MOVING HSI TO THE LEFT:

Defining pre-Acquisition Activities in the Human Systems Integration Framework (HSIF)

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Outline

• HSI Process Challenges
• HSI Framework (HSIF) Overview
• HSIF Evolution
• HSIF Features
• Pre-MDD Activities
• Way-Forward
• Technical Vision
HSI Process Challenges

- HSI and Systems Engineering have established technical processes
- Coordination and integration challenges
  - Extensive HSI-related policy, standards, and guidance
  - Inconsistent application of HSI guidance and best practices
  - Stove-piped technical efforts within HSI domains
- Impacts
  - Lack of synchronization with SETR Events and Acquisition Milestones
  - Missed opportunities to reduce HSI re-work via collaboration
  - Misalignment of HSI technical priorities with program/project cost, schedule, and performance
Extensive HSI policy and guidance: Where, Why, Who

A sample of HSI-related documents by Service

<table>
<thead>
<tr>
<th>Service</th>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoD</td>
<td>DoDD 5000.01</td>
<td>The Defense Acquisition System</td>
</tr>
<tr>
<td>DoD</td>
<td>DoDI 5000.02</td>
<td>Operation of the Defense Acquisition System</td>
</tr>
<tr>
<td>DoD</td>
<td>DAG</td>
<td>Defense Acquisition Guidebook</td>
</tr>
<tr>
<td>Navy</td>
<td>NETCINST 1510.4</td>
<td>Naval Education and Training Duty Task Analysis User Guide</td>
</tr>
<tr>
<td>Navy</td>
<td>OPNAVINST 5100.19E Volume 1: Navy Safety and Health Program Manual for</td>
<td></td>
</tr>
<tr>
<td>DoD</td>
<td>MIL-STD-1472G</td>
<td>Department of Defense Design Criteria Standard Human Engineering</td>
</tr>
<tr>
<td>DoD</td>
<td>MIL-STD-46855A</td>
<td>Human Engineering Requirements for Military Systems, Equipment, and Facilities</td>
</tr>
<tr>
<td>Navy</td>
<td>OPNAVINST 5310.23</td>
<td>Navy Personnel Human Systems Integration (NAVPRINT)</td>
</tr>
<tr>
<td>Navy</td>
<td>SECNAVINST 5000.2E</td>
<td>Department of the Navy Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System</td>
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<tr>
<td>Navy</td>
<td>SECNAVINST 5100.10J</td>
<td>Department of the Navy Policy for Safety, Mishap Prevention, Occupational Health and Fire Protection Programs</td>
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<tr>
<td>Army</td>
<td>AR 40-5</td>
<td>Preventive</td>
</tr>
<tr>
<td>Army</td>
<td>AR 40-10</td>
<td>Health Hazard Support of Decision Process</td>
</tr>
<tr>
<td>Army</td>
<td>AR 70-75</td>
<td>Support</td>
</tr>
<tr>
<td>Army</td>
<td>AR 71-9</td>
<td>Support</td>
</tr>
<tr>
<td>Army</td>
<td>AR 385-10</td>
<td>Training</td>
</tr>
<tr>
<td>Army</td>
<td>AR 570-4</td>
<td>Manpower Management</td>
</tr>
<tr>
<td>NASA</td>
<td>NASA-JSC-65995</td>
<td>Commercial Human Systems Integration Processes (CHSIP)</td>
</tr>
</tbody>
</table>

161 HSI-related documents
- When are these documents relevant?
- What can be learned from other services? From non-DOD HSI?
HSI Framework (HSIF) Overview

- The HSIF consists of process diagrams that display HSI Domain activities across the DoD Acquisition Life Cycle
  - Includes references, products, cross-domain collaborations
  - Extracted from HSI-related guidance, standards, and best practices across DoD Services and non-DoD organizations
  - Displayed in a timeline format, referenced to Systems Engineering Technical Reviews and Acquisition milestones

- HSI Opportunities and HSIF Benefits
  - Serves as a coordinating mechanism between HSI domains
  - Makes HSI tasks and products explicit to other stakeholders: Program Managers, Technical Authority, System Engineers, and Prime Contractor
  - Leverages HSI best practices across services, organizations
  - Ensures continuity as HSI support is applied throughout the cycle
HSIF Overview (cont.)

