

Key Human System Integration Plan Elements for Command & Control Acquisition

Michael B. Cowen, Ph.D.
SPAWAR Systems Center Pacific
Code 53621
53560 Hull Street
San Diego, CA 92152
619.553.8004
mike.cowen@navy.mil

Jerry L. Kaiwi, Ph.D.
SPAWAR Systems Center Pacific
Code 53621
53560 Hull Street
San Diego, CA 92152
619.553.9220
jerry.kaiwi@navy.mil

Primary POC: Michael Cowen

Topics:

C2 Architectures and Technologies
C2 Assessment Metrics and Tools
Concepts, Theory, and Policy

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE JUN 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE Key Human System Integration Plan Elements for Command & Control Acquisition				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) SPAWAR Systems Center Pacific, Code 53621, 53560 Hull Street, San Diego, CA, 92152				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Proceedings of the 15th International Command and Control Research and Technology Symposium (ICCRTS '10), Santa Monica, CA, June 22-24, 2010					
14. ABSTRACT As the Navy transitions to the guiding principles of Net-Centric Warfare, it is imperative to recognize the importance to access vital, secure and timely tactical information in any given battlespace. The Space and Naval Warfare Systems Command is the acquisition lead for several systems that will create a highly adaptive, networked and distributed defense force with the increased speed, agility and security required to support constantly evolving mission needs. The systems will provide the commander the ability to make more timely and informed decisions based upon the best information and practices. Human System Integration (HSI) is a system engineering process designed to ensure that human performance related issues are identified early in the acquisition process and mitigated during system development and testing using appropriate performance metrics and data collection methods. HSI activities are guided by an acquisition Human System Integration Plan (HSIP) that identifies and integrates design requirements for (a) Human Factors Engineering, (b) Personnel, (c) Habitability, (d) Manpower, (e) Training, (f) Safety & Occupational Health, and (g) Survivability. Key elements of HSI for Command & Control acquisition include: (1) top-down functional analysis/allocation, (2) task-centered design, (3) cognitive engineering, and (4) knowledge mapping.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 45	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Key Human System Integration Plan Elements for Command & Control Acquisition

**Michael B. Cowen
Jerry L. Kaiwi**

Abstract

As the Navy transitions to the guiding principles of Net-Centric Warfare, it is imperative to recognize the importance to access vital, secure and timely tactical information in any given battlespace. The Space and Naval Warfare Systems Command is the acquisition lead for several systems that will create a highly adaptive, networked and distributed defense force with the increased speed, agility and security required to support constantly evolving mission needs. The systems will provide the commander the ability to make more timely and informed decisions based upon the best information and practices. Human System Integration (HSI) is a system engineering process designed to ensure that human performance related issues are identified early in the acquisition process and mitigated during system development and testing using appropriate performance metrics and data collection methods. HSI activities are guided by an acquisition Human System Integration Plan (HSIP) that identifies and integrates design requirements for (a) Human Factors Engineering, (b) Personnel, (c) Habitability, (d) Manpower, (e) Training, (f) Safety & Occupational Health, and (g) Survivability. Key elements of HSI for Command & Control acquisition include: (1) top-down functional analysis/allocation, (2) task-centered design, (3) cognitive engineering, and (4) knowledge mapping.

Introduction

As the Navy transitions to the guiding principles of Net-Centric Warfare, it is imperative to recognize the importance to access vital, secure and timely tactical information in any given operational theater. The Navy's Space and Naval Warfare Systems Command (SPAWAR) is the lead organization responsible for transforming information technology in the military maritime domain (Gallagher, 2010). SPAWAR through their research and development centers and support activities is responsible for providing development, testing and acquisition of systems for future Navy command, control, communications, computers, intelligence, surveillance and reconnaissance products. They are the acquisition lead for several systems that will create a highly adaptive, networked and distributed naval force with the increased speed, agility and security required to support constantly evolving mission needs. These systems will provide the operational commanders the ability to make more timely and informed decisions based upon the best information and practices.

Human Systems Integration

Human Systems Integration (HSI) is a formal acquisition process that provides techniques for human performance in mission capability definition and system development. It is a system engineering practice designed to ensure that human performance related issues are identified early in the acquisition lifecycle and mitigated during system development and testing using appropriate performance metrics and data collection methods. HSI integrates human capabilities and limitations into system definition, design, development and evaluation to optimize total system performance in operational environments. DoD Instruction 5000.2 requires a comprehensive plan for HSI to be in place early in the acquisition process that will optimize total system performance, minimize total ownership costs, and ensure that the final product is built to accommodate the user population characteristics for operations, maintenance and logistics.

