Assessing Musculoskeletal Injury Risk During Product Development

applied ergonomics conference 2009
Practitioners talking with practitioners

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Goal: Provide information that will help participants understand how ergonomics exposures are assessed at USACHPPM

Learning Objectives

At the completion of the presentation participants will be able to:

- understand the importance of identifying and mitigating ergonomic risks during product design
- be familiar with the current Army process for identifying and mitigating injury risks from ergonomic exposures

Learning Objectives

At the completion of the presentation participants will be able to:

- be familiar with the vision for improving risk assessment of ergonomic exposures

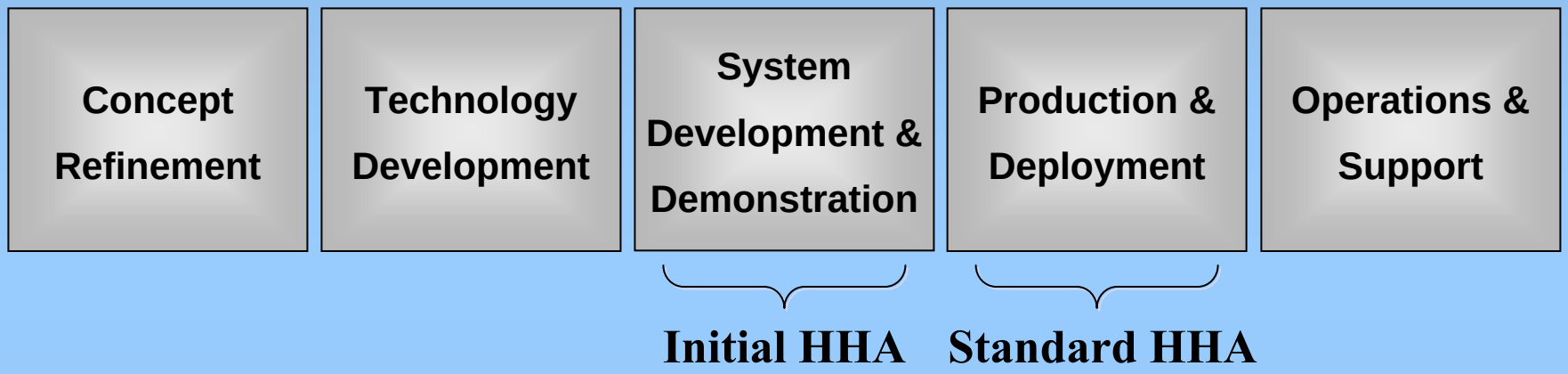
Army Regulation 40-10

Identify and assess health hazards

- Preserve and protect the health of individual Soldiers
- Design out health hazards to eliminate … health hazard-based retrofits
- Reduce environmental and occupational health hazards