• Intended uses for the HSIF
  – Describes the who, what, when, and why of ensuring human-centered system acquisition
  – Aligns HSI activities with Systems Engineering processes
  – Develops a roadmap of HSI workflow processes
  – Plan and scope HSI activities across the entire acquisition cycle
  – Represents what other domain SMEs are or should be doing at various points in time
  – Identifies integration/trade-off opportunities between HSI domains

• HSIF is not
  – A decision-making, risk analysis, or tradeoff tool
  – A guide on how to conduct HSI activities
  – A set of HSI requirements: Activities must be tailored to program/project risks and available HSI funding
HSI F Overview (cont.)

• Example user groups
  – HSI Domain SMEs / Practitioners
  – Logisticians
  – Program Managers
  – Technical Authorities / HSI Integrators
  – System Engineers
  – Prime Contractors

• Prerequisites for use
  – Basic knowledge of HSI and the Defense Acquisition System
  – Example experience: DAU Acquisition 101, DAU HSI Course (e.g., CLE 062), NPS HSI Certificate
# HSI F Evolution: Collaboration w/ Navy HSI (SPAWAR)

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 2009</td>
<td>HSI Practitioner's Guide</td>
<td>A <strong>43-page HSI guide</strong> for integrating human factors into DoD acquisition lifecycle to better communicate consistent program support activities</td>
</tr>
<tr>
<td>May 2009</td>
<td>HSI Framework 1.0</td>
<td><strong>Visualization of the practitioner guide</strong> activities over the acquisition lifecycle, to include MPT domain activities</td>
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<tr>
<td>Sep 2009</td>
<td>HSI Framework 1.3</td>
<td><strong>Added HSI domain collaboration points</strong>; drafted Safety and Occ Health domain activities; expanded integrated acquisition row to include documentation</td>
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<tr>
<td>Nov 2010</td>
<td>HSI Framework 1.4.1</td>
<td><strong>Added input documentation and output products</strong> to each activity box for HFE row</td>
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<tr>
<td>Dec 2011</td>
<td>HSI Framework 1.5</td>
<td>Refined activity boxes to align with SPAWAR HSI Work Package development</td>
</tr>
</tbody>
</table>

**Early HSIF focus areas**  
- HFE and MPT  
- IT-related Navy systems
# HSI F Evolution: Collaboration w/ USAF HSI (711\textsuperscript{th} HPW)

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 2013</td>
<td>AF HSIF 0.0</td>
<td>Included Safety, Occ Health, Survivability, and Habitability domain activities in collaboration with USAF HSI (711\textsuperscript{th} HPW)</td>
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<tr>
<td>Aug 2014</td>
<td>AF HSIF 1.0</td>
<td>Developed an <strong>HSIF interactive application</strong>. Defined and scoped technical activities for an <strong>HSI Integrator Role</strong>. Conducted a full <strong>vetting and adjudication of all HSIF content</strong>.</td>
</tr>
<tr>
<td>Aug 2015</td>
<td>AF HSIF 2.0</td>
<td>Developed <strong>web-based application</strong> with search, tracking, library, and edit capabilities. Validated <strong>Environment domain</strong> and scoped <strong>pre-MDD activities</strong>.</td>
</tr>
</tbody>
</table>

**AF HSIF 2.0**
- 8 HSI Domains + HSI Integrator Role
- 386 Activities across 6 Acquisition Phases
- 161 Unique References
- 215 Unique Products
# HSI F Roadmap

<table>
<thead>
<tr>
<th>Release</th>
<th>0.0</th>
<th>1.0</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
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<tr>
<td><strong>Development</strong></td>
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<td></td>
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<tr>
<td>Process diagrams</td>
<td>Interactive application</td>
<td>Edit capability</td>
<td>Search Indexing</td>
<td>Sharing and collaboration</td>
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<tr>
<td>Static visualization of content (Visio)</td>
<td>Dynamic content visualization (Adobe AIR)</td>
<td>Basic search</td>
<td>Save and retrieve</td>
<td>Alternative Frameworks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flagging/tracking</td>
<td>Generate reports</td>
<td>Product templates</td>
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<tr>
<td></td>
<td></td>
<td>HSI Knowledge Management</td>
<td>Import/Export</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>HTML5 / JavaScript</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client-server architecture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 HSI Domains</td>
<td>HSI Integrator Role</td>
<td>Pre-MDD content validation</td>
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<tr>
<td>Acquisition Life-Cycle (Post-MDD)</td>
<td>SETR Activities</td>
<td>Rules for HSI domain collaboration</td>
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<tr>
<td>Activity-level content</td>
<td>HSIF content refresh</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference library</td>
<td></td>
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</table>

