



SYSTEMS MANAGEMENT STANDARD

SAE6906™

REV. A

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Superseding SAE6906

(R) Standard Practice for Human Systems Integration

RATIONALE

Revision A to this SAE Standard improves clarity and reduces redundancies. It also corrects minor omissions, section numbering errors, and grammatical and typographical errors detected in the initial standard that was released in February 2019. No “shall” statements were added or deleted. This revised standard defines, for industry, standard practices required for planning and executing Human Systems Integration (HSI) activities in support of systems acquisition projects. Although primarily developed to address Department of Defense (DoD) needs, its applicability is not limited to the DoD.

FOREWORD

This SAE Standard describes contractor best practices for applying Human Systems Integration (HSI), the management and technical discipline of planning, enabling, coordinating, and optimizing all human-related considerations during system design, development, test, production, use, and disposal of systems, subsystems, equipment, and facilities. HSI is concerned with human capability, capacity, proficiency, availability, utilization, accommodation, health, safety, resilience, and survivability, as well as the ability of the system to facilitate human performance. HSI concerns are addressed through the coordination of the technical activities of the HSI domains, which include: Human Factors Engineering (HFE), Safety and Occupational Health (SOH), Habitability, Force Protection and Survivability (FPS), Manpower, Personnel, and Training. This standard, in coordination with various Department of Defense (DoD) military guidelines and handbooks, provides a mechanism for establishing and conducting a full HSI program.

The goals for HSI programs include: optimizing (1) the physical and cognitive integration of users (defined as human operators, maintainers, trainers/trainees, security, and support personnel) with complex systems; (2) the enhancement and optimization of human performance, safety, and workload; and (3) the reduction of personnel-driven system ownership costs, which can be very significant. To achieve these goals, contractor HSI programs should include significant effort in both the management of the overarching HSI process and the coordination of domain activities. When contractual efforts are not required in all HSI domains, the ability to achieve HSI goals may be compromised. For example, if the contractor is not required to conduct an HSI program including responsibilities in manpower, personnel, and training domains, contractor influence over personnel-driven ownership costs (such as recruiting, personnel management, skill development, and service schoolhouse training) would be minimal.

Early identification of HSI-level and domain-level risks, issues and opportunities for improvement and cost reduction is critical to program success. Program-level trade studies and analyses should include appropriate consideration of HSI to make accurate, informed total life-cycle cost decisions. Human performance capabilities should be considered in the specification of overall system performance requirements, sustainment, and verification of system performance requirements.

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<https://www.sae.org/standards/content/SAE6906A>

Documents

Document Sharing Hub

This standard was written in response to a documented U.S. DoD system acquisition need. It is envisioned that most citations of this standard would be in DoD contract documents. However, its applicability is not limited to the DoD; other U.S. federal agencies (e.g., Department of Homeland Security) also may find it useful, in whole or in part, in guiding contractor HSI activities. See [Appendix C](#) for mappings of HSI activities to Systems Engineering (SE) lifecycles of non-DoD federal agencies.

The G-45 Human Systems Integration Committee of SAE International developed this standard practice document, in collaboration with U.S. Government agencies, including the Department of Defense, U.S. Army, U.S. Navy, the U.S. Marine Corps, U.S. Air Force, U.S. Coast Guard, NASA, and the Department of Homeland Security. This standard will serve an even broader community of customers in the future.

Certain assumptions were made in developing this standard. Since it is widely held that HSI responsibility comprises tasks to plan, manage, and integrate the HSI domains, but does NOT include the normal activities of the domains themselves, it is important to distinguish between domain and HSI responsibilities. The committee assumed that the tasks conducted within the HSI domains are as follows:

- **Human Factors Engineering:** Activities such as specified in MIL-STD-46855 and/or HEB1.
- **Safety and Occupational Health:** Activities such as specified in MIL-STD-882 and/or GEIA-STD-0010.
- **Training:** Activities such as specified in MIL-HDBK-29612 (series) and MIL-PRF-29612.
- **Habitability:** Activities such as specified in SAE1007
- **Force Protection and Survivability:** Activities such as specified in SAE1008
- **Manpower:** Activities such as specified in SAE1010.
- **Personnel:** Activities such as specified listed in SAE1010.

Taken together, the above references were assumed to specify the HSI domain activities. The G-45 committee assumed that these are the activities that would be conducted by HSI domain specialists on DoD system acquisition programs.

Above and beyond these activities, it is the responsibility of HSI to:

- Plan, establish, coordinate, execute and document the HSI program and activities.
- Advocate for each of the HSI domains.
- Assist domain personnel in planning domain activities.
- Facilitate planning and execution of domain tasks and collaboration between domains.
- Make tradeoffs between domains to optimize the attainment of HSI goals.
- Optimize the impact of domains on the acquisition program from the perspectives of performance, sustainability, and cost.
- Integrate the results of domain activities and represent them to the rest of the acquisition program from a total HSI perspective.
- Track, status, and manage HSI risks, issues, and opportunities that surface during the execution of the program.

It is the responsibility of HSI to facilitate interactions internally between domains, and externally between HSI and the rest of the system acquisition program.

BACKGROUND

In February 1991, DoDI 5000.02 (Part 7, Section B) first established Human Systems Integration (HSI) as a concept. At that time, HSI included HFE, Manpower, Personnel, Training, and Safety and Health Hazards as the HSI domains. Over the years, the military services have established a variety of programs aimed at coordinating and optimizing human-related disciplines within the system development cycle; these programs have varied the selection and number of HSI domains.

In April 2003, the U.S. Department of Defense updated its HSI policy to include seven domains as a requirement for military systems acquisition programs (refer to DoDD 5000.01 and DoDI 5000.02). The U.S. Air Force established their HSI policy in 2005. The U.S. Navy has implemented a variety of HSI-related policies, handbooks, and guidelines, and recently released their HSI policy (OPNAVINST 5310.23A). DoDI 5000.95 provides HSI direction to the military services' Capability Developers and Program managers that guides HSI practitioner's involvement in defense system acquisition. However, until the publication of SAE6906, little or no formal guidance existed for prime and subcontractors to implement HSI on DoD system acquisition programs.

In the absence of an HSI standard practice for industry, and at the request of Dr. Robert Foster, then a director in OSD/DDR&E, the G-45 committee (under the Government Electronic Industries Association; GEIA at that time) undertook a priority task, with the assistance of various DoD specialists, to develop requirements to guide contractor HSI programs. The initial requirement documents developed by the committee were for the HSI Program Plan (HSIPP) (DI-HFAC-81743) and HSI Report (DI-HFAC-81833); these Data Item Descriptions (DID) were published and initially adopted for use by the U.S. DoD in April 2007 and March 2011, respectively. These DIDs have been used in many DoD system acquisition programs since their adoption. The DoD established an HSI Standard Working Group on June 28, 2012, to research and develop a new industry standard for HSI. In late 2015, after surveying dozens of possible source documents, the DoD requested several Standards Development Organizations (SDOs) to propose leading an industry standard development effort. In February 2016, the DoD selected the SAE International G-45 Human Systems Integration Committee to lead this task. SAE International initiated a multi-year effort in May 2016 and recruited more than 100 government, academia, and industry HSI and HSI domain specialists to contribute their expertise. This effort eventually resulted in the development and DoD adoption of this HSI standard practice.

SAE6906 was updated in the 2021-2023 timeframe to correct errors, reflect evolving DoD acquisition policy and application of the standard to DoD Adaptive Acquisition Framework pathways. [Appendix D](#) was added to assist with tailoring requirements to better fit the DoD Adaptive Acquisition Pathways. Unique numbers were added to the "shall" statements in [Appendix A](#) to facilitate tailoring of requirements.

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1. SCOPE

This SAE Standard identifies contractor activities for planning and conducting HSI as part of procurement activities on Department of Defense (DoD) system acquisition programs. This standard covers HSI processes throughout system design, development, test, production, use, and disposal. Depending on contract phase, type of the program and/or complexity of the program, tailoring of this standard **should** be applied. [Appendix A](#) lists the requirements (“shall” statements) in this standard along with unique numbers to facilitate tailoring. In addition, [Appendix D](#) provides tailoring guidance to better match requirements in this standard to the DoD’s Adaptive Acquisition Framework pathways. The scope of this standard includes prime and subcontractor HSI activities; it does not include Government HSI activities, which are covered by DoD and service-level regulations and guidelines. HSI programs **should** use the latest version of standards and handbooks listed below, unless a particular revision is specifically cited in the contract.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP292	Environmental Control Systems for Rotorcraft
ARP577	Emergency, Instruction, and Information Placards - Internal and External
EIA-649	Configuration Management Requirements for Defense Contracts
GEIA-STD-0007	Logistics Product Data
GEIA-STD-0010	Standard Best Practices for System Safety Program Development and Execution
HEB1	Human Engineering - Principles and Practices
SAE J1777	General Environmental Considerations for Marine Vehicles
SAE J1782	Ship Systems and Equipment - Hydraulic Systems - Noise Control
SAE1001	Integrated Project Processes for Engineering a System
SAE1007	Standard Practice for Habitability
SAE1008	Standard Practice for Force Protection and Survivability
SAE1010	Standard Practice for Manpower and Personnel
TA-STD-0017	Product Support Analysis

2.1.2 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-HDBK-767	Design Guidance for Interior Noise Reduction in Light-Armored Tracked Vehicles
MIL-STD-882	DoD Standard Practice: System Safety
MIL-STD-961	Defense and Program-Unique Specifications Format and Content
MIL-STD-1472	DoD Design Criteria Standard, Human Engineering
MIL-STD-1474	Noise Limits
MIL-HDBK-1908	DoD Definitions of Human Factors Terms
MIL-STD-46855	DoD Standard Practice: Human Engineering Requirements for Military Systems, Equipment, and Facilities

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside U.S.A), www.sae.org.