The DoD Acquisitions System

Phases of Product Development

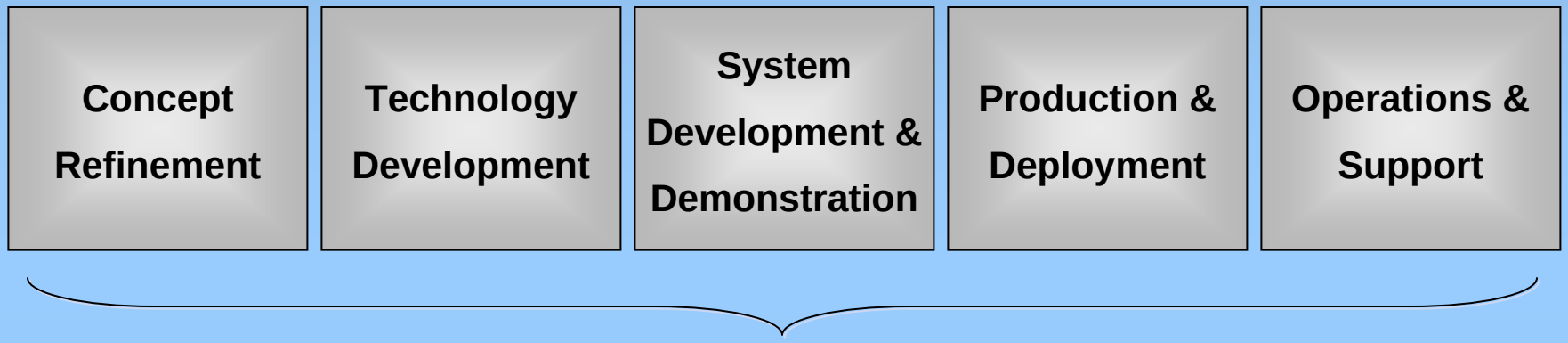


Initial HHA done while product developed

Standard HHA done after product developed or when an existing product is modified

The DoD Acquisitions System

Phases of Product Development



Though HHAs can help,

Culture is better!

Types of Products

Identify & Assess Health Hazards

- Weapons platforms
- Munitions
- Equipment
- Clothing
- Training devices
- Other materiel systems

Types of Products Reviewed

Lifting/Carrying (Setting Up/Breaking Down Simulators)

Helicopter flight training simulator

Types of Products Reviewed

Lifting/Carrying (Launching/Retrieving UAVs)

Types of Products Reviewed

Pushing/Pulling (Setting Up/Breaking Down Bladders)

Many systems use bladders to contain liquids such as water and fuel

Types of Products Reviewed

Exertions & Non-Neutral Postures (Using Sprayer)

Types of Products Reviewed

Hand-Arm Vibration (Operating Powered Hand Tools)

Commercial Off-the-Shelf Items Included in Equipment Sets

Types of Products Reviewed

Whole Body Vibration & Jolt (Operating Equipment)

