Embedding Human Systems Integration within Systems Engineering Processes – a Peek into the Draft HSI MIL-HDBK

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Abstract # 21323

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The Goal of HSI

> HSI fully considers...

the human in the design and engineering of a system, in such a way as to maximize total system performance (human + hardware + software) and minimize total ownership cost.
MISSION:
Optimize warfighter capability through a human-centric approach to system development, acquisition, and sustainment
We represent the human
- Identify human limitations and capabilities
- Identify risks along with a risk mitigation plan (risk reduction)

Goal-optimize a systems performance by
- Integrating human to system(s) processes
- Highlight inefficiencies/efficiencies caused by human-in-the-loop
- Reduce risks to system/human life
- Reduce cost
DoD needs a consistent approach for applying HSI across a system’s acquisition and sustainment life cycle

- An HSI Standard is needed to document standardized practices and processes that can be tailored and directly cited on contracts
- Discussions within the Joint HSI Working Group and Department Standardization Offices (DepSO) led to chartering the HSI Standards Working Group (WG)
- The DoD HSI Standards WG includes representatives from all Services, Coast Guard, the Office of the Secretary of Defense, and leading industry partners
Background: HSI MIL-HDBK

• SAE G45 HSI Industry Standard (SAE6906)
  - **Purpose**: Serve as HSI best practice for implementing and conducting prime contractor HSI program efforts. Intent is to be tailored and used on acquisition program contracts
  - **Document release**: Feb. 2019

• HSI MIL-HDBK as companion document to Standard
  - **Purpose**: Guidance and Practices for Government Program Managers, Systems Engineers, and HSI Practitioners on how to use the HSI Standard Practice (SAE6906). Tailoring tasks/analysis/products and Government HSI responsibilities
  - **Document release**: March 2019

• Navy is Preparing Activity, Chelsey Lawson is chair
A team representing the Services, OSD, and the Coast Guard is writing / providing input into the handbook.
V4 in internal review, Oct 2018
Senior panel review, Jan 2019
Comment adjudication, Feb 2019
Document release, March 2019
1. Scope
2. Applicable Documents
3. Definitions
4. Introduction
   - Purpose, Overview, Directives, HSI Domains, Integration Role across HSI Domains, Integration Role with Systems Engineering and Logistics, Relationship with AS6906, Roles
5. HSI in the Acquisition Phases - Timeline - “What and When”
   - Materiel Solution Analysis, Technology Development, Engineering and Manufacturing Development, Production and Deployment, Operations and Support
6. Program Execution - “Why and How”
7. HSI Documentation
8. Notes
9. Appendices
A peek...
into the Program Execution - Systems Engineering section
“Because systems engineering is the essential framework to provide capabilities to the warfighter, it is critical that HSI processes, requirements, and practitioner leadership are embedded within the systems engineering processes.”
New! Table 6.1-1: Guidance for each of the 16 SE technical and technical management processes - typical HSI activities