ARP4754	Guidelines for Development of Civil Aircraft and Systems
EIA632	Processes for Engineering a System

2.2.2 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

45 CFR Part 46	Public Welfare, Part 46: Protection of Human Subjects
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2.2.3 ANSI Accredited Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ANSI/HFES 100-2007	Human Factors Engineering of Computer Workstations
ANSI/HFES 400-2021	Human Readiness Level Scale in the System Development Process

2.2.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM F1166-07	Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities
ASTM F1337-10	Standard Practice for Human Systems Integration Program Requirements for Ships and Marine Systems, Equipment, and Facilities.

2.2.5 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 13407 Human-Centered Design Processes for Interactive Systems.

2.2.6 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 15288.1 IEEE Standard for Application of Systems Engineering on Defense Programs

IEEE 15288.2 IEEE Standard for Technical Reviews and Audits on Defense Programs

ISO/IEC/IEEE 15288 Systems and Software Engineering - System Life Cycle Processes

ISO/IEC/IEEE 29148 System and Software Engineering - Life Cycle Processes - Requirements Management

2.2.7 NASA Publications

NASA/TM-2015-218564 Minimum Acceptable Net Habitable Volume for Long-Duration Exploration Missions

NASA Technical Services, NASA STI Program STI Support Services, Mail Stop 148, NASA Langley Research Center, Hampton, VA 23681-2199, 757-864-9658, Fax: 757-864-6500, <http://ntrs.nasa.gov/>.

NASA-STD-3000 Volume I: Man-Systems Integration Standards

NASA-STD-3000B Volume II: Man-Systems Integration Standards

NASA-STD-3001 NASA Space Flight Human-System Standard

NASA/SP-2015-3709 Human Systems Integration (HSI) Practitioner's Guide

2.2.8 NATO Publications

Copies of these documents are available online at <https://www.sto.nato.int/publications/>.

TR-HFM-155 Human Systems Integration for Network Centric Warfare

2.2.9 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

2.2.9.1 U.S. Army Publications

AR 70-75 Survivability of Army Personnel and Materiel

AR 602-2 Human Systems Integration in the System Acquisition Process

AR 700-127 Logistics Integrated Product Support

U.S. Army. (1994). *U.S. Army human systems integration's soldier survivability parameter assessment list* (For official use only—restricted access: Distribution D). United States Army.

2.2.9.2 U.S. Air Force Publications

ADA218437	Aircraft Crash Survival Design Guide - Volume 4: Aircraft Seats, Restraints, Litters, and Cockpit/Cabin Delethalization
ADA218438	Aircraft Crash Survival Design Guide - Volume 5: Aircraft Postcrash Survival
ADA517632	HSI Requirements Pocket Guide
ADA519018	Human Systems Integration in Acquisition (Management Guide)
AFRSI38-201	U.S. Air Force Instruction 38-201: Manpower and Organization
DAFPAM63-128	U.S. Air Force Pamphlet 63-128: Integrated Life Cycle Management
SMC-T-006	Air Force Space Command - Space and Missile Systems Center Tailoring - Speciality and Systems Engineering Supplement to IEEE 15288.1

U.S. Air Force. (2009). *Air Force Human Systems Integration handbook: Planning and execution of Human Systems Integration*. Directorate of Human Performance Integration, Human Performance Optimization Division.

2.2.9.3 US Navy Publications

OPNAVIST 1500.76	Naval Training Systems Requirements, Acquisition and Management
OPNAVIST 5310.23A	Navy Personnel Human Systems Integration
OPNAVINST 9640.1B	Shipboard Habitability Program
CJCSI 5123.01	Charter of the Joint Requirements Oversight Council (JROC) and Implementation of the Joint Capabilities Integration and Development System (JCIDS), August, 2018
DoDD 1322.18	Military Training
DoDD 5000.01	The Defense Acquisition System
DoDI 1100.22	Policy and Procedures for Determining Workforce Mix
DoDI 5000.02	Operation of the Defense Acquisition System, Enclosure 7
DoDI 5000.88	Engineering of Defense Systems
DoDI 5000.89	Test and Evaluation
DoDI 5000.95	Human Systems Integration in Defense Acquisition
DoDI 7041.04	Estimating and Comparing the Full Costs of Civilian and Active Duty Military Manpower and Contract Support

DoD. (2010). *DoDAF Architecture Framework Version 2.02*. U.S. Department of Defense.

DoD. (2011a). *Logistics Assessment guidebook*. U.S. Department of Defense.

DoD. (2011b). *Product support BCA guidebook*. U.S. Department of Defense.

DoD. (2013). *Defense acquisition guidebook*. U.S. Department of Defense.

DoD. (2017a). *Best practices for using systems engineering standards (ISO/IEC/IEEE 15288, IEEE 15288.1, and IEEE 15288.2) on contracts for Department of Defense acquisition programs*. U.S. Department of Defense.

DoD. (2017b). *Risk, issue, and opportunity management guide for defense acquisition programs*. U.S. Department of Defense.

DoD. (2022). *Human Systems Integration guidebook*. U.S. Department of Defense.

JSSG-2010 (series) Crew Systems

2.2.9.4 Other U.S. Government Publications

Department of Homeland Security (DHS) HSI Practitioner's Guide, 2012.

DI-HFAC-80742	HESC Human Engineering Simulation Concept
DI-HFAC-80743	Notice 1: Human Engineering Test Plan (HETP)
DI-HFAC-80744	Notice 1: Human Engineering Test Report (HETR)
DI-HFAC-80745	Human Engineering Systems Analysis Report (HESAR)
DI-HFAC-80746	Human Engineering Design Approach Document - Operator (HEDAD-O)
DI-HFAC-80747	Human Engineering Design Approach Document - Maintainer (HEDAD-M)
DI-HFAC-81399	Critical Task Analysis Report (CTAR)
DI-HFAC-81742	Human Engineering Program Plan
DI-HFAC-81743	Human Systems Integration Program Plan (HSIPP)
DI-PSSS-81522	Course Conduct Information Package
DI-PSSS-81523	Training Conduct Support Document
DI-PSSS-81524	Training Evaluation Document
DI-PSSS-81525	Test Package
DI-PSSS-81526	Instructional Media Package
DI-PSSS-81527	Training System Support Document
DI-SAFT-80101	System Safety Hazard Analysis Report
DI-SAFT-80102	Safety Assessment Report
DI-SAFT-80103	Engineering Change Proposal System Safety Report
DI-SAFT-80104	Waiver or Deviation System Safety Report
DI-SAFT-80105	System Safety Program Progress Report
DI-SAFT-80106	Health Hazard Assessment Report
DI-SAFT-80931	Explosive Ordnance Disposal Data

DI-SAFT-81299	Explosive Hazard Classification Data
DI-SAFT-81300	Mishap Risk Assessment Report
DI-SAFT-81626	System Safety Program Plan
DI-SESS-81517	Training Situation Document
DI-SESS-81518	Instructional Performance Requirements Document
DI-SESS-81519	Instructional Media Requirements Document
DI-SESS-81520	Instructional Media Design Package
DI-SESS-81521	Training Program Structure Document
GAO-03-520	Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs
JCIDS Manual	Manual for the Operation of the Joint Capabilities Integration and Development System
MIL-HDBK-29612	DoD Handbook, Instructional Systems Development/Systems Approach to Training and Education (Parts 1 through 5)
MIL-HDBK-470	Designing and Developing Maintainable Products and Systems, Revision A
MIL-PRF-29612	Training Data Products Performance Specification
OSD HSI Guidebook	Office of the Deputy Director for Engineering Office of the Under Secretary of Defense for Research and Engineering, Human Systems Integration Guidebook, May 2022

2.2.10 Ministry of Defence—UK (MODUK) Publications

Available from Ministry of Defence—UK (MODUK), UK Defence Standardization, Kentigern House, Room 1138, 56 Brown Street, Glasgow G2 8EX, UK, <https://www.gov.uk/guidance/uk-defence-standardization>.

MoD Std 00-25-15	Human Factors for Designers of Systems: Principles and Process
MoD Std 00-25-16	Human Factors for Designers of Systems: Introduction and Manpower Domain Technical Guidance and Data
MoD Std 00-25-17	Human Factors for Designers of Systems: Personnel Domain - Technical Guidance and Data
MoD Std 00-25-19	Human Factors for Designers of Systems: Human Engineering Domain - Technical Guidance and Data
MoD Std 00-25-21	Human Factors for Designers of Systems: System Safety Domain - Technical Guidance and Data
MoD Std 00-25-25	Human Factors for Designers of Systems: Supporting Information - Technical Guidance and Data
MoD Std 23-10	Design Guidelines for Ministry of Defence Specialist Vehicles and Plant Equipment.

2.2.11 Other Publications

ABS. (2012). *Guide for crew habitability on workboats*. American Bureau of Shipping.

ABS. (2016). *Guide for crew habitability on ships*. American Bureau of Shipping.

Ball, R.E. (2003). *The fundamentals of aircraft combat survivability analysis and design* (Second edition). AIAA.

Boehm-Davis, D.A., Durso, F.T., and Lee, J.D. (2015). *Handbook of Human Systems Integration*. APA Handbooks in Psychology.

Booher, H.R. (2003). *Handbook of Human Systems Integration*. John Wiley & Sons, Inc.

DAU. (2022). *Air Force product support toolkit (PSTK)*. Defense Acquisition University.

INCOSE. (2015). *INCOSE systems engineering handbook: A guide for system life cycle processes and activities* (Fourth edition). John Wiley & Sons, Inc.

Lacson, F.C., Risser, M.R., Kosnik, W., and Gwynne, J. (2017). *The Human Systems Integration framework: Enhanced HSI support for systems acquisition*. Proceedings of the Human Factors and Ergonomics Society, Austin, TX: Human Factors and Ergonomics Society.

Pew, R.W. and Mavor, A.S. (2007). *Human-System Integration in the system development process: A new look*. The National Academies Press.

2.3 Definitions

CAPABILITY REQUIREMENTS: Performance that is needed to meet an organization's roles, functions, and missions in current or future operations. To the greatest extent possible, capability requirements are described in relation to tasks, standards, and conditions IAW the Universal Joint Task List or equivalent DoD Component Task List (refer to CJCSI 5123.01). Capability requirements serve as the basis for system and specification requirements.