Driving Army heavy vehicles and commercial vehicles on various road surfaces

Types of Products Reviewed

Biomechanical Stress from Head Supported Mass

Helmets & Special Optic such as Night Vision Goggles

Assessing Injury Risk From Lifting/Lowering Activities

Risk Assessment Code Matrix

RAC Matrix

	A	B	C	D	E
I	1	1	1	2	3
II	1	1	2	3	4
III	2	3	3	4	5
IV	3	5	5	5	5

Hazard Probability

A = Frequent

B = Probable

C = Occasional

D = Remote

E = Improbable

Hazard Severity

I = Catastrophic

II = Critical

III = Marginal

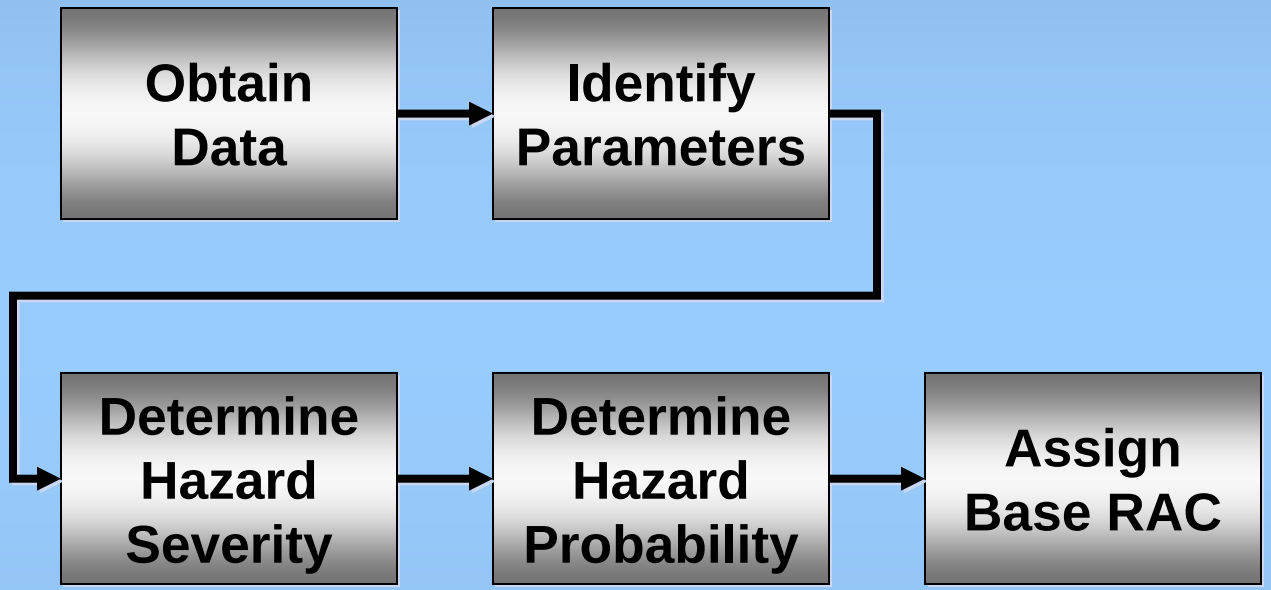
IV = Negligible

Syntax:

RAC 2 (HS II, HP C)

Determining Injury Risk

Steps in the Risk Assessment Process



Determining Injury Risk

Review Data

- Obtain data from system developer
  - Weapon Developer
  - Equipment Developer

Determining Injury Risk

Review Data

- Identify Parameters
  - Mission Scenario
  - Description of MMH Team
  - Object Characteristics
  - Description of Handling Activities

Determining Injury Risk

Review Data

- Identify Parameters

Scenario: Male & female occupational specialty
Only one person will be available to lift
Lifter will likely to be female
Frequency will be once
Trajectory will be obstacle-free
Terrain will be uneven

Item: 46 pound box (20” x 20” x 20”)
Object weight evenly distributed

Determining Injury Risk

Determine Hazard Severity (HS)

- Use MIL-STD-1472F para 5.9.11.3
  - Calculate Maximum Design Weight Limit (MDWL)

Notes:
- **Assumes young, healthy population**
- **Assumes two-handed lift**
- **MDWLs are not TLVs for injury**

http://www.safetycenter.navy.mil/instructions/osh/MILSTD1472F.pdf

Determining Injury Risk

Determine Hazard Severity (HS)

- Use MIL-STD-1472F para 5.9.11.3
  - Calculate Maximum Design Weight Limit (MDWL)

MDWL = 37 lbs

Determining Injury Risk

Determine Hazard Severity (HS)

- Calculate Lifting Index (Task Demand/MDWL)

Determining Injury Risk

Determine Hazard Severity (HS)

- Calculate Lifting Index (Task Demand/MDWL)

Lifting Index = 46 lb / 37 lb = 1.24

Determining Injury Risk

Determine Hazard Severity (HS)

- Determine HS – Magnitude of Index

Lifting Index	HS
N/A	I
> 1.88	II
> 1.50	III
> 1.00	IV
≤ 1.00	N/A

Note:
- **Ranges not validated**

Determining Injury Risk

Determine Hazard Severity (HS)

- Determine HS – Magnitude of Index

Lifting Index	HS
N/A	I
> 1.88	II
> 1.50	III
> 1.00	IV
≤ 1.00	N/A

← LI = 1.24

HS = III

Determining Injury Risk

Determine Hazard Probability (HP)

- Award points based upon presence of factors in lifting scenario

Note:

- **Factors and point values decided by USACHPPM Ergonomics Program**

Determining Injury Risk

Determine Hazard Probability (HP)

- Award points based upon presence of factors in lifting scenario

Factor	Points
Team Size	**0 = 1-2, 1 = 3-4, 2 > 4 lifters**
Grasp	**0 = 2 handed, 1 = 1 handed**
Footing	**0 = Fair to Good, 1 = Poor**
Load Symmetry	**0 = Uniform, 1 = Unequal**
Extra Point	**Optional 1 Point Levy**

