

Headquarters U.S. Air Force

Integrity - Service - Excellence

Air Force Human Systems Integration – Capabilities and Requirements Tool (HSI-CRT)



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U.S. AIR FORCE Abstract ID: 17894



- **Background**
- **HSI-CRT Design and Development**
- **Validation and Verification of Question Sets**
- **HSI-CRT Usability Study**
- **Summary**
- **Discussion**



■ Mission

- The mission of the 711th Human Systems Integration Directorate (711 HPW/HP) and purpose of Human Systems Integration (HSI) is to optimize warfighter capability through a human-centric approach to system development, acquisition, and sustainment.

■ Problem Statement

- 711 HPW/HP lacked an integrated approach for the inclusion of HSI in early systems engineering processes and documents such as the Capabilities-Based Assessment (CBA), Analysis of Alternatives (AoA) and Development Planning (DP).

■ Solution

- Develop an integrated tool for addressing human performance related issues in the CBA, AoA, and DP processes and documents to introduce HSI best practices within the DoD and affiliated acquisition processes.



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HSI-CRT Design and Development

- Conduct a comprehensive literature review to gather and review pertinent information related to CBA, AoA, and DP
 - Force Structure, Resources, and Assessment Directorate (JCS-J8). (2009, March).
 - Capabilities-Based Assessment (CBA) User's Guide Version 3.
 - Analysis of Alternatives (AoA) Handbook
 - Concept Characterization and Technical Description (CCTD) Guide
 - Development Planning (DP) Guide
 - Analysis Handbook, A Guide for Performing Analysis Studies: For Analysis of Alternatives or Functional Solutions Analyses, Office of Aerospace Studies, July 2004
 - HSI and ESOH Handbook for Pre-Milestone A JCIDS and AoA Activities
 - Capabilities-Based Assessment for Critical Care Air Transport, Force Health Protection (FHP) CBA, T-X FoS CCTD, T-X CCTD Review, HSI Role in the AoA (Applied Training presentation for 711 HPW/HP), PAR AoA, SRD Guidebook, HSI Requirements Guide
- Develop comprehensive question sets for the CBA, AoA, and DP
- Develop a strategy for assessing HSI related risks



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HSI-CRT Design and Development

Questions and Risk Assessment Strategy

- Reviewed the *Risk Management Guide for DoD Acquisition* in order to develop a strategy for risk assessment
- Held Technical Interchange Meetings with Subject Matter Experts
 - Leveraged HSI Practitioners and Domain SMEs
- Leveraged Risk Identification: Integration & Ilities (RI3) application as a framework/guide in developing the interactive tool
 - Provide questions that inherently highlight a best practice in an area
 - Questions are formulated in such a manner that a positive response indicates that the “best practice” is being followed



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Questions and Risk Assessment Strategy

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- **Developed three question sets for the CBA, AoA, and DP aligned to each HSI domain**
 - CBA – 122 questions
 - AoA – 168 questions
 - DP – 78 questions
- **Developed an approach to ensure that HSI Tradeoffs are being considered as part of the analysis**
 - HSI Tradeoff Considerations – 9 Questions



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Questions and Risk Assessment Strategy

Sample Questions

AoA

Have manpower requirements been identified for each alternative?

CBA

Was a Manpower-Expert part of the CBA Analysis Team?

DP

Have specific Manpower concepts been identified and documented with respect to capability gaps, mission tasks, MOEs, MOPs, MOSs, operational concepts, and support concepts?

Yes

- Next Question (Do not include in the Risk Matrix)
- Provide evidence of best practice occurring

No

- Assess Likelihood (the likelihood of best practice not occurring)
- Assess Consequence (the impact on the program if the best practice does not occur)
- Provide rationale for negative response

Not Applicable

- Provide rationale for why the question is not applicable



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Questions and Risk Assessment Strategy

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- **Likelihood:** The probability of the best practice (stated in the question) **NOT** occurring *(Assigned by the user)*

Level	Likelihood	Probability of Occurrence
1	Not Likely	0% - 20%
2	Low Likelihood	21% - 40%
3	Likely	41% - 60%
4	Highly Likely	61% - 80%
5	Near Certainty	81% - 100%

- **Consequence:** The impact (consequence) on the program if the best practice does **NOT** occur *(Assigned by the user)*

Level	Consequence
1	Minimal or no consequence to human effectiveness and performance with minimal or no impact on program success
2	Minor reduction in human effectiveness and performance with little or no impact on program success
3	Moderate reduction in human effectiveness and performance with limited impact on program success
4	Significant degradation in human effectiveness and performance; may jeopardize program success
5	Severe degradation in human effectiveness and performance; will jeopardize program success