There are seven HSI areas that must be considered before existing technology is modernized or new technologies are acquired and deployed: Human Factors Engineering, Personnel, Habitability, Manpower, Training, Safety & Occupational Health, and Survivability (see Table 1 for examples). The HSI process incorporates the seven domains into the systems acquisition process. The goal of the development is an effective system requiring minimal training for the user, prioritization of information necessary for the decision making process, and interfaces that effectively manage and simplify operator workload, are intuitive to use, and provide for user customization where feasible. These domains are interdependent and best HSI practices optimize the mix of these elements based on discovered interdependencies and trade-offs that balance performance and cost.

Human Factors Engineering (HFE)

HFE focuses on designing human system interfaces to optimize user performance and reduce the likelihood of user errors. HFE designs should minimize or eliminate system characteristics that require excessive cognitive, physical, and sensory skills; entail extensive training or workload intensive tasks; result in mission-critical errors; or produce safety or health hazards.

Domains						
Human Factors Engineering	Personnel	Habitability	Manpower	Training	Safety & Occupational Health	Survivability
Interface Design	Knowledge, Skills & Abilities	Quality of Work	Officer, Enlisted, Civilian Billets	Initial, Follow-on, & Refresher	Accident Avoidance	Damage Control
Workload	Personnel Classification	Quality of Life	Wartime Requirements	Delivery Systems	Health Hazards	Personnel Protection
Situation Awareness	Selection	Environmental Limits and Controls	Peacetime Requirements	Embedded Training	Risk Mitigation	Fratricide
Decision-Support	Recruiting			Distance Learning	Medical	
	Retention			Individual		
				Team		
Human Systems Integration Design Requirements						

Table 1. Human Systems Integration Design Requirements.

Personnel

Knowledge, skills, and abilities are identified to operate, maintain, and sustain the system. The human performance characteristics of the user population are assessed based on the system description, projected characteristics of target occupational specialties, and recruitment and retention trends. To the extent possible, system functionality shall not require cognitive, physical, or sensory skills beyond that found in the specified user population.

Habitability

Requirements are established for the physical environment that impact system performance related quality of life and morale which may affect personnel recruitment or retention.

Manpower

This domain determines the most efficient and cost-effective mix of personnel required and authorized to operate and support the system.

Training

Based on personnel assessments, instructional support is deployed to develop knowledge, skills, and abilities necessary to operate, maintain, and sustain the system.

Safety & Occupational Health (SOH)

SOH addresses potential for new or modernized systems to fail that can lead to accidents and explores mitigation strategies to reduce potential bodily harm with regular and routine use of the system.

Survivability

This domain addresses the need to protect the user from attacks including enemy detection and fratricide. Included here are the quality of personal gear and clothing, integrity of the crew compartments, and provisions for rapid egress when systems are severely damaged or destroyed.

Human System Integration Plan

As required by DoD Instruction 5000.2, acquisition activities are guided by a plan for HSI. An effective HSI plan is critical to the successful development, testing, and deployment of maritime systems and should be initiated early in the acquisition process to optimize total system functioning. The plan should provide a roadmap to address the extent to which humans will be required to operate, maintain, and support the capability, including analysis to reduce manpower, improve human performance, and minimize personnel risk (SECNAV Instruction 5000.2C).

Best system engineering practices for Command & Control acquisition utilize a Human System Integration Plan (HSIP). An HSIP identifies and integrates design requirements for the seven domains. A detailed requirements description of each of the seven domains to be included in the HSIP is published in **Appendix A**. The HSIP is used as a planning guide and management tool to ensure that HSI issues are appropriately and adequately accommodated during system design, development and deployment. Further, the HSIP provides an HSI audit trail by documenting program guidance, sources of applicable data, and acquisition decisions. The HSIP is generally considered a “living document” and can be expanded and updated, as required. Because of the criticality of HFE, training and personnel factors to the success of command and control systems, the HSIP should be maintained and updated as operational requirements change.

Planning for Human Systems Integration encompasses capabilities assessment, program management, systems engineering, product development, program review, and testing activities by both the formal acquisition community (typically a government entity) and the developer (typically a private contractor). An important component of the planning, development and deployment process are human systems integration working group, integrated logistic support and working-level integrated product team meetings. Here design revisions or alternatives will be considered for human system integration optimization that will improve total system performance.