<table>
<thead>
<tr>
<th>SE Process</th>
<th>Typical Documents, Products</th>
<th>Typical Gov’t. HSI practitioner activities [High level why/how]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stakeholder</strong></td>
<td></td>
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<tr>
<td>Requirements</td>
<td>CBA-related documents,</td>
<td>Conduct early HSI analysis based on ‘Top Down Mission Task</td>
</tr>
<tr>
<td><strong>Requirements</strong></td>
<td>AoA Study Guidance,</td>
<td>Task Analysis’. Ensure HSI-related requirements and</td>
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<tr>
<td><strong>Definition</strong></td>
<td>Capability Documents (e.g.</td>
<td>implications are captured during the translation of</td>
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<td></td>
<td>ICD, CDD), CONOPs, Threat</td>
<td>stakeholder capabilities into stakeholder requirements.</td>
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<td></td>
<td>documents, HSIP</td>
<td>Provide HSI-related input throughout the process from JCIDS</td>
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<td>capabilities to acquisition of material solution by</td>
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<td></td>
<td>participating on AoA team, CBA team, and JCIDS-level HPT.</td>
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<td>Provide input during the development of HSI-related MOPs,</td>
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<td></td>
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<td>MOEs, and MOSs. Participate in Development Planning</td>
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<td></td>
<td></td>
<td>activities [hyperlink to Development planning sub-section].</td>
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<td></td>
<td></td>
<td>Assess HSI aspects of affordability and risk. [hyperlinks</td>
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<td></td>
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<td>to sections in Handbook including HSI in Early SE]</td>
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<tr>
<td><strong>Requirements</strong></td>
<td>CONOPs, HSIP, HSIPP, SEP,</td>
<td>Provide human performance requirements analysis. Participate</td>
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<tr>
<td><strong>Analysis</strong></td>
<td>SEMP, Software Development</td>
<td>on SE team that translates, decomposes, and integrates</td>
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<td>Plan (SDP), Capability</td>
<td>capability requirements into system level requirements and</td>
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<tr>
<td></td>
<td>Documents (e.g. ICD, CDD),</td>
<td>verification methodology to ensure HSI-related requirements</td>
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<td></td>
<td>System level requirements</td>
<td>are met. Provide integrated and comprehensive HSI analysis,</td>
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<td>(SRD, ORD, system</td>
<td>design, and assessment of requirements. Participate in TMIs</td>
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<td></td>
<td>specifications), sub-</td>
<td>and on SE team review of contractor deliverables:</td>
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<tr>
<td></td>
<td>systems specifications,</td>
<td>requirements decomposition, functional allocation, verification</td>
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<td></td>
<td>design specifications</td>
<td>methodology; reference ‘Top Down Mission Task Analysis</td>
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<td></td>
<td></td>
<td>requirements’ review process. [hyperlinks to sections in</td>
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<td></td>
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<td>Handbook]</td>
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</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>Stakeholder Requirements Definition</td>
<td>CBA-related documents, AoA Study Guidance, Capability Documents (e.g. ICD, CDD), CONOPs, Threat documents, HSIP</td>
<td>Conduct early HSI analysis based on ‘Top Down Mission Task Analysis’. Ensure HSI-related requirements and implications are captured during the translation of stakeholder capabilities into stakeholder requirements. Provide HSI-related input throughout the process from JCIDS capabilities to acquisition of materiel solution by participating on AoA team, CBA team, and JCIDS-level HPT. Provide input during the development of HSI-related MOPs, MOEs, and MOSs. Participate in Development Planning activities. Assess HSI aspects of affordability and risk.</td>
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</tr>
<tr>
<td>Requirements</td>
<td>CONOPs, HSIP, HSIPP, SEP, SEMP, Software Development Plan (SDP), Capability Documents (e.g. ICD, CDD), System level requirements (SRD, ORD, system specifications), sub-systems specifications, design specifications</td>
<td>Provide human performance requirements analysis. Participate on SE team that translates, decomposes, and integrates capability requirements into system level requirements and verification methodology to ensure HSI-related requirements are met. Provide integrated and comprehensive HSI analysis, design, and assessment of requirements. Participate in TIMs and on SE team review of contractor deliverables: requirements decomposition, functional allocation, verification methodology; reference ‘Top Down Mission Task Analysis’ process</td>
</tr>
<tr>
<td>SEP Outline V2.0 Section</td>
<td>SEP Outline 2.0 Sub-section</td>
<td>HSI-related content</td>
</tr>
<tr>
<td>--------------------------</td>
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<tr>
<td>2.1 Architectures and Interface Control</td>
<td>n/a</td>
<td>Include human aspects of architectures and interface control as appropriate.</td>
</tr>
<tr>
<td>3 Engineering Resources and Management Sections 3.1-3.3</td>
<td></td>
<td>Insert HSI resources and activities as appropriate</td>
</tr>
<tr>
<td>3.3 Technical Risk and Opportunity Management</td>
<td>3.3.3 Risk Management</td>
<td>If HSI-related risks or opportunities exist they should be included among program risks and opportunities and documented in tables within SEP section 3.3.3.</td>
</tr>
<tr>
<td>3.4.1 Government Program Office Organization</td>
<td></td>
<td>Include HSI practitioner in Figure 3.4.1-1 organizational chart (See Figure XX in this Handbook).</td>
</tr>
<tr>
<td>3.4.4. Engineering Team</td>
<td></td>
<td>Include HSI WG among SE IPT/WG Team Hierarchy (See Figure 3.4.4-1).</td>
</tr>
</tbody>
</table>
### Table 6.1-2: a Closer Look…

<table>
<thead>
<tr>
<th>SEP Outline V2.0 Section</th>
<th>HSI-Related Content</th>
<th>Rationale/Discussion</th>
</tr>
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<tbody>
<tr>
<td>4.4 Technical Reviews</td>
<td>In each table for planned technical reviews (see Table 4.4-1), provide HSI Entrance Criteria, Exit/Success Criteria, and Products/Artifacts</td>
<td>Technical Review tables within the SEP provide criteria/artifacts that the contractor must accomplish/furnish. It’s important to include HSI criteria in the tables because results are documented and action items are driven to closure in technical reviews. HSI criteria are based on the specific technical review and analysis/verification/reports that inform the review, mitigate risk, and inform the technical baseline. As a minimum, the status of key HSI-related design considerations should be provided at each technical review...</td>
</tr>
</tbody>
</table>
Optimize total system performance
• the relative and combined performance
• human + software + hardware
• trade offs

Optimize total life cycle costs
• projecting sustainment costs
  ... over 30-70 years (adds up)!

Enable the users to effectively complete the mission

HSI analysts work to ultimately reduce overall program risk
HSI – the Means

- JCIDS: Capabilities
- Development Planning
- Tech Transition

- Requirements Development
- Product / Process Development
- Testing/Training

Fielded system

Sustainment

HSI analysts involved throughout process
Top Down Analysis

Part of the overall systems engineering process – a team effort

Decompose mission capabilities into functions and tasks

Mission Analysis

Functional Analysis

Task Analysis

Consider the human as part of the overall system

Human capabilities and limitations factored into the design EARLY

Described in MIL-STD-46855A
Top Down Analysis

Allocate functions to hardware, software, and/or human

Empowering the human to excel in tasks that they do better than machines
Designing hardware and software to assist humans when machines can do tasks better

Factors into Systems Engineering top down requirements decomposition process

Mission Analysis

Functional Analysis

Task Analysis

Commercial off the shelf or transitioning technologies
Questions?

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