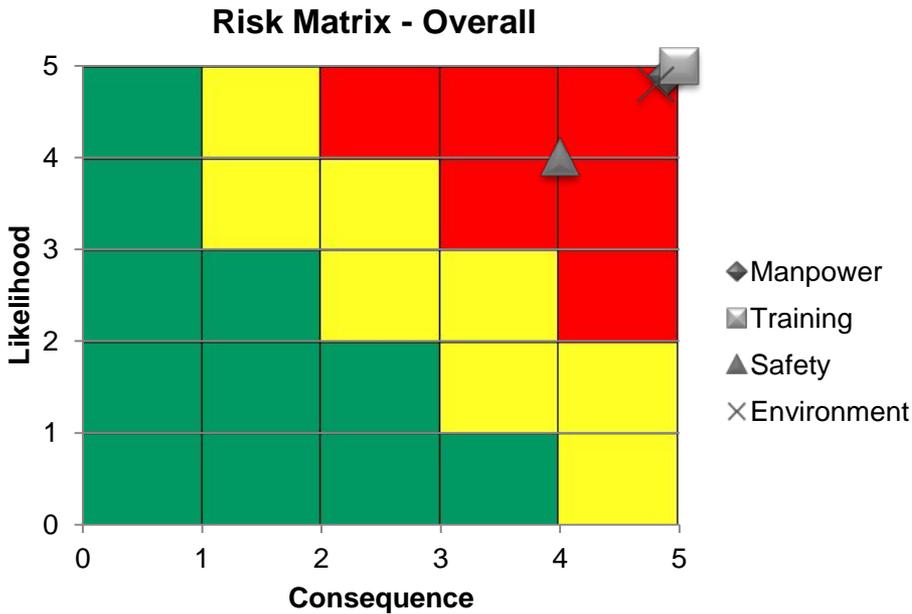


HSI-CRT Design and Development

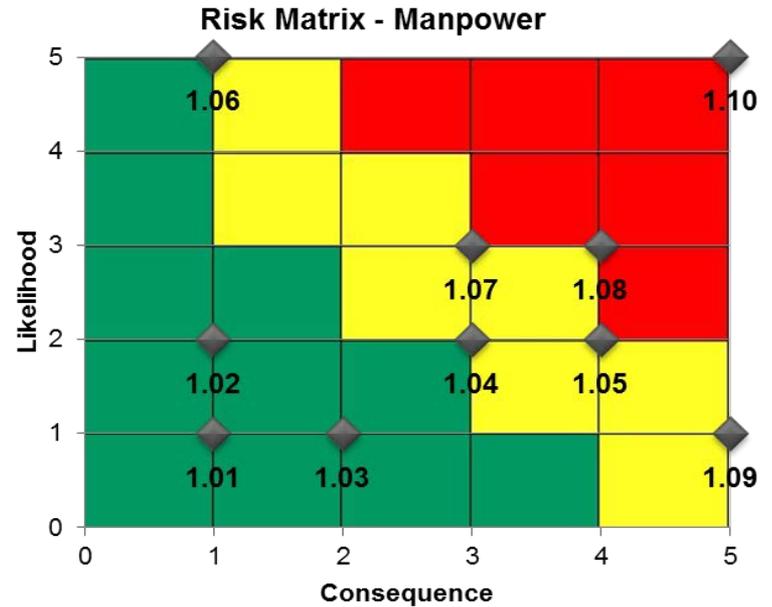
Questions and Risk Assessment Strategy

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Overall



Domain- Specific





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Questions and Risk Assessment Strategy

Overall Roll-up Chart



Likelihood and consequence ratings for each question with a “no” response are translated into an 1 dimensional rating of risk.



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HSI-CRT Design and Development

HSI-CRT Reports

Capabilities-Based Assessment

- 12 Risk Matrices
 - 1 Overall Roll-up Risk Matrix
 - 9 HSI Domains
 - 1 Tradeoff
- 1 Roll-up Chart

Analysis of Alternatives

- 12 Risk Matrices
 - 1 Overall Roll-up Risk Matrix
 - 9 HSI Domains
 - 1 General
 - 1 Tradeoff
- 1 Roll-up Chart

Development Planning

- 12 Risk Matrices
 - 1 Overall Roll-up Risk Matrix
 - 9 HSI Domains
 - 1 General
 - 1 Tradeoff
- 1 Roll-up Chart



HSI-CRT Design & Development Main Window

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Human System Integration - Capabilities and Requirements Assessment Tool

File ▾

Home | Personal Information | Analysis of Alternatives | Capabilities-Based Assessment | Development Planning | Tradeoff | Reports

HSI Assessment Tool

HSI
HUMAN SYSTEMS
INTEGRATION

To provide a means for identifying human related risks and concerns, the Survivability/Vulnerability Information Analysis Center created the Human Systems Integration Capabilities and Requirements Assessment Tool (HSI - CRAT). The HSI-CRAT uses domain-based questions to analyze human related risks in the Capabilities-Based Assessment (CBA), Analysis of Alternatives (AoA), and Development Planning (DP) process. The questions were developed by leveraging DoD and AF requirements guides. HSI-CRAT is based on a risk management approach that is familiar to system engineering and program management disciplines. The practitioner responds to a set of questions with simple yes/no answers that query the status of human centered risks at any point in the requirements planning process. The practitioner is then prompted to rate the potential human performance risk using the standard DoD risk methodology. The tool also allows the practitioner to document the HSI status by entering data that supports the risk rating. Based on user responses, the HSI-CRAT provides a report documenting the human performance risks associated with the analysis being performed.