Determining Injury Risk

Determine Hazard Probability (HP)

- Award points based upon presence of factors in lifting scenario

Factor	Points	
Team Size	0 = 1-2, 1 = 3-4, 2 > 4 lifters	0
Grasp	0 = 2 handed, 1 = 1 handed	0
Footing	0 = Fair to Good, 1 = Poor	1
Load Symmetry	0 = Uniform, 1 = Unequal	0
Extra Point	Optional 1 Point Levy	0

Determining Injury Risk

Determine Hazard Probability (HP)

- Convert points to Hazard Probability

Points	HP
0	E
1	D
2	C
3	B
≥ 4	A

Determining Injury Risk

Determine Hazard Probability (HP)

- Convert points to Hazard Probability

Points	HP
0	E
1	D
2	C
3	B
≥ 4	A

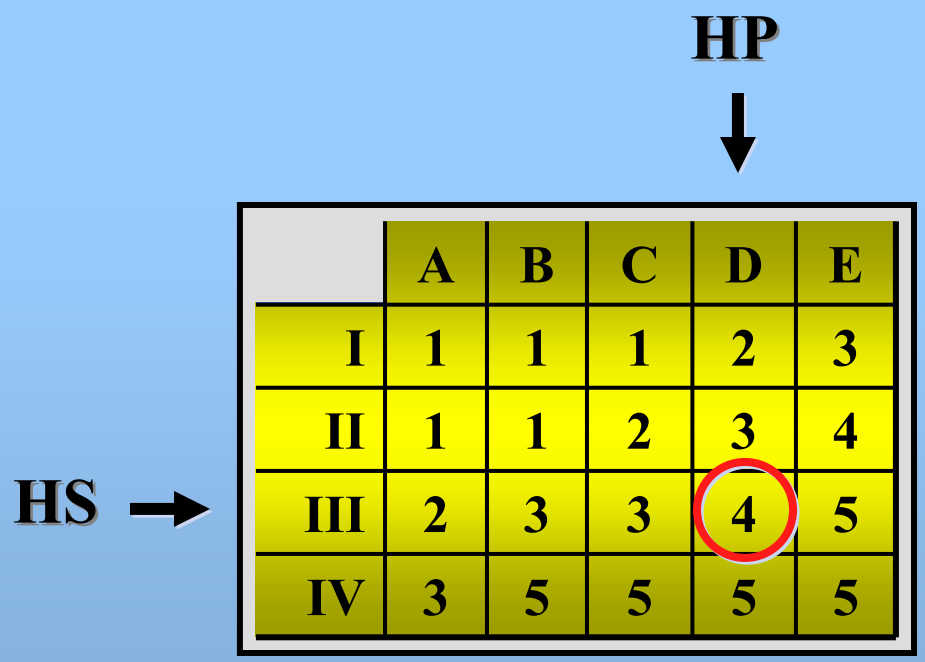
← 1 Point

HP = D

Determining Injury Risk

Assign Base RAC

- Look up in RAC Table Matrix



RAC 4

(HS III, HP D)

Lessons Learned

Learned About System Developers

- Conduct poor ergonomics reviews
- Fail to understand chronic exposures
- Misapply MIL-STD-1472F

Lessons Learned

Learned About Process

- Increases reliability
- Required additional assumptions
- Needs continued development