CONTRACTOR: The company or organization responsible for fulfilling the system acquisition contract requirements. An alternative term could be "solution provider."

CONTRACTOR HSI LEAD: Contractor person responsible for planning, coordinating, and executing the HSI program; serves as the contractor's HSI single point-of-contact.

CONTRACTOR HSI TEAM: Refers to the contractor (typically a prime contractor) HSI team responsible for performing HSI activities under a systems acquisition contract. An "extended" HSI team may also include associate contractor, subcontractor, and supplier HSI personnel.

CUSTOMER HSI TEAM: Refers to the government HSI team in the organization(s) responsible to the procuring agency for providing HSI support. The team may be in the procuring agency or distributed between the procuring agency and one or more other organizations. The team may include HSI support contractors.

DOMAIN-SPECIFIC SYSTEM REQUIREMENTS: System specification/technical requirements impacting the humans (operator, maintainer, trainer, supporter, or other type of user) associated with the one or more of the HSI domains. Specific HSI domains are responsible for the development, configuration management, and verification of these system-based requirements.

FORCE PROTECTION AND SURVIVABILITY (FP/S): The FP/S domain addresses the characteristics of a system that can reduce fratricide, detectability, and probability of being attacked, and minimize system damage and soldier injury.

HABITABILITY: The Habitability domain addresses the consideration of the characteristics of systems focused on satisfying personnel needs that are dependent upon physical environment, such as berthing and hygiene.

HSI: The Systems Engineering process and program management effort that provides integrated and comprehensive analysis, design, and assessment of requirements, concepts, and resources for HFE, manpower, personnel, training, SOH, FP&S, and habitability.

HSI ACTIVITIES: The management and technical disciplines of planning, leading, coordinating, and optimizing all human integration considerations during system design, development, test, production, use, and disposal of systems, subsystems, equipment, and facilities.

HSI ISSUES: Issues are risks that have a likelihood of 100%, or, in other words, have been realized. HSI issues are issues that affect more than one domain.

HSI METRICS: Quantitative and/or qualitative measures used to estimate the positive impact of HSI and/or HSI domains on design. Alternatively, quantitative or qualitative measures used to impact adverse consequences on the ability of HSI or HSI domains to achieve human integration, human performance, or cost reduction goals.

HSI PROGRAM: All the planning, analysis, design support, test and evaluation, coordination, and documentation activities undertaken in response to HSI programmatic requirements contained in the system acquisition contract statement of work (SOW).

HSI WORKING GROUP: Typically, a chartered organization charged with carrying out all the HSI activities associated with a system acquisition program. The HSI working group (which may be called an Integrated Product Team [IPT], depending on the program or service) is typically co-chaired by customer and prime contractor HSI leads. Membership usually includes HSI and HSI domain representatives from the prime contractor and customer. The HSI working group may also include HSI and domain representation from major subcontractors, associate contractors, and major suppliers.

HSI PRACTITIONER(S): Personnel trained and/or experienced in HSI or the HSI domains who participate in the execution of the HSI program. May also be called HSI subject-matter experts (SMEs).

HSI PROGRAMMATIC REQUIREMENTS: Statement of work (SOW) requirements for HSI tasks for the contractor HSI team to execute. Focus of these requirements is on HSI program planning, coordination, execution, documentation, and reporting.

HSI-RELATED REQUIREMENT: A requirement not directly associated with an HSI domain, but with human implications, including capability, system or lower-level specification, logistical, or human performance requirements. These requirements may interface with multiple domains and multiple disciplines. HSI or the HSI domains do not have formal responsibility for developing, managing, and testing these requirements, but are a significant stakeholder in the fulfillment of these requirements during system design/development and throughout the system lifecycle.

HSI RISK: A condition of potentially adverse impact on humans and/or systems. HSI risks can be technical, as well as programmatic. An example of a major HSI risk would be that the assigned personnel, trained in accordance with the training developed, will not be able to safely and effectively operate (or maintain) the system as delivered.

HSI TASK: Any task performed by the HSI team or HSI domain specialist that contributes materially to achieving HSI goals of improving human integration, improving human performance, or reducing personnel-driven ownership costs.

HUMAN FACTORS ENGINEERING (HFE): The HFE domain addresses the application of knowledge about human capabilities and limitations to system or equipment design and development to achieve efficient, effective, and safe system performance at minimum cost and manpower, skill, and training demands.

HUMAN PERFORMANCE: A measure of human functions and action in a specified environment, reflecting the ability of actual users and maintainers to meet the system's performance standards, including reliability and maintainability, under the conditions in which the system will be employed. (Excerpt from MIL-HDBK-1908.)

HUMAN PERFORMANCE REQUIREMENTS: A requirement articulating a need for attaining a specified level of human action with in a particular environment, with or without system facilitation, in order to support mission attainment.

LOGISTICS REQUIREMENTS: A requirement that articulates a specific need for operations support and sustainment within an acquisition effort. This type of requirement can define support metrics, such as Reliability Availability and Maintainability (RAM) and Operational Availability (A_o) (system availability based on component part life expectancy), but may also contain human-based aspects, such as manning estimates, supply chain concepts/methodologies, and training systems. Manpower, Personnel, and Training requirements are often considered as logistics requirements.

MANAGEMENT: Contractor senior managers and/or program manager. Since this standard applies only to contractors, the term “management” does not apply to the procuring agency program manager or senior managers.

MANPOWER: The Manpower domain addresses the total number of personnel or positions required to perform specific tasks. Indexed by requirements including jobs lists, slots, or billets characterized by descriptions of the people required to fill them and the number of people required to operate, maintain, train, and support a system.

PERSONNEL: The Personnel domain addresses the human aptitudes (i.e., cognitive, physical, and sensory capabilities); knowledge, skills, abilities; and experience levels needed to properly perform job tasks and required to train, operate, maintain, and sustain materiel and information systems.

PROCURING AGENCY: The procuring agency is the organization responsible for system acquisition and as such can be considered the “customer” (e.g., Naval Air Systems Command).

SAFETY AND OCCUPATIONAL HEALTH (SOH): The SOH domain addresses the characteristics of system design that can: minimize the risk of acute or chronic illness, disability, injury or death to the operator or maintainers; and enhance the job human performance and productivity of personnel who operate, maintain, or support the system in the intended operational environment.

SENIOR MANAGER OR PROGRAM MANAGER: Refers to the contractor’s senior manager or program manager.

SHALL: **Shall** indicates normative requirements, those for which compliance with the specific statement is required.

SHOULD: **Should** is used for informative statements, wherever noncompliance with the specific recommendation is permissible.

STANDARD PRACTICE (OR BEST PRACTICE): The recommended process to be followed in implementing and executing work for a program (i.e., HSI efforts for a program) against which other practices are measured. For HSI, best practices are determined by a broad-based group of DoD and contractor SMEs, who are experienced in the practice and application of HSI on a variety of acquisition programs.

TOTAL SYSTEM PERFORMANCE: The end state functionality achieved by a system when including the human with hardware and software components under its intended operational condition(s) to achieve required operational, effectiveness, and suitability, survivability, safety, and affordability.

TRAINING: The Training domain addresses the policy, processes and techniques, training aids, devices, simulators and simulations, planning, and provisioning for the training, to include equipment used to train personnel to operate, maintain, and support a system.

USER: Personnel who will operate, maintain, train, and support the equipment, system, or facility.

2.4 Acronyms

AOA	Analysis of Alternatives
APA	Additional Performance Attributes
AR	Army Regulation
ASAP	Aircrew Systems Advisory Panel

ASMS	Analyses, Studies, Modeling, and Simulation
ASTM	American Society for Testing and Materials
ASVAB	Armed Services Vocational Aptitude Battery
BCA	Business Case Analysis
CAD	Computer-Aided Design
CARD	Cost Analysis Requirements Description
CCE	Component Cost Estimate
CCP	Component Cost Position
CDD	Capability Development Document
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CFS	Contract Field Services
CLS	Contractor Logistics Support
CMS	Contractor Maintenance Services
CONEMP	Concept of Employment
CONOPS	Concept of Operations
COMS	Contractor Operation and Maintenance of Simulators
COTS	Commercial Off-the-Shelf
CSWG	Crew Systems Working Group
CTP	Critical Technical Parameter
CSCI	Computer Software Configuration Item
DAG	Defense Acquisition Guidebook, or Design Advisory Group
DDR&E	Deputy Director for Research and Engineering
DET	Displaced Equipment Training
DHS	Department of Homeland Security
DID	Data Item Description
DoD	Department of Defense
DoDAF	Department of Defense Architecture Framework
DoDD	Department of Defense Directive

DoDI	Department of Defense Instruction
ECP	Engineering Change Proposal
EFM	Emergent Failure Mode
EMD	Engineering and Manufacturing Development (Acquisition Phase)
FMECA	Failure Modes and Effects Criticality Analysis
FRP	Full Rate Production
FOC	Full Operational Capability
FPS	Force Protection and Survivability
FPSSP	Force Protection-Survivability Program Plan
FTA	Fault Tree Analysis
GAO	Government Accountability Office
GEIA	Government Electronic Industries Association
GFE	Government-Furnished Equipment
GFP	Government-Furnished Property
GFI	Government-Furnished Information
HDBK	Handbook
HEDAD-M	Human Engineering Design Approach Document-Maintainer
HEDAD-O	Human Engineering Design Approach Document-Operator
HESAR	Human Engineering Systems Analysis Report
HFAC	Human Factors (Standardization)
HFE	Human Factors Engineering
HRL	Human Readiness Level
HSI	Human Systems Integration
HSIPP	Human Systems Integration Program Plan
HSIR	Human Systems Integration Report
HWCI	Hardware Configuration Item
IAW	In Accordance With
ICD	Initial Capabilities Document
IEEE	Institute of Electrical and Electronics Engineers