Begin



HSI-CRT Design & Development Program/Reviewer Information

Human System Integration – Capabilities and Requirements Assessment Tool

File ▾

Home **Personal Information** Analysis of Alternatives Capabilities-Based Assessment Development Planning Tradeoff Reports

Program Information

Program Name*:

*Required Fields

HSI Practitioner Information

Title (Mr., Ms., Rank, etc):

First Name*:

Last Name*:

Email:

Phone:

Address:

Back Next



HSI-CRT Design & Development Analysis of Alternatives

Human System Integration – Capabilities and Requirements Assessment Tool

File ▾

Home | Personal Information | **Analysis of Alternatives** | Capabilities-Based Assessment | Development Planning | Tradeoff | Reports

Please provide rationale for your selection* Likelihood Consequence

1) Have the appropriate predecessor documents been reviewed and considered in terms of human impacts to the AoA? (CBA, ICD, CONOPS, Intelligence, AoA Study Guidance, DP analysis, CCTD, DOTMLPF analysis, etc.)	<input type="text"/>	<input type="text"/>
2) Have the appropriate HSI domain experts been identified and added to the AoA study team?	<input type="text"/>	<input type="text"/>
3) Were human capabilities, characteristics, and limitations considered when defining the study scope in the AoA study plan?	<input type="text"/>	<input type="text"/>
4) Were human capabilities, characteristics, and limitations considered when identifying Ground Rules, Constraints, and Assumptions in the AoA study plan?	<input type="text"/>	<input type="text"/>

*: Required Field

Back Next

General | Manpower | Personnel | Training | Human Factors | Environment | Safety | Occupational Health | Survivability | Habitability



HSI-CRT Design & Development Capabilities-Based Assessment

Human System Integration – Capabilities and Requirements Assessment Tool

File ▾

Home | Personal Information | Analysis of Alternatives | **Capabilities-Based Assessment** | Development Planning | Tradeoff | Reports

Please provide rationale for your selection* Likelihood Consequence

1) Was a Manpower-Expert part of the CBA Analysis Team?	<input type="text"/>	<input type="text"/>
2) Were Manpower requirements defined and understood in terms of the objectives of the CBA?	<input type="text"/>	<input type="text"/>
3) Did the Manpower objectives align with the Strategic Guidance (National Security Strategy, National Defense Strategy, National Military Strategy, and Joint Operations Concepts)?	<input type="text"/>	<input type="text"/>
4) Did the Manpower objectives align with GEF (Guidance on the Employment of the Force) and GDF (Guidance on Development of the Force)?	<input type="text"/>	<input type="text"/>

Manpower | Personnel | Training | Human Factors | Environment | Safety | Occupational Health | Survivability | Habitability



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HSI-CRT Design & Development Development Planning

Human System Integration – Capabilities and Requirements Assessment Tool

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Home | Personal Information | Analysis of Alternatives | Capabilities-Based Assessment | **Development Planning** | Tradeoff | Reports

Please provide rationale for your selection* Likelihood Consequence

1) Have the appropriate predecessor documents been reviewed and considered in terms of human impacts to the CCTD? (CBA, ICD, CONOPS, ST Technical Reports, Industry Reports)	<input type="text"/>	<input type="text"/>	
2) Have appropriate HSI or domain experts been identified and added to the Concept Materiel team?	<input type="text"/>	<input type="text"/>	
3) Were human capabilities, characteristics, and limitations considered when defining the Program Characterization and Design (Operating Concept, Architectural Considerations, Sustainment Features, Required Enabling Capability, Cost Drivers, etc.)?	<input type="text"/>	<input type="text"/>	
4) Were human capabilities, characteristics, and limitations considered when defining the Concept Characterization and Implementation Analysis (Critical Technologies, Technology Maturation Approach, Test Evaluation Approach, Prototyping Approach, Manufacturing Approach, Sustainment Approach, etc.)?	<input type="text"/>	<input type="text"/>	

*: Required Field

General | Manpower | Personnel | Training | Human Factors | Environment | Safety | Occupational Health | Survivability | Habitability

Back Next



HSI-CRT Design & Development

Tradeoff

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Human System Integration – Capabilities and Requirements Assessment Tool

File

Home | Personal Information | Analysis of Alternatives | Capabilities-Based Assessment | Development Planning | **Tradeoff** | Reports

Please select the Human Systems Integration tradeoff considerations that are most applicable to the Capabilities Based Analysis being performed. Please provide rationale for your selection.

