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

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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

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Extensive HSI policy and guidance: Where, Why, Who

A sample of HSI-related documents by Service

Service	Name	Title
DoD	DoDD 5000.01	The Defense Acquisition System
DoD	DoDI 5000.02	Operation of the Defense Acquisition System
DoD	D…	
DoD	Se…	
DoD	D…	
DoD	M…	
DoD	M…	
DoD	M…	

Service	Name	Title
Navy	NETCINST 1510.4	Naval Education and Traini… Duty Task Analysis User Gu…
Navy	OPNAVINST 5100.19E (vol 1)	Volume 1: Navy Safety and… Health Program Manual fo…
Navy		
Navy		
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Navy		

Service	Name	Title
Army	AR 40-5	Preventive…
Army	AR 40-10	Health Haz… Support of… Decision Pr…
Army	AR 70-75	Su…
Army	AR 71-9	W…
Army	AR 385-10	Th…
Army	AR 570-4	Manpower Management

Service	Name	Title
Air Force	AFD-090121-054	Air Force Human Systems Integration Handbook
Air Force	AFD-090121-055	USAF HSI Requirements Pocket Guide
Air Force	AFD-100122-034	Human Systems Integration in Acquisition: Acquisition Phase Guide
Air Force	AFI 38-201	Management of Manpower Requirements and Authorizations
Air Force	AFI 63-101/20-101	Integrated Life Cycle Management
Air Force	AFI 99-103	Capabilities-based Test and Evaluation
Air Force	AFMAN 63-119	Certification of System Readiness for Dedicated Operational Testing
Air Force	AFPD 63-1/20-1	Integrated Life Cycle Management
Air Force	AFPD 91-2	Safety Programs

Service	Name	Title
NASA	NASA-JSC-65995	Commercial Human Systems Integration Processes (CHSIP)
NASA	NASA-STD-3001 (vol1)	Volume 1: NASA Space Flight Human System Standard

161 HSI-related documents

- When are these documents relevant?
- What can be learned from other services? From non-DOD HSI?

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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

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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

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HSIF 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

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HSIF Evolution: Collaboration w/ Navy HSI (SPAWAR)

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

Early HSIF focus areas
- HFE and MPT
- IT-related Navy systems

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HSIF Evolution: Collaboration w/ USAF HSI (711th HPW)

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

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

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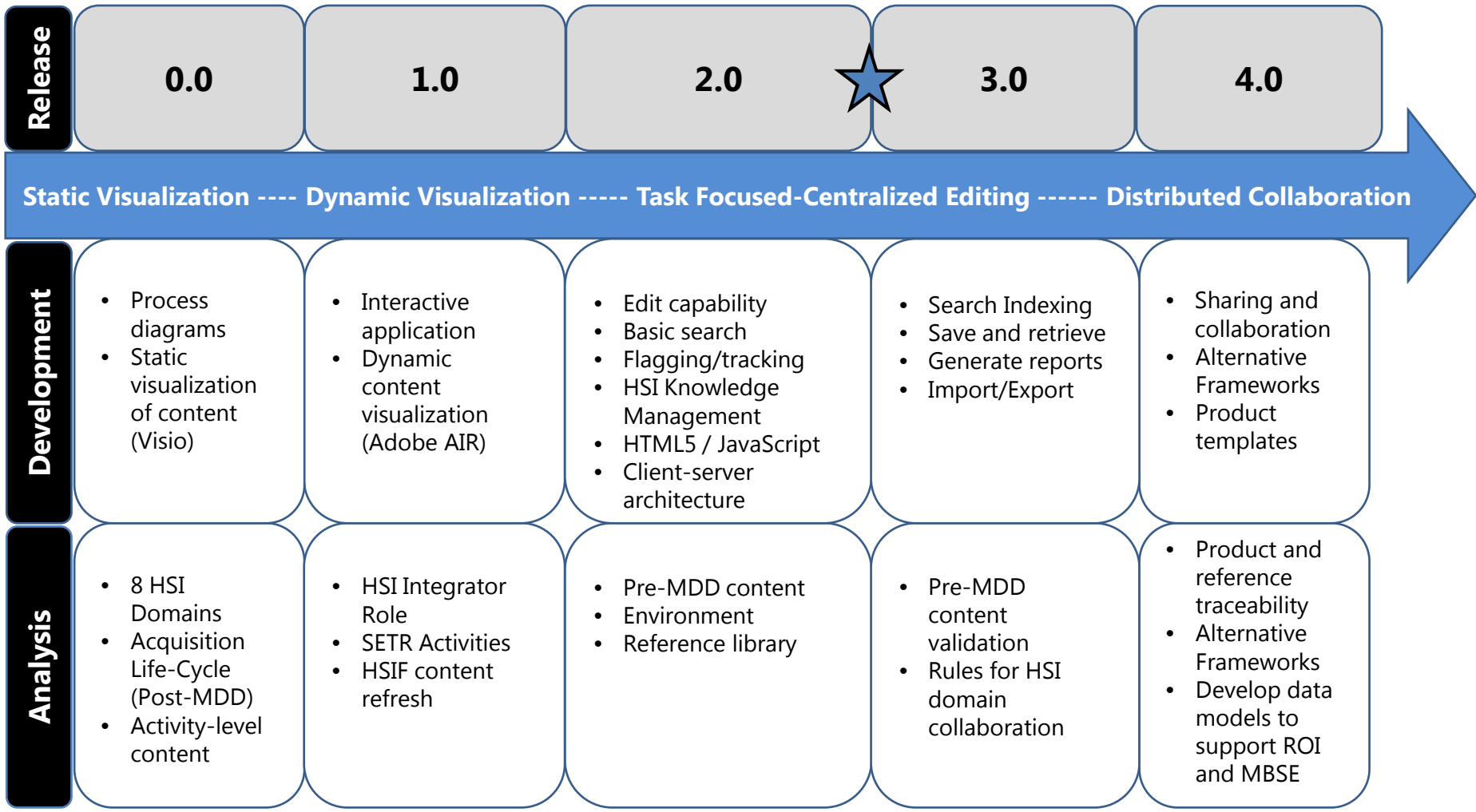
HSIF Roadmap