ICD	Interface Control Document
ICE	Independent Cost Estimate
IDD	Interface Design Description
ILA	Independent Logistics Assessment
IMP	Integrated Master Plan
IMPRINT	Improved Performance Research Integration Tool
IMS	Integrated Master Schedule
INCOSE	International Council on Systems Engineering
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IMA	Instructional Media Analysis
IPS	Integrated Product Support
IPSP	Integrated Product Support Plan
IPT	Integrated Product Team
ISEO	In-Service Engineering Office
ISO	International Organization for Standardization
ISS	Instructional System Support
JCIDS	Joint Capabilities Integration and Development System
JTA	Job Task Analysis
KPP	Key Performance Parameter
KSA	Key System Attribute
LA	Learning Analysis
LCC	Life-Cycle Cost
LCMP	Life-Cycle Management Plan
LCSP	Life-Cycle Sustainment Plan
LO	Learning Objective
LORA	Level of Repair Analysis
LRIP	Low Rate Initial Production
MANPRINT	Manpower and Personnel Integration (early US Army name for Human Systems Integration)

M&P	Manpower and Personnel
MAP	Maintainer Advisory Panel
MER	Manpower Estimate Report
MOE	Measure of Effectiveness
MOS	Military Occupational Specialty
MTA	Maintenance Task Analysis
NASA	National Aeronautics and Space Administration
NBC	Nuclear Biological Chemical
NEPA	National Environmental Protection Act
NET	New Equipment Training
NTSP	Navy Training Systems Plan
OBS	Organizational Breakdown Structure
ODASD	Office of the Deputy Assistant Secretary of Defense
OJT	On-the-Job Training
ONO	Chief of Naval Operations
OPEVAL	Operational Evaluation
OPNAVINST	Instruction Issued by the Chief of Naval Operations
OPT&E	Operational Test & Evaluation
OPSTEMPO	Operations Tempo
OSA	Other System Attribute
OSD	Office of the Secretary of Defense
PDR	Preliminary Design Review
POM	Program Objectives Memorandum
PESHE	Programmatic Environmental Safety and Health Evaluation
POE	Program Office Estimate
POM	Program Objective Memorandum
PSA	Product Support Analysis
PSE	Product Support Element
RCM	Reliability Centered Maintenance

RFP	Request for Proposal
RSTA	Reconnaissance, Surveillance, and Target Acquisition
SA	Situation Awareness
SDD	System Design and Development (Acquisition Phase)
SDRL	Subcontract Data Requirements List
SE	Systems Engineering
SEMP	Systems Engineering Management Plan (Contractor)
SME	Subject-Matter Expert
SOO	Statement of Objectives
SOW	Statement of Work
S/OH	Safety/Occupational Health (also SOH)
STD	Standard
SRD	System Requirements Document
STRAP	System Training Plan
SRS	Software Requirements Specification
SSA	System Safety Assessment
SSS	Sub-System Specification, or System Segment Specification
SyRS	System Requirements Specification
TAD	Target Audience Description
TADSS	Training Aids, Devices, Simulators, and Simulations
T&E	Test and Evaluation
TEE	Training Effectiveness Evaluation
TEMP	Test and Evaluation Master Plan
TMRR	Technology Maturation and Risk Reduction (Acquisition Phase)
TPM	Technical Performance Measure
TRL	Technology Readiness Level
TSRA	Training Systems Requirements Analysis
TSA	Training Situation Assessment
UJTL	Universal Joint Task List

WBS Work Breakdown Structure

WG Working Group

3. HSI OVERVIEW

3.1 General

3.1.1 Human Systems Integration (HSI)

The HSI discipline was established with the primary objective of enhancing the effectiveness of DoD systems by placing humans (functioning as individuals, crews/teams, units, and organizations) on the same level in the design process with technological elements of the system such as hardware and software. Human performance is a key factor in total system performance, and human performance is itself impacted by the design of the hardware and software. In most cases, human performance enhancements correlate directly to enhanced mission performance and reduced total ownership costs.

The HSI discipline is comprised of seven domains, including Human Factors Engineering (HFE), Manpower, Personnel, Training, Safety and Occupational Health, Habitability, and Force Protection and Survivability (refer to DoDI 5000.95). The intent of this standard practice document is to establish the HSI best practice and associated processes and product requirements for the conduct of an HSI program. It is not intended to detail the HSI domain requirements as those are covered in other standards. This document discusses typical HSI domain activities as they relate to the HSI-level integration and management tasking. As such, the primary focus of this document is to provide guidance on HSI-level tasking and products. To provide context for what HSI practitioners need to understand regarding the domains, a description of each domain's scope, typical activities and tasks, and references are provided in [Appendix B](#).

The top part of [Figure 1](#) represents a visual of the core HSI process as it relates to the DoD Acquisition Framework and lifecycle (refer to DoDD 5000.01 and DoDI 5000.02). Additionally, [Figure 1](#) provides a mapping of the sections of this document as they relate to the DoD HS acquisition lifecycle.

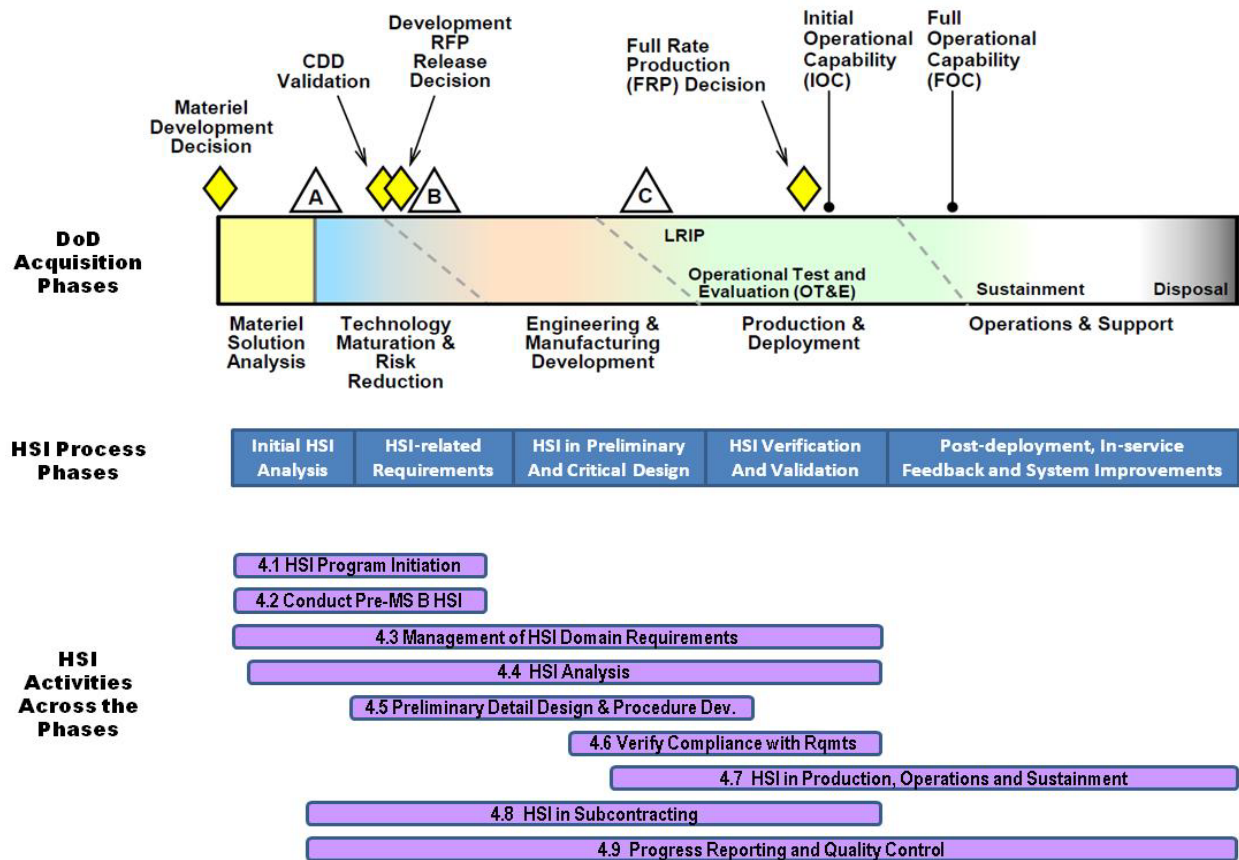


Figure 1 - HSI process

To optimize total system performance, users (defined as human operators, maintainers, trainers/trainees, IT, and support personnel) **should** be considered as an integral part of the system during design. To achieve this goal, HSI **should** be applied during development and acquisition of military systems, equipment, and facilities, including modifications and major system revisions.

An HSI effort **should** be provided to accomplish the following objectives: (a) specify human-related requirements; (b) identify and manage human-related risks, issues, and opportunities; (c) identify, evaluate, and develop or improve all human interfaces of the system; (d) achieve required effectiveness of human performance during system operation, maintenance, support, control, and transport to meet mission and total system performance requirements; and (e) minimize demands upon Manpower and Personnel resources, skills, training, and costs by analyzing the impact of design decisions on total ownership costs. The HSI effort **should** include active participation in the HSI process including: (1) Initial HSI analysis; (2) HSI domain system requirements; (3) HSI in preliminary and critical design; (4) HSI verification and validation; and (5) post-deployment, in-service feedback, and system improvements.

3.1.2 HSI—Typical Activities

While there is a wide variety of specific domain-related tasks and products, the intent of this standard practice is to establish the required and recommended HSI practices to execute in support of DoD major acquisition programs. [Figure 2](#) illustrates how the various HSI domains may interact, including sample data, products, and focus areas that exchange and feed each domain. In [Figure 2](#), the outputs from each domain (not a complete list) are shown as they are relevant to the other domains. For example, HFE is expected to send task and workload analysis data to the Personnel domain to effectively complete Personnel requirements, products, and analyses. Another example is HFE providing situation awareness (SA) data to the Force Protection and Survivability domain. [Figure 3](#) demonstrates how an HSI program might interact with other functional groups on a typical system acquisition program. Both [Figures 2](#) and [3](#) are included to make the point that HSI internal and external interactions are important and must be considered when establishing an HSI program.