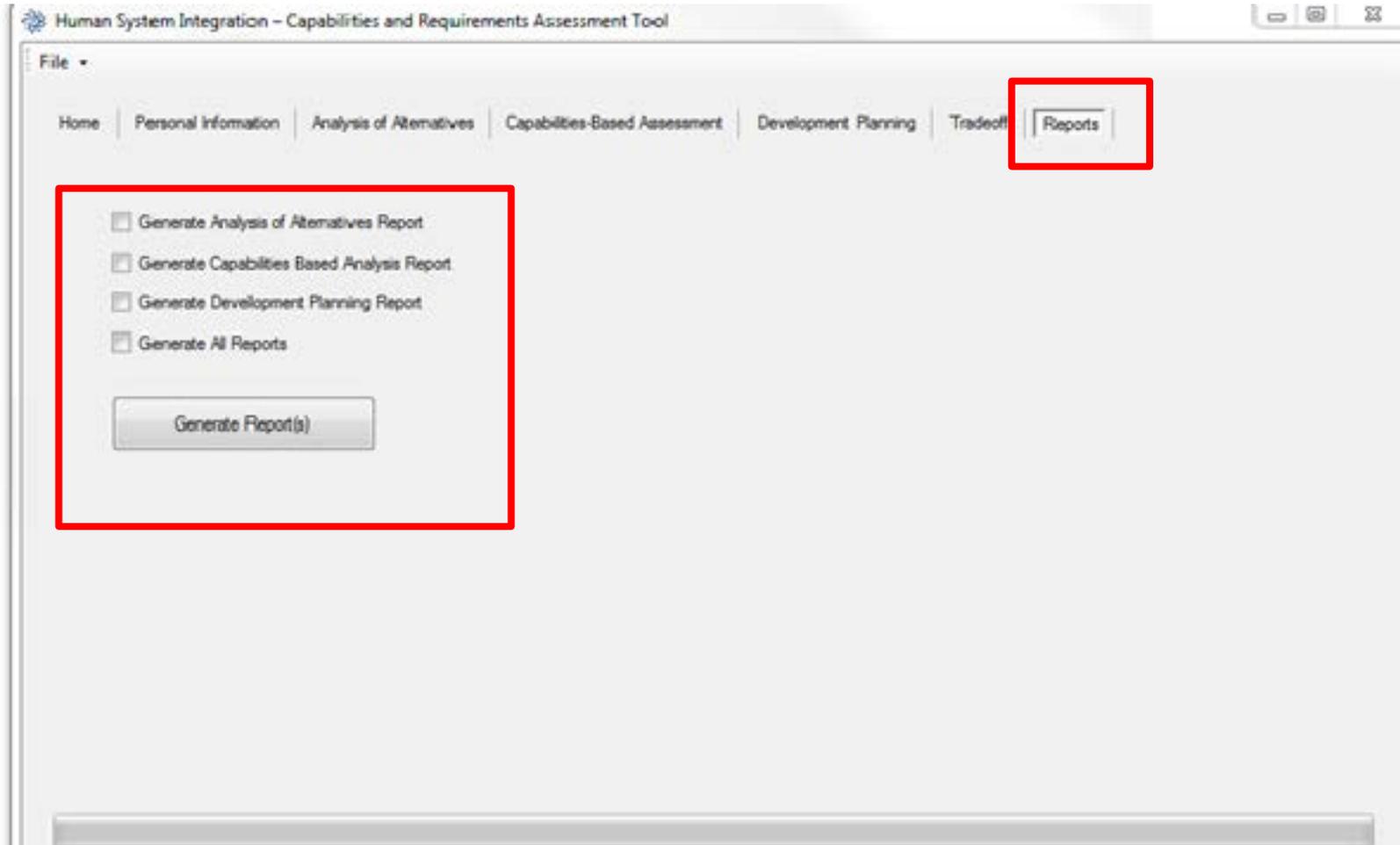
	Manpower	Personnel	Training	Human Factors	Environment	Safety	Occupational Health	Survivability	Habitability	Rationale*	Likelihood	Consequence
1) Manpower	<input type="checkbox"/>											
2) Personnel		<input type="checkbox"/>										
3) Training			<input type="checkbox"/>									
4) Human Factors				<input type="checkbox"/>								
5) Environment					<input type="checkbox"/>							
6) Safety						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
7) Occupational Health							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
8) Survivability								<input type="checkbox"/>	<input type="checkbox"/>			
9) Habitability									<input type="checkbox"/>			

*: Required Field

Back Finish



HSI-CRT Design & Development Report Generation





HSI-CRT Design & Development Report Generation

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Overall Risk Matrix

The overall risk matrix, shown in Figure 1, is created by calculating the average values of likelihood and consequence ratings for the following risk matrices.

- Manpower
- Personnel
- Training
- Human Factors
- Environment
- Training
- Safety
- Occupational Health
- Survivability
- Habitability
- Integration

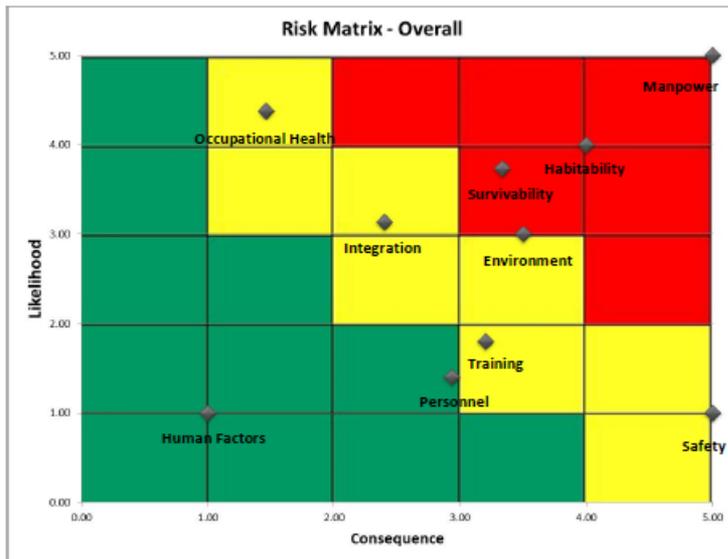


Figure 1: Overall Risk Matrix

Manpower

The Manpower Risk Matrix, shown in Figure 2, is created by plotting the likelihood and consequence ratings for each of the manpower questions.