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HSIF Design and Development: Capabilities and features

Navigation	Edit	HSI Management	Document Libraries	Search
• Free-form "smart" canvas • Add, delete, and resize activity boxes • 3 forms of navigating: o Panning o Zooming (with slider UI or with mouse scroll) o Mini map control • Multi-selection	• Add, delete, and resize activity boxes • Add, delete, and edit content of activity boxes • Add, delete, and edit references library	• Set states for HSI risk and activity statuses • Set activity due dates • Maintain HSI management notes and personal annotations	• Direct link to local references • Searchable acronym, references, and product tables • Add, delete, and edit documents in references library	• Search suggestions • Display search results on canvas

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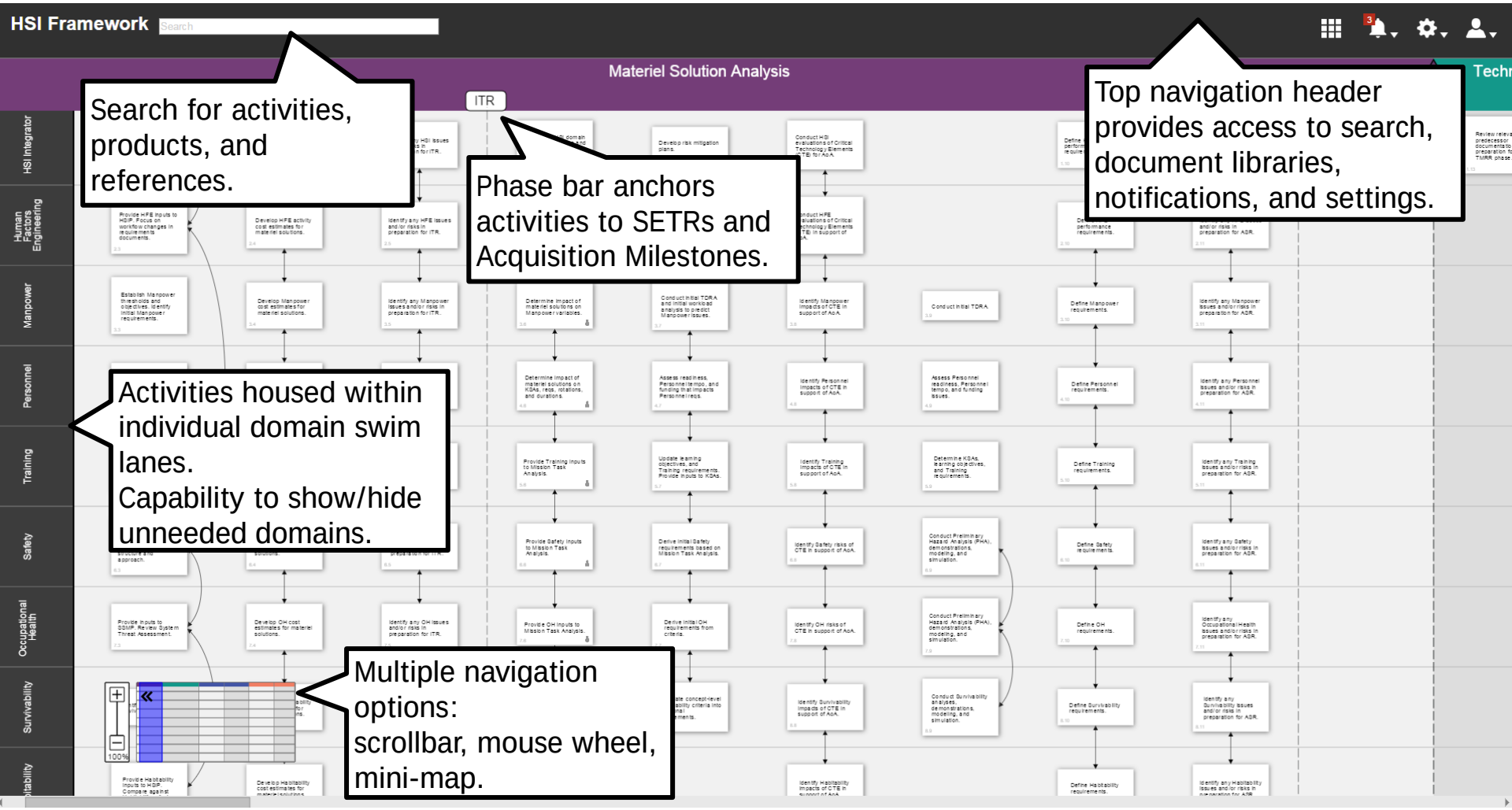
HSIF Design and Development: Overview



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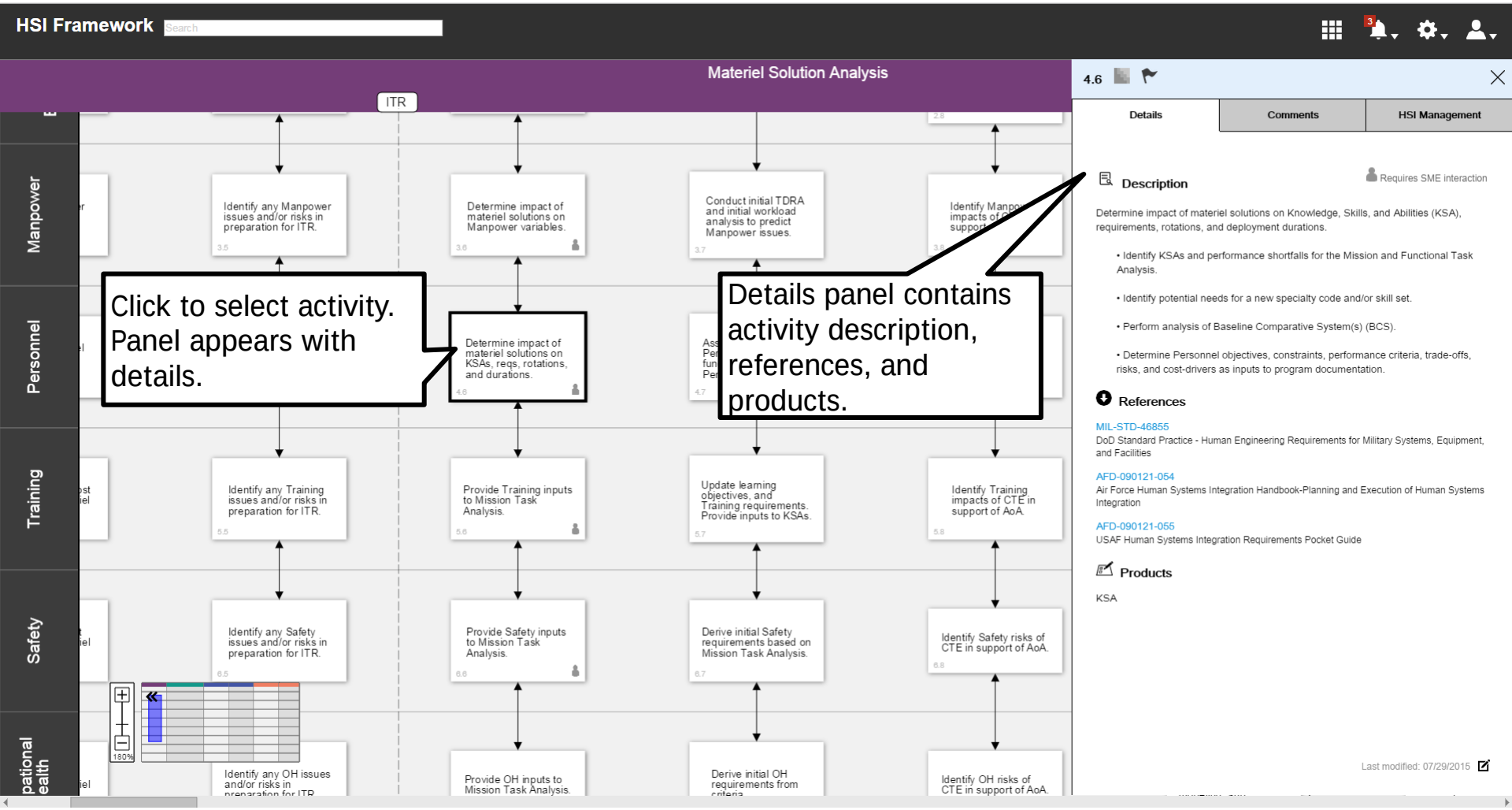
HSIF Design and Development: Details