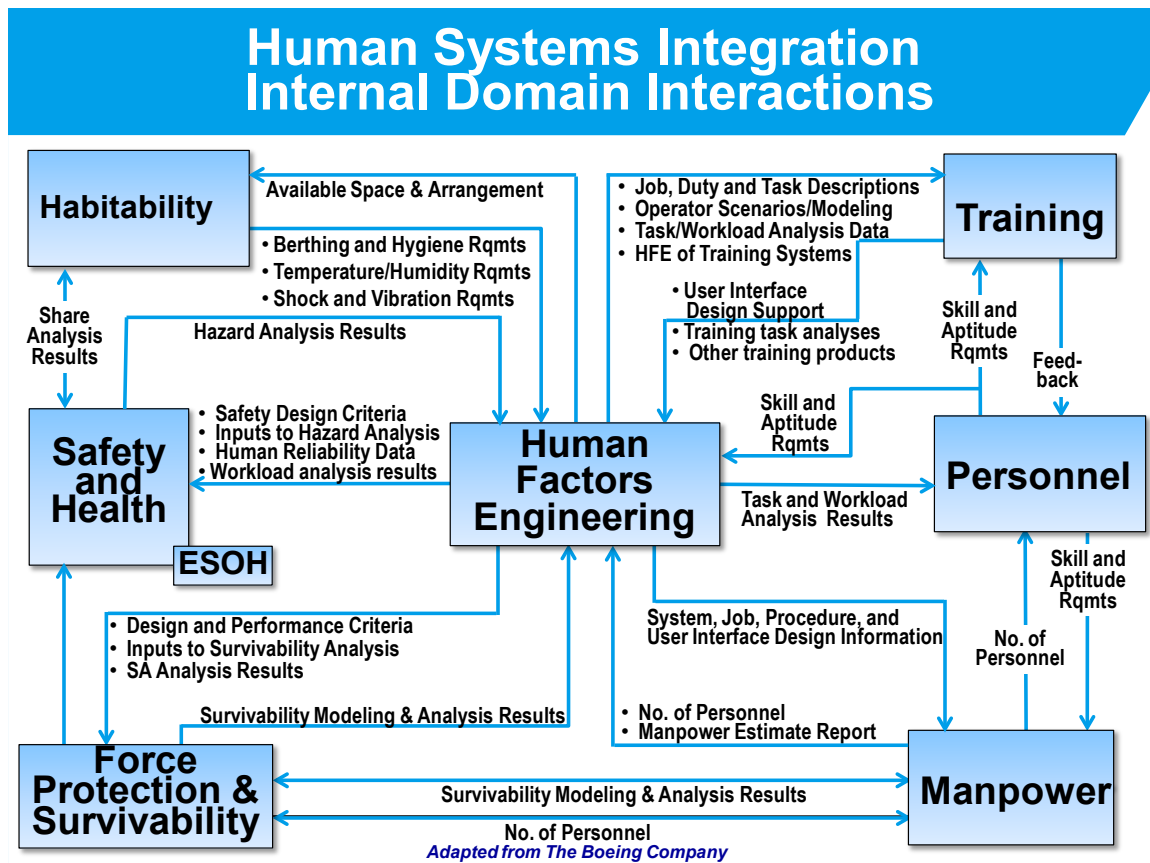


Figure 2 - Notional HSI internal interactions

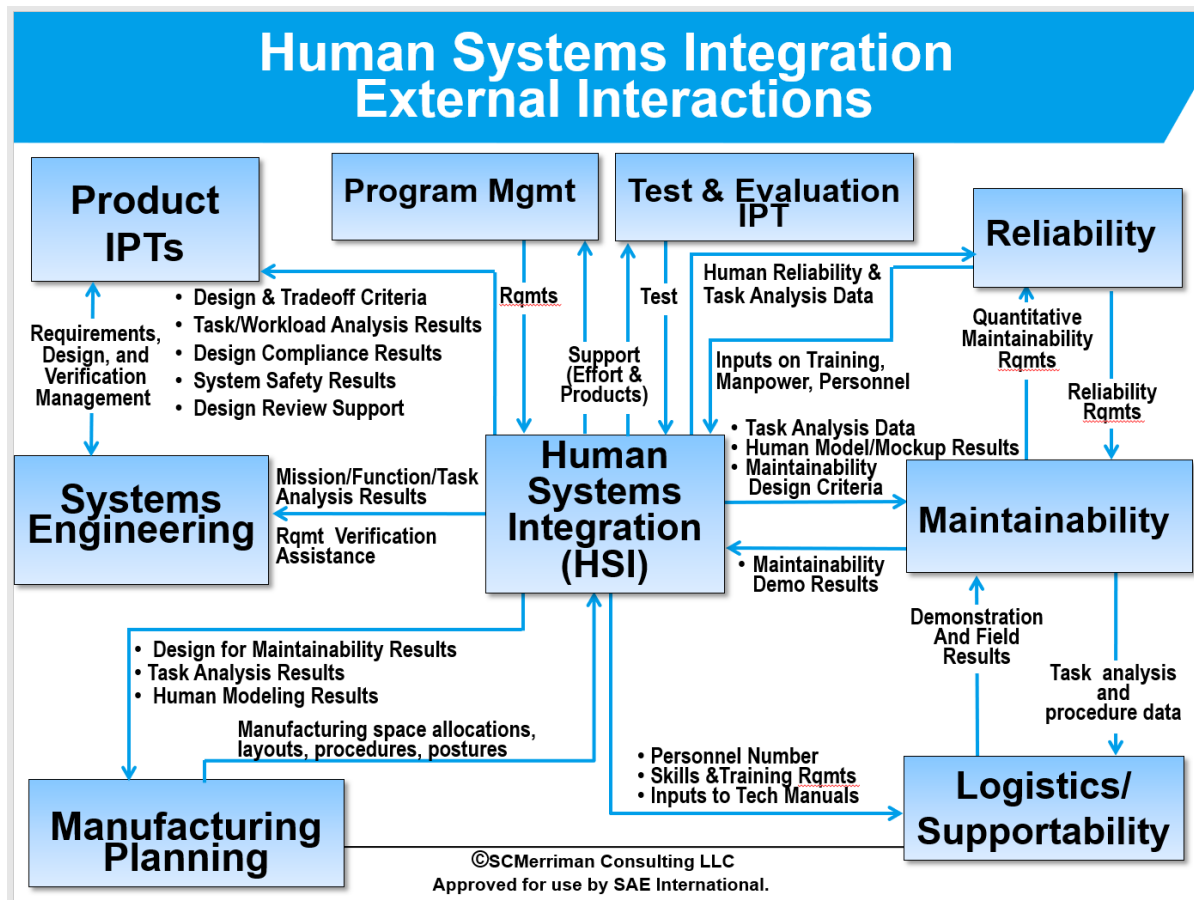


Figure 3 - Notional HSI external interactions

NOTE: For definitions of each of the domains and descriptions of typical domain activities across the course of an acquisition life-cycle, see [Appendix B](#).

3.1.3 References

3.1.3.1 Applicable Documents

There are no applicable documents specified herein.

3.1.3.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

3.1.3.2.1 SAE Publications

ARP4754 Guidelines for Development of Civil Aircraft and Systems

3.1.3.3 Other Publications

ASTM F1337-10 Standard Practice for Human Systems Integration Program Requirements for Ships and Marine Systems, Equipment, and Facilities.

Boehm-Davis, D.A., Durso, F.T., and Lee, J.D. (2015). *Handbook of Human Systems Integration*. APA Handbooks in Psychology.

Booher, H.R. (2003). *Handbook of Human Systems Integration*. John Wiley & Sons, Inc.

DoDI 5000.02 Operation of the Defense Acquisition System, Enclosure 7

DoDI 5000.95 Human Systems Integration in Defense Acquisition

INCOSE. (2015). *INCOSE systems engineering handbook: A guide for system life cycle processes and activities* (Fourth edition). John Wiley & Sons, Inc.

ISO 13407 Human-Centered Design Processes for Interactive Systems.

ISO/IEC/IEEE 15288 Systems and Software Engineering - System Lifecycle Processes.

MoD Std 23-10 Design Guidelines for Ministry of Defence Specialist Vehicles and Plant Equipment.

NASA/SP-2010-3407 Human Integration Design Handbook

OSD HSI Guidebook Office of the Deputy Director for Engineering Office of the Under Secretary of Defense for Research and Engineering, Human Systems Integration Guidebook, May, 2022

Pew, R.W. and Mavor, A.S. (2007). *Human-System Integration in the system development process: A new look*. The National Academies Press.

SMC-T-006 Air Force Space Command - Space and Missile Systems Center Tailoring - Speciality and Systems Engineering Supplement to IEEE 15288.1

3.2 HSI Relationship with Systems Engineering

The HSI program and its process is the systems-level discipline responsible for management, planning, and implementation of human-related considerations into system design to ensure achievement of mission objectives and programmatic success, as well as effective and affordable performance throughout the system lifecycle. The HSI program **should** be fully integrated into the overall systems engineering approach that is applied throughout the full product lifecycle and reflected in the HSI Program Plan (HSIPP). Humans perform functions essential to mission performance during system operation, maintenance, and sustainment.

3.2.1 Integration with Systems Engineering

HSI program activities, to be effective, **should** be an integral part of the project and interface with Systems Engineering throughout the system life cycle, as reflected in SAE1001. During the pre-acquisition Materiel Solution Analysis and Technology Maturation and Risk Reduction activities, the role of HSI is to inform system concept/implementation trade analyses and develop/refine human-in-the-system mission requirements. These are often government activities, but may involve contractor support or execution as study tasks. During the contractor-performed system acquisition activities comprising Phase B (Engineering and Manufacturing Development) and Phase C (Production and Deployment), the emphasis becomes planning and executing HSI and domain activities necessary to design, integrate, test and support systems that achieve the mission needs and objectives. In the sustainment activities of Operations and Support, the role of HSI and the domains, which may involve contractor performance, is to assess the human-in-the-system performance and support the required system operations and evolution.