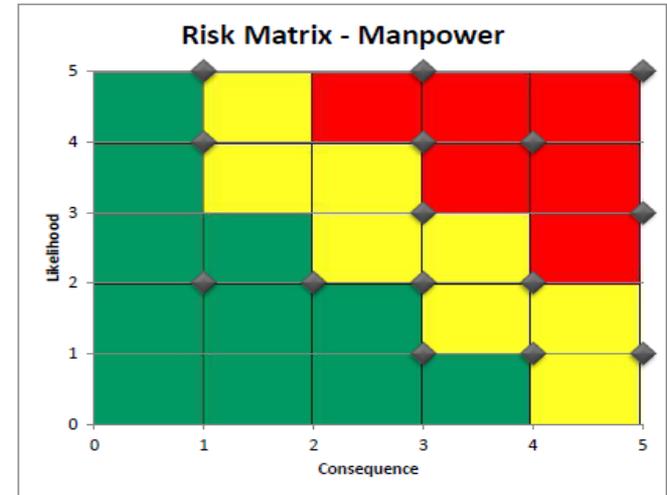


Figure 3: Risk Matrix - Manpower

The user responses to Manpower questions are depicted below.

2.01 Was a Manpower-Expert part of the CBA Analysis Team?

Yes

Please provide rationale for your selection... (The default text should be deleted once the user clicks inside the box).

2.02 Were Manpower requirements defined and understood in terms of the objectives of the CBA?

• No

Likelihood:

Consequence:

Please provide rationale for your selection... (The default text should be deleted once the user clicks inside the box).



Verification & Validation of Question Sets

Overview

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■ **Purpose**

- Review and evaluate the domain-based question sets associated with CBA, AoA, and DP for accuracy, comprehensiveness, completeness, and applicability.

■ **Process**

- Collected background information on Subject Matter Experts (SMEs)
- Interviewed SMEs
- Solicited written feedback from SMEs



Verification & Validation of Question Sets

SME Information Form

■ SME Information Form

- Contact Information
- HSI and HSI Domain Experience
- Air Force Acquisition Experience
- CBA , AoA, and DP participation experience

Contact Information

Full Name: _____
Title First Last

Office Phone: _____

Email: _____

Human Systems Integration (HSI) and Domain Experience

How knowledgeable are you in the following?

	Not Knowledgeable	Somewhat Knowledgeable	Knowledgeable	Very Knowledgeable	Years of Experience
Human Systems Integration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Manpower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Personnel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Human Factors Engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Occupational Health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Survivability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Habitability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Acquisition Experience

How knowledgeable are you about the following?

	Not Knowledgeable	Somewhat Knowledgeable	Knowledgeable	Very Knowledgeable	Years of Experience
Air Force Acquisition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Capabilities – Based Assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Analysis of Alternatives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Concept Characterization and Technical Description	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

How many Capabilities – Based Assessments (CBA) have you participated in? _____

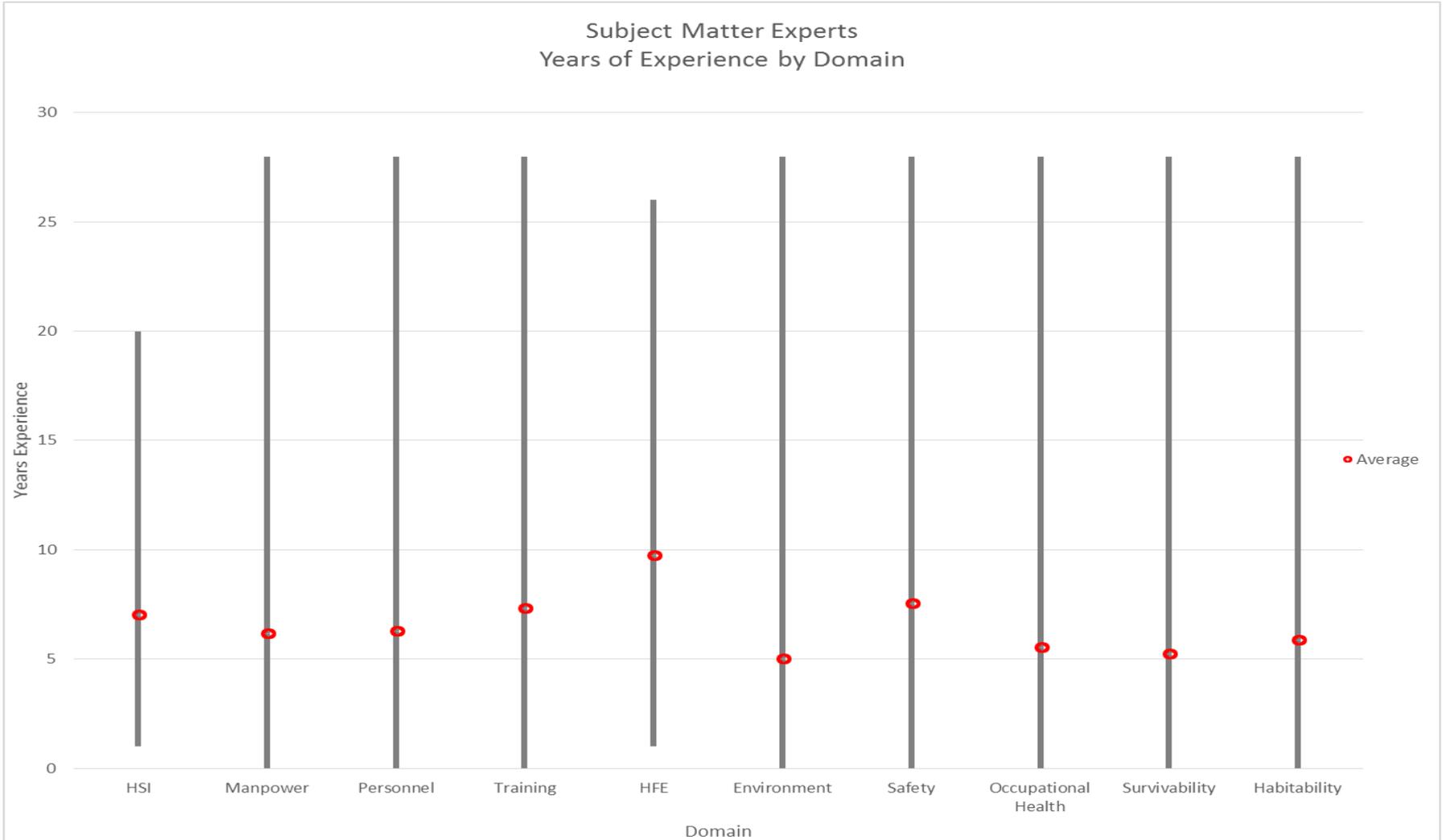
How many Analysis of Alternatives (AoA) have you participated in? _____