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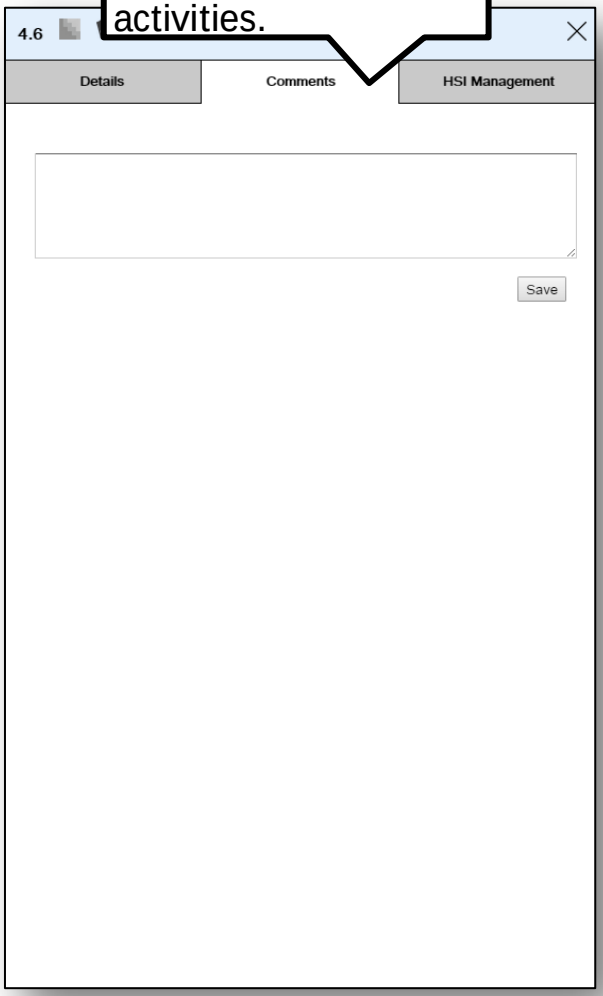
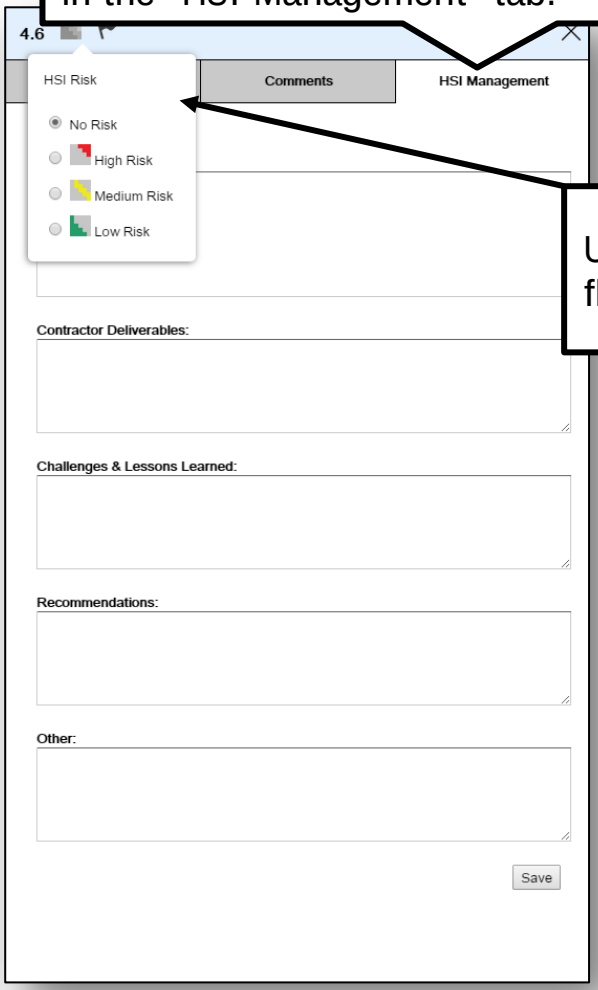
HSIF Design and Development: Commenting and HSI Management