HSI and HSI domain process integration **should** include integration with both the project's SE technical management processes and the technical processes. The HSI planning and analysis activities **should** coordinate with the SE technical processes, including: stakeholder requirements definition, requirements analysis, architecture, transition, validation, verification, integration, and implementation, as well as technical management processes, including: decision analysis, technical planning, technical assessment, requirements management, risk management, configuration management, technical data management, and interface management. The HSI domain technical activities **should** be coordinated with the SE technical processes including: business/mission analysis, stakeholder needs and requirements definition, architecture definition, design definition, system analysis, implementation, integration, verification, transition, validation, operations, maintenance, and disposal.

3.2.2 Facilitation of Interfaces Between Disciplines

During HSI project initiation (see [4.1](#)), the contractor **should** ensure that HSI planning is comprehensive and tailored to reflect the needs of the system being developed and coordinate the activities of the domains for an effective project execution. In addition, coordination with other domain areas that impact, or are impacted by, human requirements, such as reliability, sustainment/logistics, and testing, **should** be conducted. During this planning, it is also important to identify the responsible entities, such as working groups or integrated product teams, and coordinate their activities both within and between the HSI domains, and with the greater project effort, including subcontractors and suppliers. The HSI and domain plans **should** be coordinated with the program's Systems Engineering Management Plan (SEMP), subcontractor management plan, and the integrated master plan/schedule. Individual domain plans **should** be clearly documented, configuration managed, and updated as required to provide the basis for an effective execution throughout the project's lifecycle.

3.2.3 Program Execution

During programmatic and technical reviews, the interaction between HSI and the HSI domains with SE processes **should** ensure that HSI and domain-specific activities/considerations are addressed within the context of the program's execution. This **should** include HSI program status reporting at programmatic reviews such as program management review, integrated baseline reviews, integrated system reviews and engineering change proposal reviews. Technical activities and accomplishments of the HSI domains **should** be addressed in planning, entry/exit criteria development, and conduct of the technical reviews. Likewise, verification of HSI-domain and HSI domain requirements **should** be coordinated with the overall test program, especially where there are touch points with other engineering specialties or system-level requirements, to ensure comprehensive and effective verification/validation of requirements and mission capabilities.

The integration of HSI and the domains with systems engineering helps ensure that the project is executed in a holistic and coordinated manner to achieve both programmatic and mission success.

3.2.4 References

3.2.4.1 Applicable Documents

There are no applicable documents specified herein.

3.2.4.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

3.2.4.2.1 SAE Publications

SAE1001 Integrated Project Processes for Engineering a System

3.2.4.2.2 Other Publications

ADA519018 Human Systems Integration in Acquisition (Management Guide)

Department of Homeland Security (DHS) HSI Practitioner's Guide, 2012.

DoD. (2013). *Defense acquisition guidebook*. U.S. Department of Defense.

DoD. (2017a). *Best practices for using systems engineering standards (ISO/IEC/IEEE 15288, IEEE 15288.1, and IEEE 15288.2) on contracts for Department of Defense acquisition programs*. U.S. Department of Defense.

DoDI 5000.02 Operation of the Defense Acquisition System, Enclosure 7

DoDI 5000.88 Engineering of Defense Systems

IEEE 15288.1 IEEE Standard for Application of Systems Engineering on Defense Programs

IEEE 15288.2 IEEE Standard for Technical Reviews and Audits on Defense Programs

INCOSE. (2015). *INCOSE systems engineering handbook: A guide for system life cycle processes and activities* (Fourth edition). John Wiley & Sons, Inc.

ISO/IEC/IEEE 15288 Systems and Software Engineering - System Life Cycle Processes

NASA/SP-2015-3709 Human Systems Integration (HSI) Practitioner's Guide

Office of the Deputy Assistant Secretary of Defense (ODASD) - *Systems Engineering Guidebook, December 2021*.

3.3 HSI Roles in Supporting Logistics

HSI and its domains can contribute significantly to the ability to provide required logistics support and data at the minimum cost. "Logistics," "logistic support," "supportability," "sustainment engineering," and "life-cycle logistics" are all terms that apply to being able to adequately maintain and support the acquired system throughout its operational life at the lowest life-cycle cost. Logistics includes a variety of product support elements and requires the accomplishment of a variety of analyses over the life-cycle of the system. Manpower, Personnel, and Training costs over the operational life of the system may exceed all other costs combined (including development and production), so they **should** be considered in the development of the system, the support concept, support equipment, facilities (e.g., training, warehouses, etc.), processes, and other support materials. The HSI team **should** be an advocate for logistics support and associated life-cycle costs and concerns to Systems Engineering and Program Management leaders during system development. HSI is in a unique position of including both engineering and logistics elements within its scope. In summary, the HSI team **should** contribute to all aspects of logistics planning, analysis, and execution, due to its significant impact on life-cycle ownership costs.

3.3.1 HSI Relationship with Logistics

The HSI team **should** assist in analyzing acquisition products, operator and maintainer tasks and processes for their impacts on life-cycle supportability and life-cycle cost, and assisting in their development of logistics products.

3.3.1.1 Product Support Analysis (PSA)

SAE TA-STD-0017 describes the analyses required to create the package of support functions required to field and maintain the readiness and operational capability of weapon systems, subsystems, and components, including all functions related to weapon system readiness. SAE TA-STD-0017 is used to define the PSA framework and activities as an integral part of the Systems Engineering process, and includes the selection and tailoring of those activities to meet DoD program supportability objectives. SAE TA-STD-0017 offers guidance on DoD's implementation of SAE Standard TA-STD-0017, which establishes general principles and descriptions of activities that, when performed in a logical and iterative nature, comprise the Product Support Analysis (PSA) process.

The goals of PSA are to ensure that supportability is included as a system performance requirement and to ensure that the system is concurrently developed or acquired with the optimal support system and infrastructure. PSA includes the integration of various analytical techniques with the objective of designing and developing an effective and efficient Product Support Package. The primary techniques used in PSA are: Failure Mode, Effects, and Criticality Analysis (FMECA), Fault Tree Analysis (FTA), Reliability Centered Maintenance (RCM) Analysis, Level of Repair Analysis (LORA), Maintenance Task Analysis (MTA), and core logistics analysis, source of repair analysis, and depot source of repair analysis.

The PSA process begins at the system-level to affect design and operational concepts; identify gross product support resource requirements of alternative concepts; and relate design, operational, and supportability characteristics to system readiness objectives and goals. Once system-level tradeoffs are made, the analysis shifts to lower system indenture levels and toward support system optimization within the framework established by the system-level analysis. This analysis defines the product support resource requirements of the system through an integrated analysis of all operator and maintenance functions and tasks to determine task frequencies, task times, personnel and skill requirements, supply support requirements, etc., and **should** include all elements of HSI. Optimization is achieved at lower indenture levels through allocation of functions and tasks to specific maintenance levels, repair versus discard analyses, reliability analyses, and formulating design recommendations to optimize maintenance times and product support resource requirements.

HSI efforts **should** play a major role in the planning and conduct of the various analyses and products in PSA, as well as provide HSI data to inform the various analyses. The HSI team **should** play a key role in the following major PSA activities (from SAE TA-STD-0017).

- a. **Comparative Analysis (Activity 8).** Interfacing activities include HFE, reliability, maintainability, environment, safety, occupational health, design engineers, and integrated product support (IPS) element managers.
- b. **Functional Requirements (Activity 9).** Interfacing activities include design engineering, reliability, maintainability, HFE, safety, and IPS element managers. For example, human factors engineering specialists may be best qualified to identify and analyze operations functions.
- c. **Evaluation of Alternatives and Tradeoff Analysis (Activity 11).** Interfacing activities include design engineering, reliability, maintainability, affordability, safety, HFE, cost estimating, and IPS element managers.
- d. **Task Analysis (Activity 12).** Interfacing activities include reliability, maintainability, HFE, and safety.
- e. **Determination of Product Support Resource Requirements (Activity 12 and 13).** Interfacing activities include design engineering, human engineering, and IPS element managers. Design, reliability, maintainability, HFE, environment, safety, PHS&T (Packaging, Handling, Storage, and Transportation), and occupational health **should** be involved in satisfying the activity analysis requirements of Activity 12. The PSA program integrates and translates these inputs into output products required for preparation of IPS documents.

Contractor PSA **should** draw on HFE, system safety, and other aspects of the HSI Program to determine impacts on design goals. Qualitative maintainability design and task requirements **should** also be analyzed by the HSI engineering team to ensure consistency with overall supportability goals. The HSI team **should** coordinate with PSA personnel to identify and coordinate HSI support needs and resources.

3.3.1.2 Product Support Elements

Product support is the application of integrated Product Support Elements (PSE) and support functions necessary to sustain the readiness and operational capability of the system. The HSI team **should** contribute to Product Support Element planning and execution. Technical data **should** be provided by at least HSI, HFE, and safety domains. Manpower, Personnel, and Training domain efforts **should** be major contributors to the analysis and determination of baseline product support strategies. The HSI team **should** assure that representative personnel are used during Logistics demonstrations and, through observation, assess user job performance, safety, and training effectiveness. HSI **should** contribute to the definition of design interfaces, provision of technical data, review of training and training support, manpower, and personnel. The HSI team also **should** provide support to the procuring agency in preparing for pre-acquisition milestone HSI assessments.

3.3.1.3 Logistics Product Data (GEIA-STD-0007)

Logistics product data are required for all operational and maintenance tasks associated with a system. The HSI team **should** provide support, as appropriate, to assist logistics personnel in analyzing and gathering the following types of data: task inventory and task analysis data, task times and frequencies, tool and support equipment needs, task criticality, personnel skill and aptitude requirements, including physical and mental (including ASVAB range for each specialty), educational requirements, task training, and support requirements. The HSI team **should** place emphasis on supporting the development of "C" entries in the logistics data model.