How many Concept Characterization and Technical Descriptions (CCTD) have you participated in? _____



Verification & Validation of Question Sets

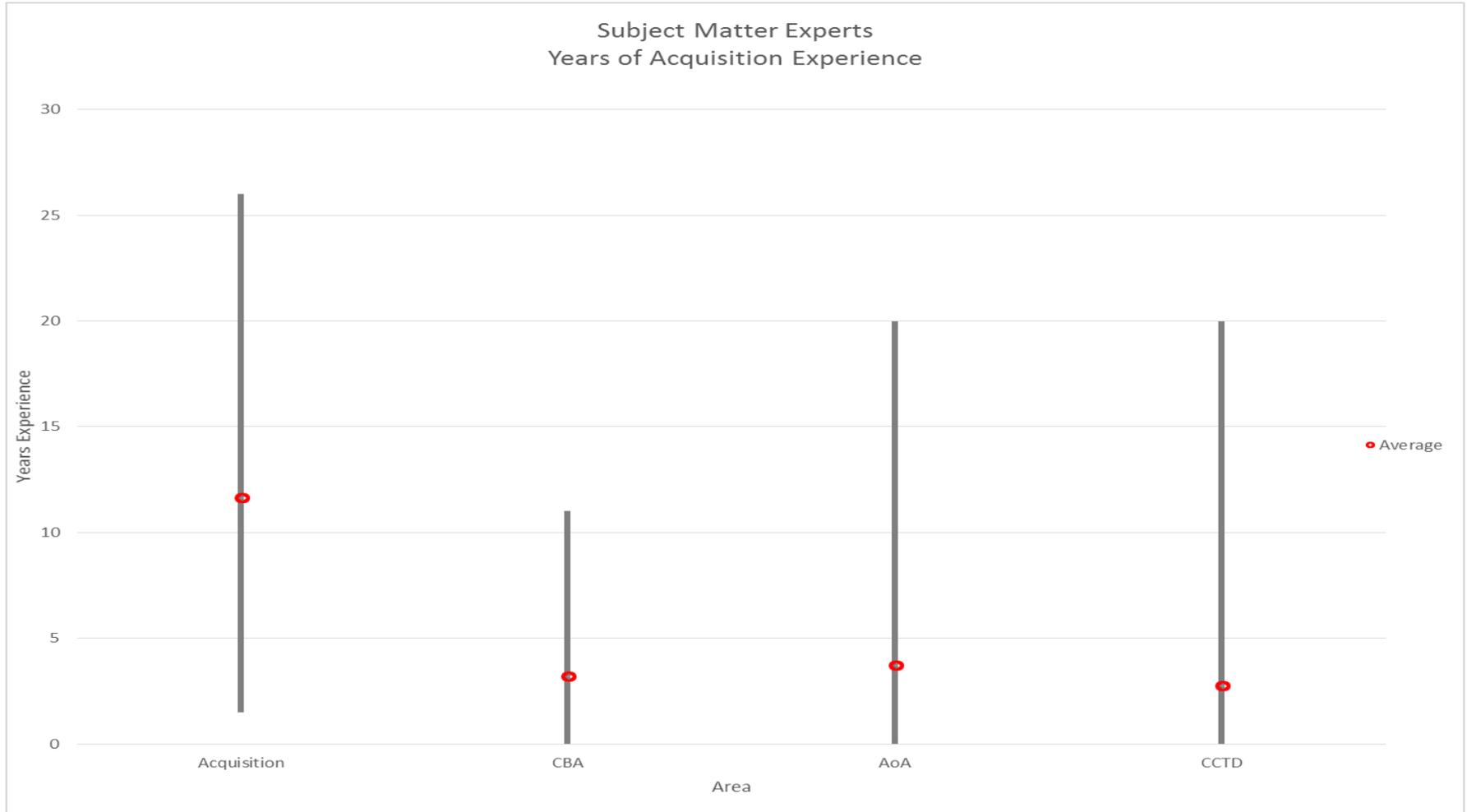
SME HSI Experience Overview





Verification & Validation of Question Sets

SME Acquisition Experience Overview





■ **Objectives**

- Determine design inconsistencies and usability problem areas within the user interface
- Exercise the application under controlled test conditions with representative users
- Establish baseline user performance and user satisfaction levels of the interface for future usability evaluations
- Determine what, if any, features are missing from the tool

■ **Participants**

- 16
- Included both HSI practitioners and non-HSI practitioners
- Participant Requirement: PC Proficiency