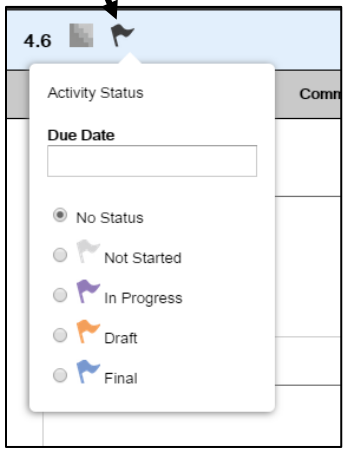
Users can generate local comments on HSIF activities.



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



Users can determine risk flags and activity status.



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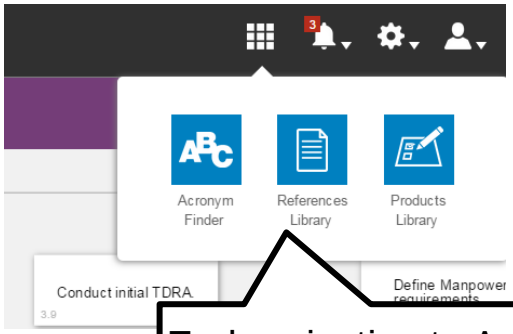
HSIF Design and Development: Document Libraries



Tool navigation to Acronym Finder, References Library, Products Library

Reference and Product metadata supports searchable tables

Reference Library

search

Add New Reference

Short Name	Full Name	Version	Section	Year	Type	Domain	Service/Organization	Action
DoDI 5000.02	Operation of the Defense Acquisition System		p. 118, Enclosure 7	2015	Policy	HSI	DoD	Edit / Delete
OPNAVINST 5310.23	Navy Personnel Human Systems Integration (NAVPRINT)			2009	Policy	HSI	USN	Edit / Delete
AFPD 63-1/20-1	Integrated Life Cycle Management			2012	Policy	HSI	USAF	Edit / Delete
AFI 63-101/20-101	Integrated Life Cycle Management			2013	Policy	HSI	USAF	Edit / Delete
DoDD 1100.4	Guidance for Manpower Management			2005	Policy	MPT	DoD	Edit / Delete
AFI 38-201	Management of Manpower Requirements and Authorizations			2014	Policy	MPT	USAF	Edit / Delete
OPNAVINST 1500.76	Naval Training Systems Requirements, Acquisition, and Management	C		2013	Policy	MPT	USN	Edit / Delete
AFI 36-2251	Management of Air Force Training Systems			2003	Policy	MPT	USAF	Edit / Delete
AFMAN 36-2234	USAF Instructional System Development			1993	Guidance	MPT	USAF	Edit / Delete
DoDD 5000.01	The Defense Acquisition System	Certified Current 2007	p. 9, Section E1.1.23 p. 10, Section E1.1.29	2003	Policy	HSI	DoD	Edit / Delete
MIL-STD-882	DoD System Safety	E		2012	Standard	ESOH	DoD	Edit / Delete
CJCSM 3170.01	Operation of the Joint Capabilities Integration and Development System	C		2007	Guidance	HSI	DoD	Edit / Delete