3.3.1.4 Manpower Estimate in the Cost Analysis Requirements Description (CARD)

The customer manpower assessment document (developed by the Government) provides a complete, detailed description of a DoD program for use in preparing an Independent Cost Estimate (ICE), Program Office Estimate (POE), DoD Component Cost Estimate (CCE), DoD Component Cost Position (CCP), or other cost estimate, as required. The foundation of a sound cost estimate is a well-defined program, and the customer manpower assessment is used to provide that foundation. The customer manpower assessment describes the key technical, programmatic, operational, and sustainment characteristics of a program, along with supporting data sources, and provides all the program information necessary to develop a cost estimate. By using the customer manpower assessment, different organizations preparing cost estimates can develop their estimates based on the same understanding of program requirements. As a program evolves and its costs and funding needs change, the customer manpower assessment, as a living document, evolves with it. The contractor HSI team **should** support the government in revising system-related manpower estimates reflected in the customer manpower assessment as the system design, operational concepts and support concepts evolve.

One of the tables in the customer manpower assessment is entitled “Manpower Time Phased.” This table provides annual headcounts (by phase and major function) necessary to support staff-loading cost estimating. In addition to the direct O&S categories of operate, maintain, support, and train, personnel requirements for Systems Engineering, Program Management, and continuing software efforts throughout the remainder of the life-cycle are also included. This table replaces the Manpower Estimate Report (MER) which was used previously to communicate manpower and personnel needs of the system being acquired (refer to DoDI 5000.02). Customer HSI personnel **should** support development and periodic update of the Manpower Time Phased table of the customer manpower assessment. Contractor HSI personnel **should** periodically compare these manpower estimates published in the customer manpower assessment against manpower needs of the specific material solution being designed and developed.

3.3.1.5 System Training Plan

The HSI team **should** review the System Training Plan, which is required in support of Milestone B. The System Training Plan is the customer’s master training plan and training tool for a new or modified system. Each service has such a plan, although each service calls it by a different name. It outlines the development of the total training concept, strategy, and training support system resourcing estimates for integrating the system or family of systems into the operational, institutional, and self-development domains. The HSI team **should** periodically assess the assumptions in the System Training Plan pertaining to the kinds, duration, timing, and costs of training for both operators and maintainers against the system design.

3.3.2 HSI Documentation as Source Data for Technical Manuals and Training

During system development, the HSI team conducts a variety of analyses that contribute to development of the system baseline design. Many of these analyses contribute to the definition of personnel roles, jobs, functions, and tasks, and they end up defining personnel numbers, types, skills, and experience required to conduct operational, maintenance, and support tasks. Often, HFE specialists conduct task analyses to evaluate the ability of designated personnel to accomplish their jobs within time constraints to the required level of performance. Personnel job, function, task, and other HSI-related analysis results **should** be documented and made available as draft documents, analysis results or source data for technical manuals and training. For example, the Human Engineering Design Approach Document-Operator (DI-HFAC-80746) and the Human Engineering Design Approach Document-Maintainer (DI-HFAC-80747) could provide excellent source data for operator manuals, maintenance manuals, and training materials. HSI personnel **should** act as subject matter experts in the development and review of technical manuals and training materials since these personnel are usually familiar with the mission, environment tasks, and time-pressure demands.

During the development of technical manuals and training systems, HSI personnel **should** coordinate with these other disciplines and ensure that they include available HSI documentation and expertise in their plans. All HSI product handoffs **should** be captured in the contract IMP and IMS.

3.3.3 Independent Logistics Assessments (ILAs)

Independent Logistics Assessments (ILA) are periodically conducted to validate a program's planning and implementation of Integrated Product Support (IPS), and the ability of the logistics program to meet established performance requirements. Preferably, ILAs are conducted by an independent and impartial team of Subject Matter Experts (SMEs) not directly associated with the program being assessed. Results of these assessments provide a primary input to acquisition milestone and other decision reviews, including the corresponding gate reviews.

The HSI portion of an ILA is directed toward the planning and execution of a successful supportability program. The HSI portion of the ILA helps determine if there is a plan in place to sustain the system from a logistical perspective, such that the design of the system does not pose an undue burden on the manpower, training, or support of the overall system. The HSI portion of the ILA is primarily concentrated in the "Design Interface" category, which is focused on influencing supportability and maintainability. The government and contractor HSI teams **should** collaborate, coordinate, and contribute HSI data and documentation at all program ILAs. The products and data **should** include government and contractor HSI plans (HSIP and HSIPP, respectively), status of HSI risks and issues, any HSI domain system requirements being tracked or evaluated, and data impacting logistics plans and efforts. Several of the HSI domains **should** provide information in support of ILAs; particularly Safety, Occupational Health, Manpower, Personnel, Training, and HFE.

3.3.4 References

3.3.4.1 Applicable Documents

There are no applicable documents specified herein.

3.3.4.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

3.3.4.2.1 SAE Publications

GEIA-STD-0007 Logistics Product Data

TA-STD-0017 Product Support Analysis

3.3.4.2.1.1 Other Publications

AR 700-127 Logistics Integrated Product Support

4. HUMAN SYSTEMS INTEGRATION (HSI) PROCESS REQUIREMENTS

The purpose of this section is to provide programmatic requirements to contractors for activities and products during the initiation of an HSI program in support of a system acquisition contract.

Consistent with the acquisition policies and philosophy of the U.S. Department of Defense and other procuring agencies, the contractor requirements in this section **should** NOT duplicate technical activities of the domains that comprise HSI.

For the purposes of this standard, domain activities are viewed as separate technical inputs that contribute to an HSI program. HSI is viewed as a technical and management function that coordinates, trades off, and optimizes domain contributions collectively to maximize human performance, safety, effectiveness, and cost.

This standard covers HSI processes throughout design, development, test, production, use, and disposal. Depending on contract phase and/or complexity of the program, tailoring **should** be applied.

4.1 HSI Program Initiation

During program initiation, the contractor **shall** establish an HSI program.

4.1.1 HSI Program Planning

The contractor **shall** plan the HSI program, including a clear definition of the technical objectives, the scope, the processes, and the end product(s), consistent with the terms of the contract, the system requirements, and the phase of acquisition. Developing and updating planning documentation is an iterative process which is refined as acquisition activities progress. Human performance capabilities and limitations **shall** be factored into analytical assumptions and constraints as early as possible to ensure the human is included as a critical component of the system as the technology evolves. All aspects of human interaction with the system **should** be understood to optimize the system and human capabilities. The contractor **shall** coordinate the HSI plan with the procuring agency and place the plan under configuration management for contractual execution (reference SAE EIA649 as applicable). Tailoring of the HSI program activities **should** be consistent with the RFP/contract. Data Item Description DI-HFAC-81743 describes HSIPP content elements necessary for sound HSI program planning.

4.1.1.1 Documentation, Assessment, and HSI Program Planning Associated with HSI Requirements

HSI programmatic requirements and technical requirements are defined by the customer and provided in contractual documentation. One of the first steps in scoping and planning the contractor's HSI program is to document customer-provided requirements with HSI-related context. Next, evaluate the requirements to determine adequacy, completeness and HSI-related issues/risks. The HSIPP **should** document the contractor's process for HSI efforts in requirements analysis, flow-down, alignment, and derivation.

4.1.1.1.1 HSI-Related Key Performance Parameters (KPP)

For every customer-provided KPP, the contractor **shall** identify and document anticipated HSI/domain impacts and the HSI/domain activities that **should** be accomplished to address and mitigate those impacts. Key Performance Parameters are "performance attributes of a system considered critical or essential to the development of an effective military capability," as defined in the U.S. Chairman of the Joint Chiefs of Staff Manual for the Operation of the Joint Capabilities Integration and Development System (JCIDS Manual).

4.1.1.1.2 HSI-Related Key System Attributes (KSA)

For every customer-provided KSA, the contractor **shall** identify and document anticipated HSI/domain impacts and the HSI/domain activities that **should** be accomplished to address and mitigate those impacts. Key System Attributes are "performance attributes of a system considered important to achieving a balanced solution/approach to a system, but not critical enough to be designated a KPP," as defined in the JCIDS Manual.

4.1.1.1.3 Other Customer-Provided Requirements

For every customer-provided requirement (e.g., Additional Performance Attributes [APA] and Other System Attributes [OSA]), the contractor **shall** identify and document anticipated HSI/domain impacts and the HSI/domain activities that **should** be accomplished to address and mitigate those impacts, if known. During the early capabilities analyses, development and design activities, HSI domain-specific and other HSI-related requirements at all levels (i.e., capability, system, specification, logistical, and human performance) may not yet be entirely understood or explicitly defined.

Additional Performance Attributes are "Performance attributes of a system not important enough to be considered a KPP or KSA, but still appropriate to include in the Capability Development Document (CDD)," according to the JCIDS Manual. Other System Attributes include "HSI considerations that have a major impact on system effectiveness and suitability," according to the JCIDS Manual.

4.1.1.1.4 Assessment of HSI Domain-Specific and HSI-Related Requirements to Identify Risks and Issues

The contractor **shall** review HSI domain-specific and other HSI-related requirements at all levels (i.e., capability, system, specification, logistical, and human performance) and identify those with the potential to create risks, issues, and opportunities. The contractor **should** assess legacy system (or like system) HSI lessons learned to ensure that known HSI issues are not repeated in the new system or increment. If it is determined that gaps in requirements, risks, or issues exist, the contractor **should** document gaps and provide recommendations for mitigation as applicable.

4.1.1.1.5 Proposed Contract Document Review

The contractor **shall** review proposed contract documents for adequacy and completeness of HSI, HSI domain-specific, and other HSI-related programmatic requirements and inform the procuring agency of any HSI risks, issues, or opportunities.

4.1.1.1.6 Requirements and Verification Process

The contractor **shall** identify and document the HSI activities within the requirements analysis, flow-down, translation, alignment, and derivation process, as well as in the determination of requirement verification plans and methods.

4.1.1.2 Assessment of Draft Contractual Documents

4.1.1.2.1 Customer-provided Plans

The contractor **shall** establish the contractor's HSIPP, consistent with contractual requirements and the customer's HSI plan or planning within the SEP and the LCSP (if available). The contractor's HSI activities **should** also align with the SEP and the LCSP. When available the contractor may review other acquisition documents such as the Systems Training Plan, the PESHE, and the manpower estimate to formulate the contractor HSI approach.