Future Developments

Current Effort

Contained in Excel

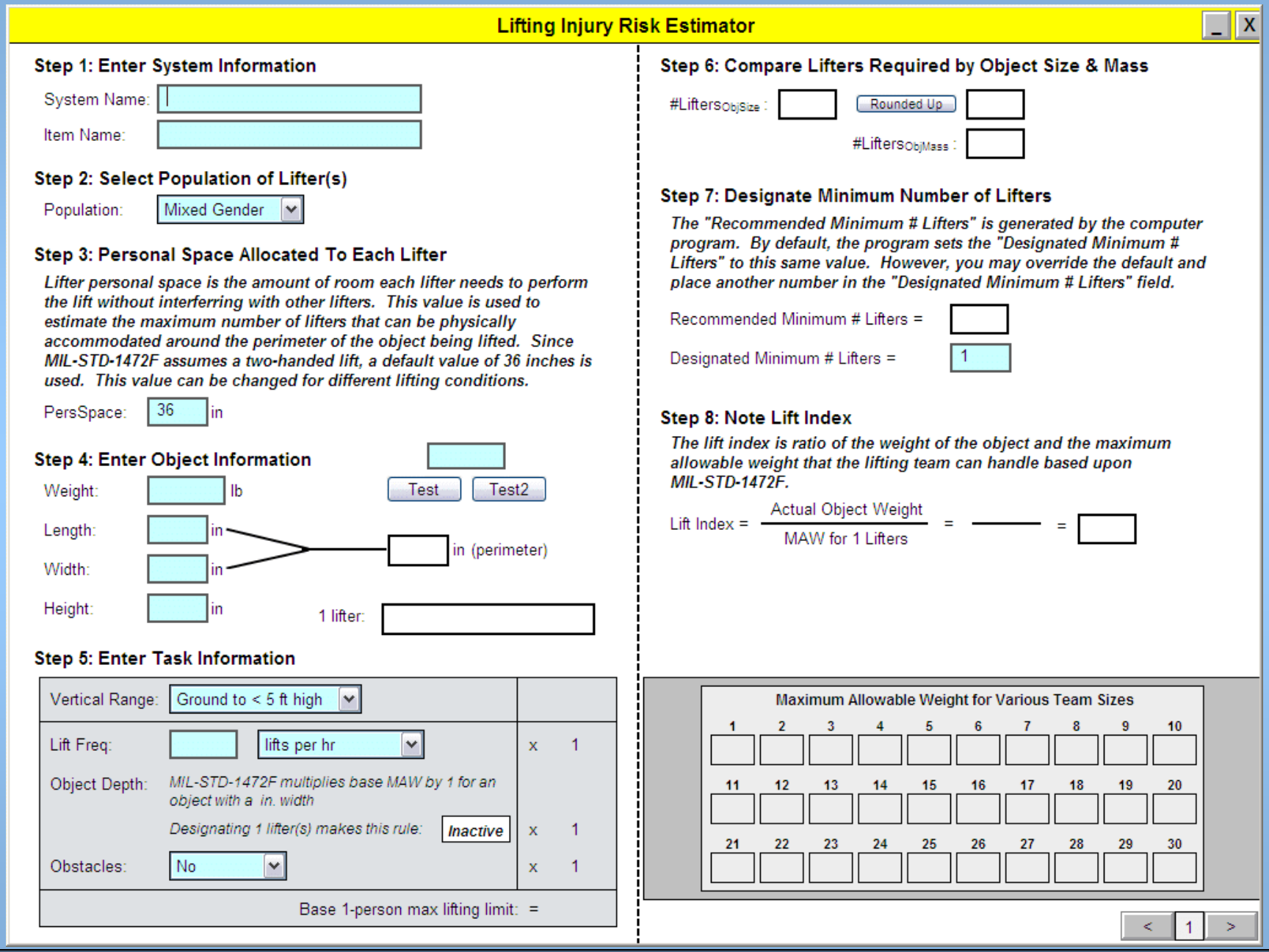
- Considers more variables
- Excel constrains individual flexibility