Acronyms Library

Add New Acronym

search

Acronym	Meaning
ACAT	Acquisition Category
AFOTEC	Air Force Test and Evaluation Center
AoA	Analysis of Alternatives
AS	Acquisition Strategy
ASR	Alternative Systems Review
ATEC	Army Test and Evaluation Command
CAD	Computer Aided Design
CARD	Cost Analysis Requirements Description
CDD	Capability Development Document
CDR	Critical Design Review
CDRA	Critical Design Review Assessment

Product Library

search

Product Name
List of system stakeholders
Updated CBA
ICD
CCTD
AoA Guidance
AoA Study Plan
DCR
CONOPS
HSI Gaps
DOTMLPF-P Change recommendations
HSI Workflows

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Updated HSIF 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

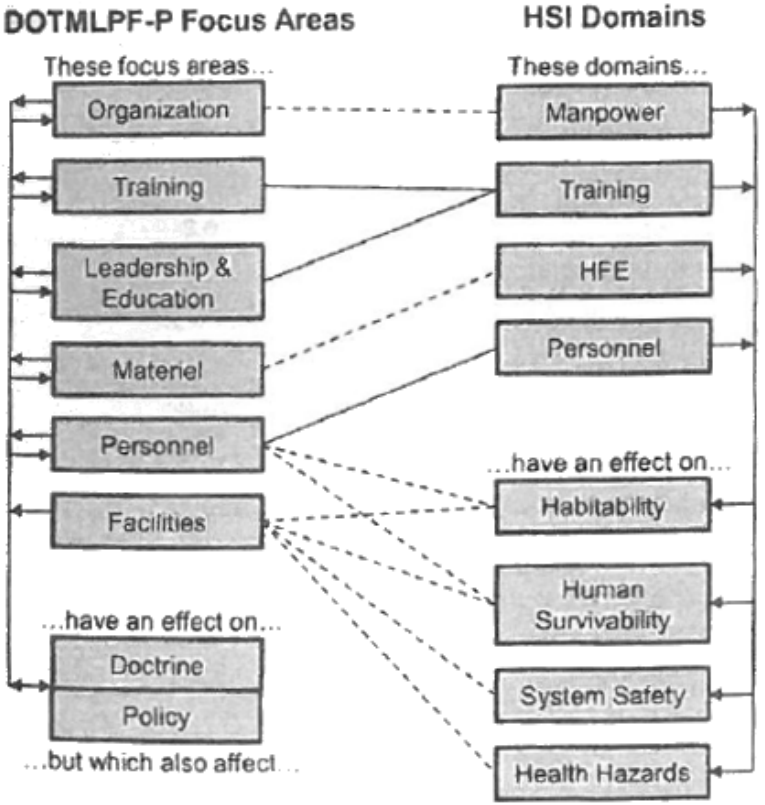

FIGURE 3.1. Relationship between doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy (DOTMLPF-P) categories and human systems integration (HSI) domains. HFE = human factors engineering.

Drillings, M., Knapp, B., & Shattuck, N.L. (2015) "Human Systems Integration in the Military" in Boehm-Davis, D. A., Durso, F. & Lee, J. D., (Eds.), *Handbook of human-systems integration.* Washington, DC: American Psychological Association Press.

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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

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Updated HSIF Content: Pre-MDD Sources

Source Type	Title
Policy	Joint Capabilities Integration and Development System (CJCSI 3170.01H)
Policy	Operation of the Defense Acquisition System (DoDI 5000.02)
Policy	Development Planning to Inform Materiel Development Decision (MDD) Reviews and Support Analyses of Alternatives (AoA) (DTM 10-017)
Guidance	Pre-Materiel Development Decision (MDD) Analysis Handbook
Guidance	HSI and ESOH Handbook for Pre-Milestone A JCIDS and AoA Activities
Guidance	Concept Characterization and Technical Description (CCTD) Guide
Guidance	Capabilities-Based Assessment (CBA) User's Guide
Guidance	Analysis of Alternatives (AoA) Handbook
Guidance	Defense Acquisitions: Many Analyses of Alternatives Have Not Provided a Robust Assessment of Weapon System Options (GAO-09-665)
Guidance	DAU Milestone Document Identification (MDID) Website (https://acc.dau.mil/CommunityBrowser.aspx?id=638309)

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Updated HSIF 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

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Updated HSIF 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

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

Core Question:
Was a [HSI domain name] domain-expert part of the CBA Study Team?