HSI-CRT Usability Study

Usability Study Plan

Task	Task Description	Time
Complete User Information Form	The user will be required to complete a User Information Form. The form solicits pertinent contact information such as e-mail and phone number from the user.	5 minutes
HSI-CRT Overview/Training	A member of the research team will provide a brief background of the HSI-CRT as well as outline the basic features of the tool. Additionally, the user will be given a 1-page quick reference sheet that highlights the basic features of the tool.	10 minutes
Scenario 1	<p>The user will be required to complete the following tasks in Scenario 1.</p> <ul style="list-style-type: none"> • Open the HSI-CRT application • Start a new analysis • Enter Program Information • Enter HSI Practitioner Information • Answer 3 Manpower questions in the Analysis of Alternatives • Answer 3 Personnel questions in the Analysis of Alternatives • Answer 3 Training questions in the Analysis of Alternatives • Select and answer 3 Tradeoff questions in the Analysis of Alternatives • Save current progress • Exit the HSI-CRT application 	15 minutes
Scenario 2	<p>The user will be required to complete the following tasks in Scenario 2.</p> <ul style="list-style-type: none"> • Open the HSI-CRT application • Open an existing CBA analysis from USS2.xlsx from the Desktop • Answer 3 Safety questions in the CBA • Answer 3 Occupational Health questions in the CBA • Select and answer 3 Tradeoff questions in the CBA • Save current progress • Generate HSI-CRT Report • View HSI-CRT Report • Exit the HSI-CRT application 	15 minutes
PSSUQ Survey	The user will be required to evaluate the software capabilities of the tool in a quantitative manner by completing the PSSUQ survey.	10 minutes
Wrap-up	A member of the research team will debrief the user.	5 minutes
Total		60 minutes



■ **Observation**

- Participant's interaction with the application was monitored by the facilitator/observer seated in the same room.

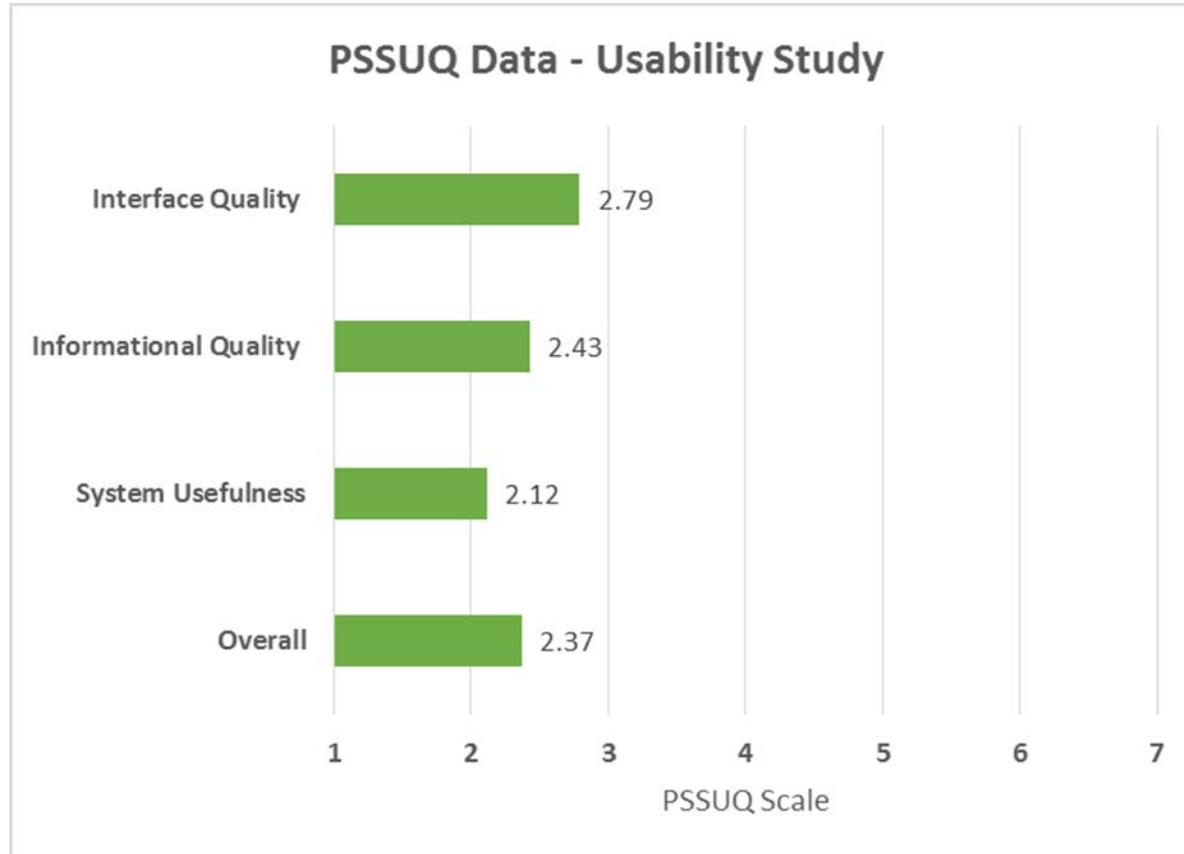
■ **Post-Study System Usability Questionnaire**

- 19 Questions
 - Overall
 - System Usefulness
 - Informational Quality
 - Interface Quality
- 7-point scale
 - 1: Strongly Agree
 - 2: Strongly Disagree