HSI and Command & Control

The purpose of Command & Control is to enable the effective transfer of information between and among systems and operational users to gain situational awareness, make decisions and execute of appropriate courses of action. A major thrust of HSI is to research concepts and develop tools to facilitate the

effectiveness and ease of knowledge management, information foraging and exchange, collaboration, and decision-making in the networked command environments of this century. It is essential that Command & Control architectures consider how to effectively integrate operational users with information technologies and networks:

The integrated command environment, as it pertains to warfighting, is one of the most complex control environments in existence today. The functions that must be accomplished by the “commanders” of this environment are many, varied, and often time-critical with life-or-death outcomes. Human performance, in this context, must be optimized. We can select what we believe are “optimum” humans to accomplish this functionality, and we can train them, but no amount of selection and training can compensate for poor design (Perry, Crisp, McKneely, & Wallace, 2000).

As shown in Appendix A, effective HSI planning relies heavily on human factors engineering to specify human-system interactions for user interface design, optimizing human awareness, decision-making and actions. This is especially true for Command & Control:

From the perspective of the user of a fielded product, the user interface is the rest of the system. If the user cannot find a particular function or a piece of information, then it may as well never have been developed. The best way to account for users in system design is to determine their needs, design the system to support completion of their tasks, and perform early and iterative evaluation with representative users (Wallace, Winters, Dugger & Lackie, 2001).

The key elements of HSI for Command & Control are from the HFE domain, because advanced mission systems require decision-aiding and an understanding of the human tasks to-be-performed:

Top-down functional analysis and allocation

System functions are identified and then decomposed to tasks. Tasks can be allocated to users or be automated. User roles are defined and skill sets are determined.

Task-centered design (TCD)

TCD is a user-interface design process which systematically identifies and takes into account relevant human performance issues and objectives. Task-centered design attempts to optimize the user interface around the capabilities of the user, rather than forcing the user to accommodate the system or function.

Cognitive engineering

Individual users at various levels need access to critical information related to their assigned jobs, with the ability to access more detail as required. Development of a concept of operations must be focused on the tasks that the operational users have to perform. User testing at all stages during development is needed to assure appropriate functionality.

Knowledge mapping

Developing an adaptive system for the operational user requires a full understanding of what decision-makers need to know to perform their jobs and designing the system to customize information access and representation.

The key HFE elements for acquisition of Command & Control systems and products should be documented in eight reports required by the HSIP. A detailed requirements description of these eight HSIP deliverables is published in **Appendix B**.

Conclusion

HSI is a vital ingredient in the acquisition of Command & Control systems. HSI integrates user capabilities with system definitions, designs, development, and deployment to operational environments and is part of the total systems engineering approach to concept refinement, design, development and testing. Key HSI elements for command & control evolve around situational awareness, distributed decision-making, and action. These elements should be documented, guided by the requirements specified in the HSIP. SPAWAR recognizes the need to optimize human performance to realize a highly adaptive, networked and distributed naval force and has taken the lead in integrating HSI requirements into existing and future Navy Command & Control systems.

References

Gallagher, S. (2010, Jan. 19). Testing the Navy's integrated future. *Defense Systems*. Retrieved from <http://defensesystems.com>.

Perry, A. A., Crisp, H. E., McKneely, J. A., & Wallace, D. F. (2000). The solution for future command and control: Human-centered design. In P. Hamburger (Ed.) *Proceedings of the Society of Photo-Optical Instrumentation Engineers: Vol. 4126. Integrated Command Environments* (pp. 42-53). Bellingham, WA: SPIE.

Wallace, D., Winters, J., Dugger, M., & Lackie, J. (2001). Human-centered systems engineering process guidance. Naval Surface Warfare Center Dahlgren Division (NSWCCD) TR-01/101.

Appendix A: Description HSI Specific Domain Requirements

The system shall meet the requirements of the following HSI domains:

1.0 Human Factors Engineering – The human subsystem shall perform an effective interface leading to satisfactory mission performance in accordance with MIL STD 1472F.

1.1 The system shall conform to the most current military standards for Human Engineering design for marine systems, equipment, and facilities.

1.2 Human performance shall be demonstrated and measured through human-in-the-loop simulation tests using representative operator and maintainer personnel and representative operational scenarios.

1.3 Equipment used in operation, maintenance, setup and support shall be designed in accordance with human factors engineering design standards that minimize human error occurrence and maximize tolerance of errors, human performance capability, and human awareness of the tactical situation.