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Updated HSIF 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.

Sample of DRAFT Activities

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.

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Pre-MDD Activities: Integrate HSI Best Practices

- HSIF 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

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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**

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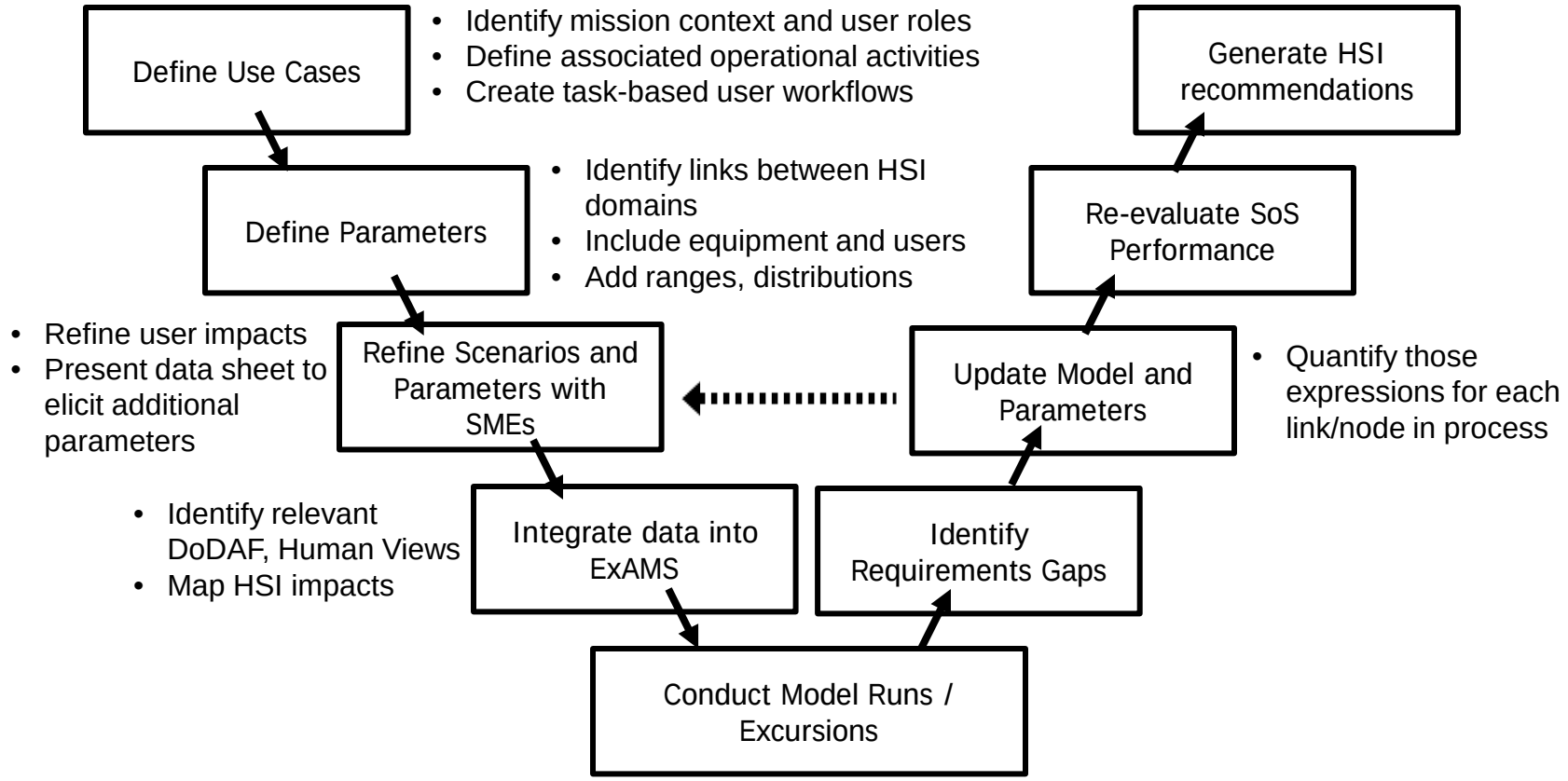
HSI Best Practices: M&S (cont.)