Future Plans

Create a software application

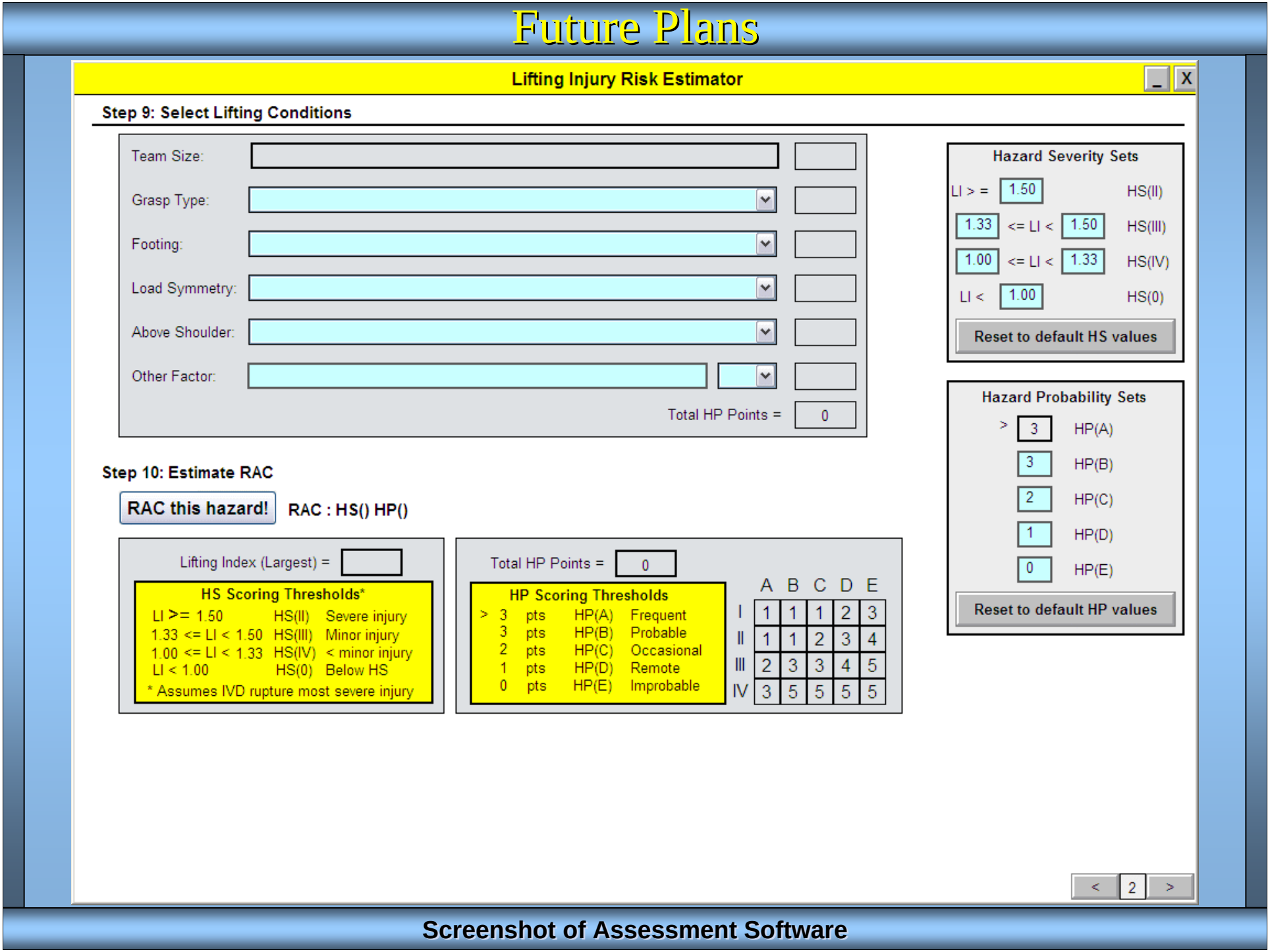
- Interface will increase visibility
- Platform will structure assessment
- Platform will allow more flexibility