1.4 Operators shall be capable of performing assigned mission critical tasks within accuracy, time, and energy constraints consistent with overall availability criteria for the system.

1.5 Labeling, including all printed, pictorial, or symbolic information presented visually to personnel for purposes of providing equipment, system or sub-system identification, safety and hazard alerts or procedures, operation and maintenance instructions, general information, pipe content and flow direction, space or compartment identification and informational displays, shall be designed such that the label content, format, location, coding, and structure shall be in compliance with current military standards.

1.6 The system shall provide support for an intelligence system comprising all machine and human interfaces, sensing devices, signal distribution mechanisms, processors, displays, software, decision aids, storage devices, and necessary interfaces with other onboard and off-board systems required to provide intelligence support to the operational mission.

1.7 The system design shall consider automation in areas where a reduction in personnel can be achieved without loss of combat effectiveness or human performance and safety.

1.8 The design shall emphasize simplicity and reliability of automated equipment to achieve the maximum practicable reduction in total personnel.

1.9 Human-machine interfaces shall be designed to be intuitive and interoperable to produce a common look and feel with consistent protocols for system operation.

1.10 The design of Open Systems Architecture and the integration of its major elements shall follow sound HSI principles to maximize human performance as an element of total system performance, and the resulting integrated design will not overload the cognitive sensory and physical capabilities of the operators, maintainers and support personnel.

1.11 Displays shall be designed, labeled, arranged and located in compliance with current military standards.

1.12 Human-computer interfaces shall be designed to ensure rapid and accurate information manipulation and assimilation.

1.13 Displays shall only present to the user the information required at a point in time, in a format designed to make the information immediately accessible, readable and usable.

1.14 The design, format, coding, and structure of labels used throughout the system shall follow a common approach.

1.15 Human error will not degrade the reliability of systems. A human-machine interface design strategy shall be implemented that emphasizes HSI design of interfaces, software, and systems to be standardized (following current military standards), and to be error resistant and error tolerant.

1.16 The communications system shall include management functions for monitoring, controlling, and configuring communications assets.

1.17 Systems shall be designed to promote commonality of communications message content, format, procedures, hand shake, and syntax.

1.18 Communications systems design and implementation shall address communications effectiveness, speech intelligibility, message understandability, error modes in transmitting and receiving messages, and use of constrained language, controlled syntax, and restricted vocabulary.

1.19 Speech intelligibility of voice communication systems shall be assessed as part of test and evaluation exercises and in compliance with current military standards.

1.20 Workload shall be reduced for legacy and developmental systems by consolidating control and by simplifying system operation and control through extensive use of job performance aids, decision aids, procedures guides and augmented human-machine interfaces.

1.21 Decision aids shall be used for managing system complexity; assisting users in coping with information overload; focusing the user's attention; assisting the user in accomplishing time-consuming activities more quickly; assisting when limited data results in uncertainty; overcoming human limitations that are associated with uncertainty, the emotional components of decision-making, finite-memory capacity, and systematic and cognitive biases; and assisting the user in retrieving, retaining, representing or manipulating large amounts of information, combining multiple cues or criteria, allocating resources, managing detailed information, performing computations, and selecting and deciding among alternatives.

1.22 Decision aids shall reduce the number of response options, which focuses the user's attention on the most viable options.

1.23 The elements of a situation display, such as symbology, shall be designed and organized to support a rapid assessment and understanding of the tactical situation.

1.24 Computer systems shall be usable by intended users. In this context usability of a system interface refers to the extent to which: (a) human-computer interfaces have been designed in accordance with user cognitive, perceptual and memory capabilities; (b) software command modes are transparent to the user; (c) displays are standardized and are easily read and interpreted; (d) the user is always aware of where he or she is in a program or problem (situational awareness); (e) procedures are logically consistent; (f) user documentation is clear, easily accessed and readable; (g) on-line help is available and responsive; (h) the user is only provided with that information needed when it is needed; and (i) the user understands how to navigate through a program and retrieve needed information.

1.25 Usability requires that user expectancies are met, that operations are intuitive, that displays are readable, that presented information and communications are immediately meaningful, that the incidence and impact of user errors are minimized, and that human interfaces are designed in conformity with current human engineering design standards.

1.26 In designing for maintainability in an optimized manning system, the effort shall identify the issues attendant to maintenance effectiveness and safety with reduced manning; identify the roles of the on-board human maintainer vs. automation and shore-side personnel in system/watercraft/platform maintenance; and identify maintainability reduced manpower HSI design concepts and criteria.