4.1.1.2.2 Assessment of Data Sources

The contractor **should** assess existing HSI and HSI-related standards, guidelines, and handbooks for citation in the HSIPP and for use during the HSI program effort.

4.1.1.3 HSI Objectives, Strategy, Major Activities, and Products Consistent with Requirements

The contractor **shall** develop HSI program objectives and strategy based on review of contractual documents and requirements, SEP, and customer logistics plans and estimates. The contractor **shall** integrate HSI objectives, strategy, and activities with the Systems Engineering Management Plan (SEMP), Integrated Master Plan (IMP), and Integrated Master Schedule (IMS). The contractor **shall** document the HSI program objectives and strategy in the HSIPP, or the SEM if an HSIPP is not required.

4.1.1.4 Communication with Customers

Communication with customer HSI counterparts can help ensure HSI planning and requirements are aligned with customer expectations. The contractor **should** develop and maintain clear communication with customer HSI counterparts. The contractor **should** understand how input from customer user groups will be gathered and communicated.

Beginning with initial program planning and continuing through the contract period of performance, contractor personnel responsible for HSI **should** coordinate with customer HSI managers and technical personnel to maintain compatibility with customer HSIPs and schedules throughout the contract period of performance. Program compatibility is especially important regarding program goals, the division of activities and labor between government and contractor HSI organizations, schedules, information and product exchanges, contractor use of Government-furnished property/information, and progress reporting.

Contractor HSI personnel **should** inform customer HSI personnel of any HSI issues potentially affecting total ownership costs.

4.1.1.5 HSI Support to Affordability and Performance Requirements

The contractor **shall** document how system affordability and performance requirements are addressed within the HSI Program per DI-HFAC-81743.

4.1.1.6 HSI Organization, Organizational Relationships, Working Groups, and Customer Interactions

4.1.1.6.1 HSI Leadership

The contractor **shall** identify an HSI lead to direct and oversee the planning and execution of the HSI program. The contractor **shall** define how HSI leadership is related to contractor program team structure. The HSI lead **shall** be responsible for planning the HSI program and preparing required documentation of that plan. The HSI lead **shall** direct and oversee the execution of the HSI program, and modify the plan as needed. The HSI lead **shall** coordinate activities across the HSI domains, seeking to maximize resource sharing, program impact, and use of common data as appropriate. The HSI lead **shall** represent the interests and concerns of all the HSI domains to systems engineers and program managers.

4.1.1.6.2 HSI Working Group (WG)

The contractor **shall** establish an HSI working group, in conjunction with the customer, as applicable per the contract. The contractor **shall** document the WG charter, to include working group composition, responsibility, authority, accountability, duration, and activities.

4.1.1.6.3 HSI Organizational Relationships

The contractor **should** consider defining relationships between the contractor HSI team and other disciplines such as systems engineering, reliability, maintainability, information assurance, risk and issue management, user interface design, software and hardware engineering, product/process IPTs, supportability/logistics, manufacturing planning, test and evaluation, program management, finance, and other relevant organizations, and the customer's HSI team. The contractor **shall** document organizational relationships among HSI, the HSI domains, and other program disciplines and groups. Contractor personnel responsible for HSI **shall** document activities, schedules, and significant interactions with Procuring Agency personnel in the HSIPP, or the SEMP if an HSIPP is not required. HSI personnel **should** ensure that individual domain plans include provision of adequate support to HSI in planning, analysis, modeling and simulation, design/procedure development and assessment support, risk/issue management, requirement verification, activity coordination, product and deliverable data development and distribution.

4.1.1.6.4 HSI Products and Handoffs

The contractor **shall** identify and document HSI and HSI domain products and handoffs in the HSIPP, or the SEMP if an HSIPP is not required. The contractor **should** understand who the stakeholders are and how stakeholder input on products will be gathered and communicated; stakeholders are both on the contractor side and the customer side. The contractor **should** understand the appropriate channels for gathering information from the user community: the operators, maintainers, and support team of similar or predecessor/legacy systems. Customer interactions may involve scheduling of design assessments, tests and evaluations with end-users as subjects.

4.1.1.7 Level of HSI Effort to be Conducted by Subcontractors

If subcontractors are involved, the [prime] contractor **shall** document HSI processes, tasks, and relationships with subcontractors, associate contractors, and suppliers in the HSIPP or the SEMP if an HSIPP is not required. See [4.8](#).

4.1.1.8 HSI Activities, Processes, Procedures, Metrics, and Domain Interactions

The contractor **shall** document HSI participation in system analysis, system design, procedure development, verification and support. The contractor **shall** document activities regarding HSI-related Technical Performance Measures (TPM) as called out in the contract in the HSIPP, or the SEMP if an HSIPP is not required. The contractor **should** plan contracted HSI program activities so that they can be executed on or ahead of schedule and on or under budget with high quality.

NOTE: TPMs are measures based on select requirements that are listed in the SEP and SEMP; TPMs are technical assessments that are tracked throughout the systems engineering process. Some TPMs may be HSI-related.

4.1.1.9 HSI Practitioner Inputs to the SEMP and Other Technical Plans

The contractor **shall** ensure that HSI planning, activities, and products are summarized in the SEMP and other applicable technical plans and schedules. If the contractor develops an HSIPP, the contractor **shall** reference the HSIPP in the SEMP. Consideration also **should** be given to including HSI information in logistics/product support, maintainability, modeling and simulation, affordability, cyber security, risk/issue/opportunity management, verification, and other plans, as appropriate.

4.1.1.10 Plan Utilization of Government Resources

As a part of HSI planning, the contractor **shall** document HSI needs for government personnel, Government-Furnished Property (GFP), Equipment (GFE), Information (GFI), services, or facilities. For example, GFP might include customer-developed tools such as workload models (e.g., Improved Performance Research Integration Tool [IMPRINT]), or operator/maintainer anthropometry models.

4.1.2 HSI and HSI Domain Resources

The contractor **shall** document resource requirements (e.g., staffing, subcontracts, facilities, budgets) for the entire contractual HSI effort required by the contract SOW. The contractor **shall** document a time-phased schedule and level of effort, spanning the contract period of performance.

The contractor **shall** coordinate HSI activities, product handoffs, and budget through appropriate program management activities to ensure program manager support and to resolve any issues over product developments, product handoffs, task interdependencies, and schedules. The contractor **should** periodically review HSI domain budgets to ensure sufficient resources will be available to support HSI program needs.

4.1.3 HSI Program Schedule

4.1.3.1 HSI Program Schedule Development

The contractor **shall** document HSI activities (including subcontractor activities), purchases, need dates for Government resources, deliverable data submissions, product handoffs (to and from HSI), major events (e.g., HSI working group meetings, major design reviews) consistent with contract requirements in schedule form, indicating interdependencies as appropriate. The contractor **shall** include HSI activities in the IMS.

4.1.3.2 Schedule Alignment with Other Disciplines

The contractor **shall** align HSI activities, handoffs and schedules with SEMP, logistics/product support plans, IMP/IMS, and other planning documents as appropriate.

4.1.4 References

4.1.4.1 Applicable Documents

EIA-649 Configuration Management Requirements for Defense Contracts

4.1.4.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

4.1.4.2.1 SAE Publications

There are no related SAE publications specified herein.

4.1.4.2.2 Other Publications

JCIDS Manual Manual for the Operation of the Joint Capabilities Integration and Development System

DI-HFAC-81743 Human Systems Integration Program Plan (HSIPP)

4.2 Define and Conduct Pre-Milestone B HSI Activities

The procuring agency may contract with one or more contractors prior to Milestone B to advance system development planning, reduce risks, draft procurement documents, and/or assist with conducting analyses and tradeoffs. The purpose of this section of the standard is to specify HSI activities and products of Pre-Milestone B contracts, if the activity is specified by contract.

4.2.1 Identify HSI and HSI-Related Risks and Issues

4.2.1.1 Identify HSI and HSI-Related Risks and Issues

Prior to Milestone B, the contractor **shall** document HSI and HSI-related risks, issues, and opportunities. The contractor **should** consider including the following types: human operational, maintenance, training, and support roles; functions and performance; manpower, personnel, training; safety, occupational health, habitability, force protection, and survivability.

4.2.1.2 Propose an HSI Strategy and Level of HSI Activity

The contractor **shall** document an HSI strategy by developing a plan to address identified HSI risks, issues, and opportunities. The strategy and level of activity **should** be consistent with the DoD acquisition pathway, approach, maintenance and support concepts, program schedule, and funding profile. The contractor **should** coordinate concepts and plans with the customer HSI organization and adjust based on obtained feedback. Typically, the government provides assistance to the contractor to conduct this activity.

4.2.2 Identify and Conduct Activities Required by the Pre-Milestone B Contract

The contractor **shall** propose and conduct in coordination with systems engineering and logistics organizations any analyses, modeling and simulation activities, concept studies, tradeoffs, analyses, and experiments in support of concept development and risk reduction activities that are specified by the Pre-Milestone B contract.

4.2.3 Provide HSI Support to Development of the System Concept and Preliminary Design

The contractor **should** support systems engineering and logistics/product support organizations by proposing and conducting analyses, tradeoff evaluations, and other studies to help advance, analyze, and refine the contractor's system concept and preliminary design, including HSI risk/issue identification and analysis, risk reduction, design refinement, HSI analysis, modeling and simulation, mockup and prototype evaluation, etc.

4.2.4 Support the Analysis of Alternatives (AOA)

The contractor **shall** conduct HSI analyses and provide input to the AOA. HSI inputs could include:

- a. Operational concept, including concept of employment (CONEMP) and concept of operations (CONOPS).
- b. Material solution (inputs on system design).
- c. Manpower and personnel support concept (personnel number, types, skills, aptitudes, experience, training, etc.).
- d. Logistics/Product Support concept.
- e. Acquisition strategy/draft contract documents.
- f. HSI technologies and alternatives.
- g. Cost/affordability/life-cycle cost (LCC).