other insults.

MCOTEA Methodology

Pros & Cons

Pros

- Resolves Fatality
  - "Unacceptable Risk to Fatality"
- Resolves Injury Severity
  - No Injury
  - Minor Injury
  - Moderate Injury
  - Severe Injury
- Quantifiable Results
  - Constructive measure
- Can Be applied across platforms for comparison
- Utilizes current ARL products

Cons

- Not Fully Comprehensive

  No Input for:
  - Soft Tissue Trauma
  - Organ Trauma
  - TBI
- Not all Data from the ATDs can be assessed by ARL
- Quantitative assessment of Qualitative values

Methodology already utilized on Several USMC LF Service Reports Vehicle Comparisons
Path Forward: JLTV

Conclusion

MCOTEA has a methodology to evaluate Fatality (“Unacceptable risk to fatality”) to include Injury Severity across multiple injuries

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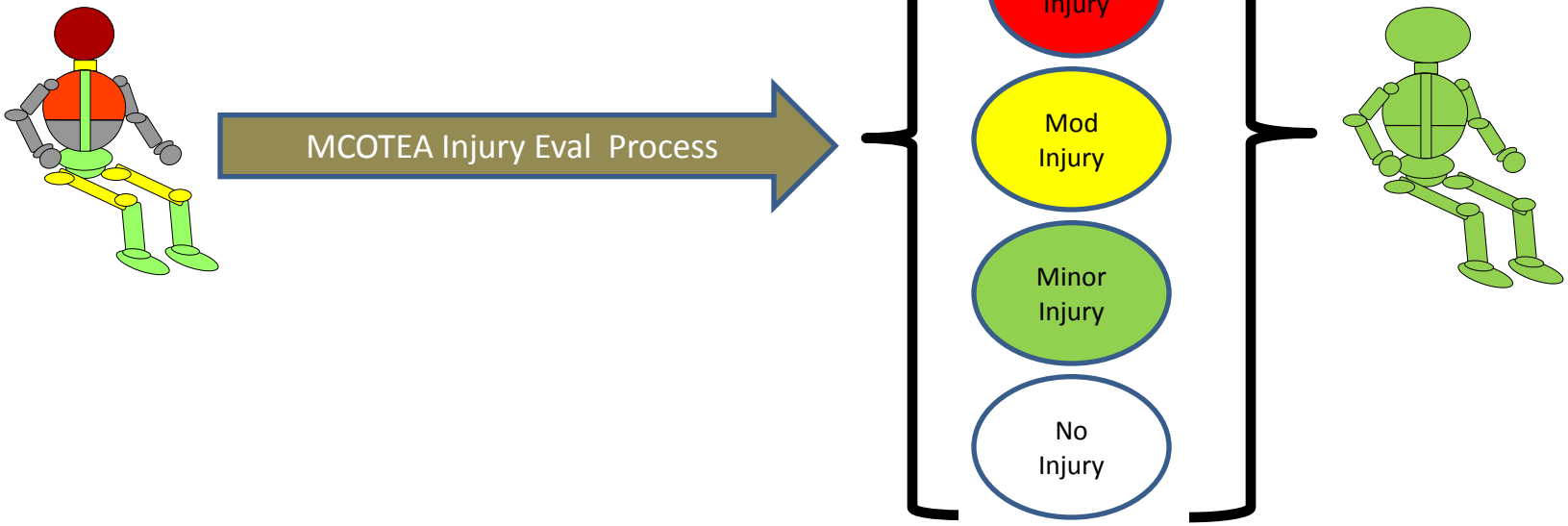
This approach utilizes the latest and current crew casualty criteria provided by ARL/SLAD



Questions

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