## Static Visualization ---- Dynamic Visualization ---- Task Focused-Centralized Editing ------ Distributed Collaboration

### Static Visualization
- Process diagrams
- Static visualization of content (Visio)

### Dynamic Visualization
- Interactive application
- Dynamic content visualization (Adobe AIR)

### Task Focused-Centralized Editing
- Edit capability
- Basic search
- Flagging/tracking
- HSI Knowledge Management
- HTML5 / JavaScript
- Client-server architecture

### Distributed Collaboration
- Search Indexing
- Save and retrieve
- Generate reports
- Import/Export
- Sharing and collaboration
- Alternative Frameworks
- Product templates

### Additional Features
- Edit capability
- Basic search
- Flagging/tracking
- HSI Knowledge Management
- HTML5 / JavaScript
- Client-server architecture
- Search Indexing
- Save and retrieve
- Generate reports
- Import/Export
- Sharing and collaboration
- Alternative Frameworks
- Product templates
- Process diagrams
- Static visualization of content (Visio)
- Interactive application
- Dynamic content visualization (Adobe AIR)
- HSI Integrator Role
- SETR Activities
- HSIF content refresh
- Pre-MDD content
- Environment
- Reference library
- Pre-MDD content validation
- Rules for HSI domain collaboration
- Product and reference traceability
- Alternative Frameworks
- Develop data models to support ROI and MBSE

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**Note:** The roadmaps indicate transitions from static to dynamic visualization, centralization to task-focused editing, and centralized to distributed collaboration.
# HSI F Design and Development: Capabilities and features

<table>
<thead>
<tr>
<th>Navigation</th>
<th>Edit</th>
<th>HSI Management</th>
<th>Document Libraries</th>
<th>Search</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Free-form “smart” canvas</td>
<td>• Add, delete, and resize activity boxes</td>
<td>• Set states for HSI risk and activity statuses</td>
<td>• Direct link to local references</td>
<td></td>
</tr>
<tr>
<td>• Add, delete, and resize activity boxes</td>
<td>• Add, delete, and edit content of activity boxes</td>
<td>• Set activity due dates</td>
<td>• Search suggestions</td>
<td></td>
</tr>
<tr>
<td>• 3 forms of navigating:</td>
<td>• Add, delete, and edit references library</td>
<td>• Maintain HSI management notes and personal annotations</td>
<td>• Search results on canvas</td>
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</tr>
<tr>
<td>o Panning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Zooming (with slider UI or with mouse scroll)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Mini map control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Multi-selection</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
HSI F Design and Development: Overview

Top navigation header provides access to search, document libraries, notifications, and settings.

Phase bar anchors activities to SETRs and Acquisition Milestones.

Activities housed within individual domain swim lanes. Capability to show/hide unneeded domains.

Multiple navigation options: scrollbar, mouse wheel, mini-map.

Search for activities, products, and references.
Click to select activity. Panel appears with details.

Details panel contains activity description, references, and products.
Users can generate local comments on HSI F activities.

Lessons learned, due dates, and other relevant details can be stored in the “HSI Management” tab.

Users can determine risk flags and activity status.
Updated HSI F Content: Why conduct HSI prior to System Development?

- Improves effectiveness of HSI planning and requirements development.
- Mitigates HSI-related risks that not be realized until late in the Acquisition cycle.
- Adapts to alternative and rapid acquisition strategies.
- Provides technical insight to the user-related components of non-materiel solutions.