■ **Open-ended Questions**



HSI-CRT Usability Study Results





- **Some of the changes made as a result of the usability study:**
 - Larger font
 - Larger response box
 - More functions
 - Save As
 - Sort
 - Separate workflows for each document
 - Increased tool responsiveness
 - Change in the location of the tabs
 - Fixed the location of the navigation buttons



■ Purpose

- Develop an integrated tool for addressing human performance related issues in the CBA, AoA, and DP processes and documents to introduce HSI best practices within the DoD and affiliated acquisition processes

■ HSI-CRT Capabilities

- Comprehensive question sets for the requirements documents and processes
- Integrated approach to assess human related risks to program success
- Effective and engaging user interface



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Discussion



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Back-up Slides



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Risk Matrix Roll-up Strategy

Maximum One-Dimensional Rating Bar Chart

HSI-CRT Results



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PA Case No: 88ABW-2015-4499 Date Cleared: 21 SEP 2015



Project Overview – Methods

AFRL RI3 - 2.0.0

File Utility Help

Navigator

- Configuration**
- Analysis**
 - [Design Maturity & Stability](#)
 - [Scalability & Complexity](#)
 - [Integrability](#)
 - [Testability](#)
 - [Software](#)
 - [Reliability](#)
 - [Maintainability](#)
 - [Human Factors](#)
 - [People, Organization & Skills](#)
- Results**
 - [Roll-up Bar Chart](#)
 - [5x5 Matrix](#)
 - [Iity Charts](#)

Configuration

Program Name:	
UUE:	
WBS #:	
Program Manager:	
Program Manager Contact:	
Evaluator:	
Evaluator Contact:	
Date Created:	Thu, 17 Dec 2009 13:41:46
Date Saved:	

Notes

Clear Program Information Clear All Data

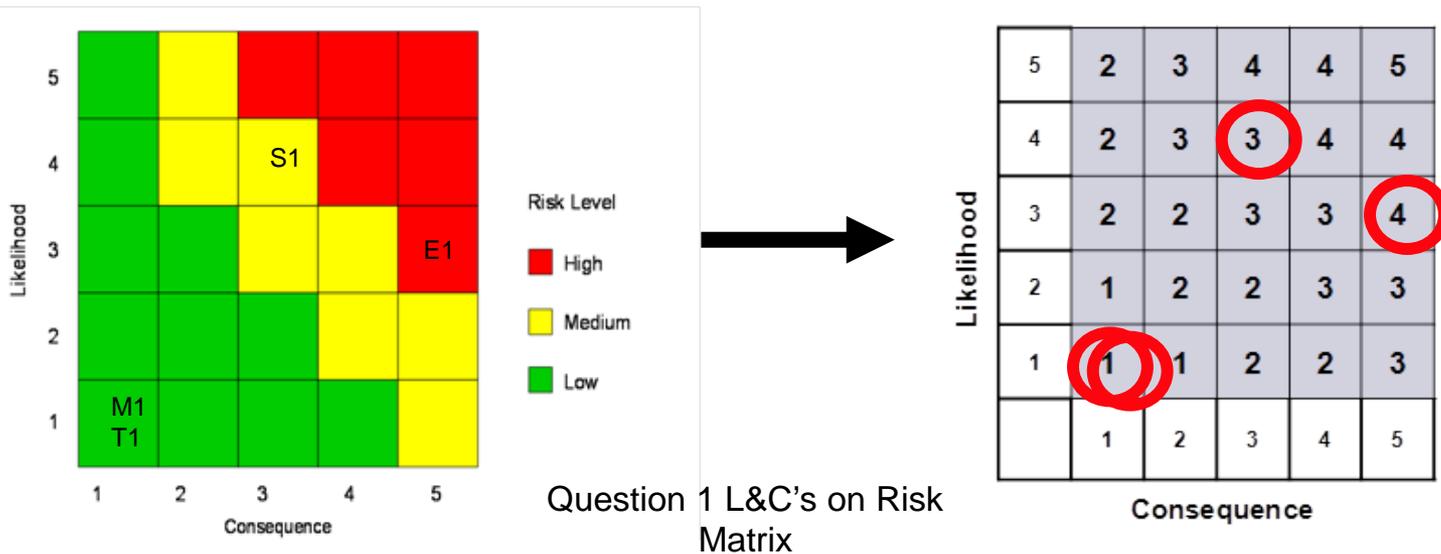
Iity	Include / Exclude
Design Maturity & Stability	X
Scalability & Complexity	X
Integrability	X
Testability	X
Software	X
Reliability	X
Maintainability	X
Human Factors	X
People, Organization & Skills	X



HSI-CRT Design and Development

Approach to Risk Assessment – An Example

Transform each Likelihood & Consequence Rating to one-dimensional rating



	Manpower		Training		Safety		Environment	
	L	C	L	C	L	C	L	C
Q1	1	1	1	1	4	3	3	5



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HSI-CRT Design & Development

HSI-CRT User Manual

- **Concise, step-by-step instructions on how to navigate the tool**
 - Home
 - Personal Information
 - Capabilities – Based Assessment
 - Analysis of Alternatives
 - Development Planning
 - HSI Tradeoff Considerations
 - HSI-CRT Report

Report

Human Systems Integration-Capabilities and Requirements Assessment Tool (HSI-CRAT) User Manual

09/24/2014

CONTRACT NUMBER SP0700-03-D-1380, TAT 13-0684, D.O. 522



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HSI-CRT Design & Development

User Interface Design Process