Future Plans



Screenshot of Assessment Software

Future Plans



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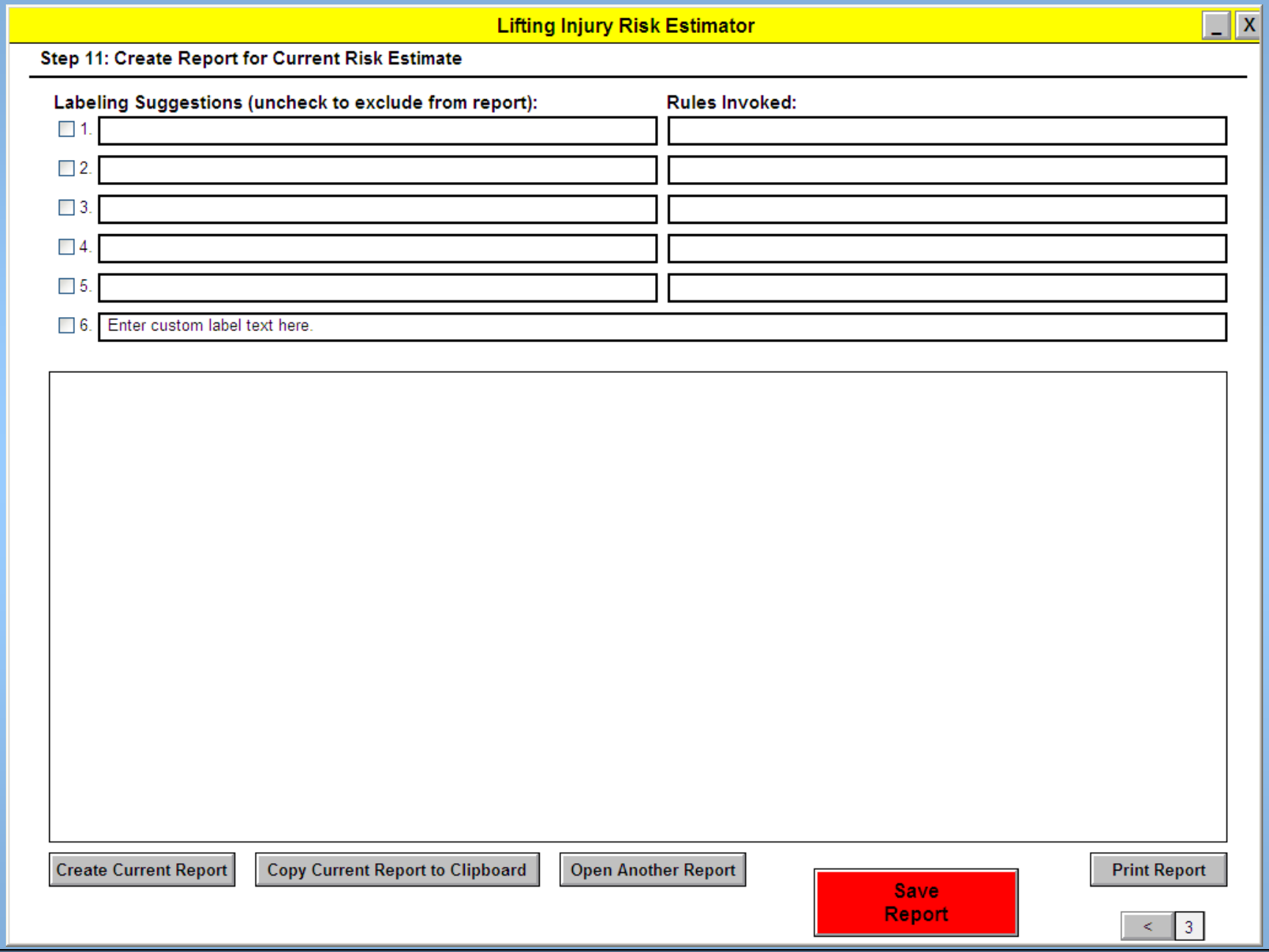

Screenshot of Assessment Software

Questions