Defining Pre-MDD Activities: Technical Approach

1. Collect relevant pre-MDD policy and guidance
2. Generate structure of HSI practitioner activities (top-down)
3. Elicit content from pre-MDD sources: Capability Requirements Tool
4. Integrate HSI pre-MDD, early Acquisition best practices: M&S, S&T (bottom-up)
5. Conduct working groups with HSI practitioners to refine structure and domain-specific activities
# Updated HSI F Content: Pre-MDD Sources

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>Policy</td>
<td>Joint Capabilities Integration and Development System (CJ CSI 3170.01H)</td>
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<tr>
<td>Policy</td>
<td>Operation of the Defense Acquisition System (DoDI 5000.02)</td>
</tr>
<tr>
<td>Policy</td>
<td>Development Planning to Inform Materiel Development Decision (MDD) Reviews and Support Analyses of Alternatives (AoA) (DTM 10-017)</td>
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<tr>
<td>Guidance</td>
<td>Pre-Materiel Development Decision (MDD) Analysis Handbook</td>
</tr>
<tr>
<td>Guidance</td>
<td>HSI and ESOH Handbook for Pre-Milestone AJCIDS and AoA Activities</td>
</tr>
<tr>
<td>Guidance</td>
<td>Concept Characterization and Technical Description (CCTD) Guide</td>
</tr>
<tr>
<td>Guidance</td>
<td>Capabilities-Based Assessment (CBA) User’s Guide</td>
</tr>
<tr>
<td>Guidance</td>
<td>Analysis of Alternatives (AoA) Handbook</td>
</tr>
<tr>
<td>Guidance</td>
<td>Defense Acquisitions: Many Analyses of Alternatives Have Not Provided a Robust Assessment of Weapon System Options (GAO-09-665)</td>
</tr>
</tbody>
</table>
Updated HSI F Content: Pre-MDD Structure

1. Coordinate and build HSI team
2. Provide user-related HSI inputs to CONOPS development
3. Conduct Science & Technology (S&T) review
4. Provide inputs to Capability Based Assessment (CBA)
5. Contribute to Initial Capabilities Document (ICD)
6. Contribute to DOT_LPF Change Recommendations (DCR)
7. Provide HSI inputs to Development Planning (DP)
8. Contribute of estimates of HSI technical effort to plans and budgets
9. Develop AoA Study Guidance and AoA Study Plan inputs
10. Prepare for MDD review
Updated HSI F Content: Pre-MDD Questionnaire Analysis

- Leveraged content from 711 HPW HSI-CRT
  - Risk assessment questionnaire containing 335 questions
  - Questions categorized by HSI Domain, Capabilities Based Assessment (CBA), Analysis of Alternatives (AoA)
- Extracted HSI-related questions pertaining to pre-MDD
  - 16 general questions that are independent of HSI domain
  - 35 core questions that address HSI domain were obtained by reducing questions appearing in all HSI domains to a single question

<table>
<thead>
<tr>
<th>Item No.</th>
<th>HSI Domain</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.01</td>
<td>Manpower</td>
<td>Was a Manpower domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>3.01</td>
<td>Personnel</td>
<td>Was a Personnel domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>4.01</td>
<td>Training</td>
<td>Was a Training domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>5.01</td>
<td>Human Factors</td>
<td>Was a Human Factors domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>6.01</td>
<td>Environment</td>
<td>Was an Environment domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>7.01</td>
<td>Safety</td>
<td>Was a Safety domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>8.01</td>
<td>Occupational Health</td>
<td>Was an Occupational Health domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>9.01</td>
<td>Survivability</td>
<td>Was a Survivability domain-expert part of the CBA Study Team?</td>
</tr>
<tr>
<td>10.01</td>
<td>Habitability</td>
<td>Was a Habitability domain-expert part of the CBA Study Team?</td>
</tr>
</tbody>
</table>

Core Question: Was a [HSI domain name] domain-expert part of the CBA Study Team?
Updated HSI F Content: Pre-MDD
Questionnaire Analysis (cont.)

HSI Integrator: Provide Inputs to CBA

Ensure that HSI elements are considered in the CBA.
- Identify operational capability requirements.
- Identify capability gaps & dependencies.
- Consider both materiel & non-materiel solutions (DOTMLPF)
- Provide recommendations for capability solutions.
- Review predecessor policy & guidance documents.