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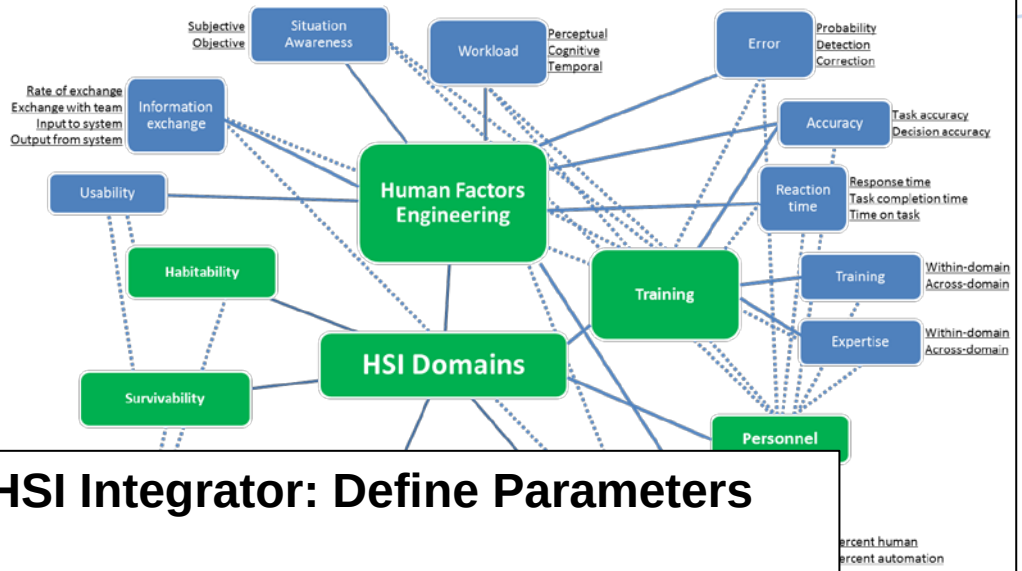
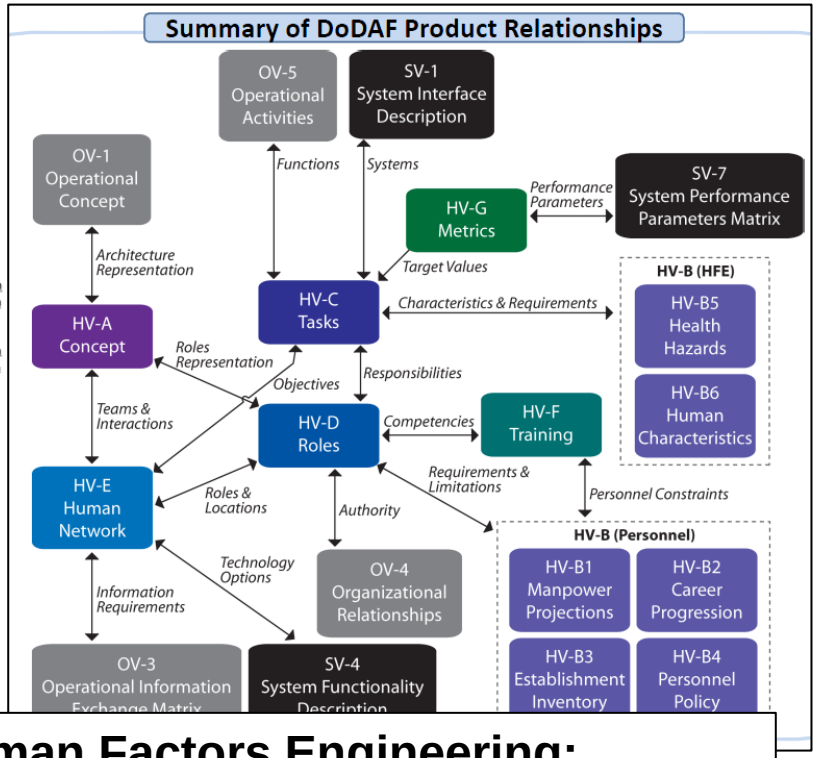
HSI Best Practices: M&S (cont.)





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.

Sample of DRAFT Activities

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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

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HSI Best Practices: S&T (cont.)

- Sample HSIF 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

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HSIF 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

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HSIF 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)

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Questions?

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