Human Factors Engineering: Provide Inputs to CBA

Document system capabilities and known capability gaps.
- Define HFE requirements in terms of the objectives of the CBA.
- Identify target audience for CBA, e.g., operators, maintainers, admin.
- Describe HFE issues in terms of capability gaps, mission tasks, & operational support concepts.
- Develop HFE objectives based on analysis of HFE issues.
- Align HFE objectives with policy & strategic guidance documents.

Sample of DRAFT Activities
Pre-MDD Activities: Integrate HSI Best Practices

- HSI F Content is not only generated from policy, standards, and guidance documents.
- Best practices from program experiences provide HSI Practitioners insight on conducting effective and timely HSI
- Leveraging best practices to inform pre-MDD activities
  - HSI Modeling & Simulation for System of Systems Engineering
  - HSI analyses of S&T to transition to Program of Record
HSI Best Practices: Modeling & Simulation (M&S)

- **Use case: HSI M&S for System of Systems Engineering**
  - Evaluates overall system performance based on real-time changes to DoDAF architecture views

- **M&S considerations / Challenges for HSI**
  - **Achieve traceability of HSI parameters:** Between HSI Domains and towards SoS Measures of Effectiveness (MOE), Measures of Performance (MOP).
  - **Precision of user impacts in mission scenarios:** Locating areas of user impact in architecture diagrams, tracking user impacts as mission scenarios are updated.
  - **Scalability of M&S tools for HSI Domains**
HSI Best Practices: M&S (cont.)

Define Use Cases
- Identify mission context and user roles
- Define associated operational activities
- Create task-based user workflows

Define Parameters
- Identify links between HSI domains
- Include equipment and users
- Add ranges, distributions

Refine Scenarios and Parameters with SMEs
- Refine user impacts
- Present data sheet to elicit additional parameters
- Identify relevant DoDAF, Human Views
- Map HSI impacts

Integrate data into ExAMS
- Identify requirements gaps

Update Model and Parameters

Generate HSI recommendations
- Quantify those expressions for each link/node in process

Re-evaluate SoS Performance

Conduct Model Runs / Excursions

Present data sheet to elicit additional parameters
HSI Integrator: Define Parameters

Identify links and relationships between HSI domains.

- Collect metrics from HSI Domain experts.
- Collaborate with Subject Matter Experts (SMEs) to identify ranges and parameter distribution of HSI metrics.

Human Factors Engineering: Identify Human Performance Tools

Identify suitable and appropriate tools to measure and predict the HFE component of system performance. Survey and select existing M&S tools.
HSI Best Practices: Science & Technology (S&T)

- **Use case:** Distributed Common Ground System – Navy (DCGS-N) Increment 2
- **S&T considerations / challenges for HSI**
  - Integration of COTS/GOTS software solutions toward a usable System-of-Systems (SoS)
  - Utility and usability evaluation of capabilities with standardized scoring metrics for inclusion and engineering trade-offs
  - Inclusion of Fleet user feedback on prototype technologies
  - Alignment of HSI process with existing engineering capability assessment process
HSI Best Practices: S&T (cont.)

• Sample HSI F S&T evaluation activities
  1. Develop S&T HSI entrance and acceptance criteria for Gate reviews
  2. Provide inputs to Technology Transition Agreements (TTAs)
  3. Develop S&T evaluation tools
  4. Identify appropriate users for S&T evaluation
  5. Perform HSI evaluation of capabilities (HFE, Training, Personnel)
  6. Provide recommendations to S&T performers
  7. Deliver metrics into gate report to support trade decisions
HSI F Way-Forward

• Design and Development
  – Generate reports
  – Improve search capability: index all content, documents, provide faceted search results
  – Save, retrieve, and share selected activities (e.g., different models)
  – Import/Export activities
  – Refine document and document repositories

• Analysis
  – Incorporate pre-MDD and Environment content
  – Rules for HSI domain collaboration
  – HSI product traceability
  – Define dependencies among HSI tasks
HSI F Vision

- Achieve full HSI representation: From all DoD Services and government agencies
- Achieve continuous improvement: Design and content feedback from working groups
- Integrate with DoD-wide HSI Standards
- Expand collaboration capability for use as a knowledge management tool
- Adapt to emergent Acquisition Models (DoDI 5000.02)
- Define HSI, Systems Engineering, and Acquisition product traceability
- Integrate with HSI tool integration: Shared COI tool suite (ROI, MBSE)
Questions?

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