1.27 The system shall be designed to minimize maintenance, and maintenance personnel shall be provided the necessary tools, information, technical documentation and skills to perform maintenance.

1.28 Each item in which a failure may occur shall be capable of isolation from the rest of the operating equipment and system for maintenance and repair.

1.29 On-board maintainer workloads and skill requirements shall be reduced through reach-back to provide technical assistance and "just-in-time-training," and extensive use of job performance aids, decision aids, procedure guides and augmented human-machine interfaces.

1.30 Maintenance functions and tasks shall be simplified and maintainer workloads reduced through extensive intelligent decision aiding and incorporation of a maintainer's associate to assist in diagnostics decision making.

1.31 Maintenance of human-machine interfaces shall be designed in terms of HSI standards, and will incorporate decision support, intelligent tutoring, on-line help, job performance aiding, data fusion,

embedded training, and multi-modal/multi-media/hyper-media capabilities to achieve function, task simplification and consolidation.

1.32 The design of the human-machine interface to facilitate maintenance shall be in compliance with current military standards.

1.33 Technical manuals shall be designed to be readily accessible, readable, and usable by intended users.

1.34 Design of a technical manual shall be appropriate to the knowledge and skills of its users, to the tasks they will perform using the document, and to the environment in which the users will perform these tasks.

1.35 Systems, equipment and components shall be installed to facilitate accessibility for operating efficiency and for inspection, adjustment, maintenance and repair, replacement and removal.

1.36 The system shall provide space to enable the disassembly, repair, test, and checkout of systems and equipment to be repaired in place without dismantling other machinery, piping or structure.

1.37 The system shall be operable and maintainable by personnel whose physical characteristics range from the 5th percentile female to the 95th percentile male.

1.38 The system shall ensure crew rest levels are in accordance with current military standards.

1.39 Structures and components: Design, orientation, labeling and access to valves shall be in compliance with current engineering design standards.

1.40 The system shall use current military standards for the determination of whether there are one or two accesses and whether they are by inclined ladder, vertical ladder, or both, and whether the escapes are trunked.

1.41 Design of doors, hatches, and all provisions for access shall comply with current military standards.

1.42 Passageways shall be designed to allow for emergency egress of all personnel to safe areas.

1.43 Design of walkways and passageways shall comply with current military standards.

1.44 Weight lifting and carrying limits for human transport of material shall be in compliance with current military standards.

1.45 Equipment shall be arranged to facilitate access for maintenance and operation by a person within the 5th percentile female through the 95th percentile male range of applicable anthropometric data as defined by current military standards.

1.46 Interoperability and usability system testing and certification shall be accomplished starting in design and continuing during construction by, where feasible, leveraging joint test networks.

1.47 Lighting requirements in the system shall be in compliance with current military standards.

2.0 **Personnel** – The system shall be capable of being operated and maintained by crew with the lowest level of knowledge, skills, and abilities commensurate with satisfactory mission performance.

3.0 **Habitability** – The system shall provide an adequate environment, i.e., noise, light, heat, vibration, etc., for crew operation and maintenance.

4.0 **Manpower** – The number and mix of personnel shall support effective mission performance and drive the design activities. The systems shall provide sufficient manning levels to enable the crew to perform simultaneous, safe evolutions throughout the mission.

4.1 The system shall automate damage control actions to the most practical extent to support manning level requirements.

4.2 The system shall provide sufficient manning levels to enable the crew to perform simultaneous evolutions throughout the mission.

4.3 Crew size will be minimized through function allocation, human-centered design and function / task consolidation, elimination or automation features that will reduce watch station, maintenance and training requirements, and enhance human performance.

4.4 Implementation of the system shall leverage existing shore infrastructure (manpower and training assets) where feasible, and unique shore infrastructure requirements must be defined and resourced.

4.5 All systems shall be designed for maintainability, and reductions in manpower requirements for system maintenance (both planned and unscheduled) shall be achieved through an in-depth analysis of maintenance related tasks, early identification of maintenance concepts, and definition of maintenance requirements and constraints early in the design process. Burdens imposed on manpower, personnel and training related to system maintenance shall be identified as early as possible and refined throughout the development process.

5.0 **Training** – Training time and effort shall be consistent with system complexity.

5.1 Total System Training Architecture (TSTA) shall be implemented to minimize the use of unique equipment; to provide seamless proficiency training; and to include new learning techniques, simulation technology, embedded training and instrumentation systems that provide anytime, anyplace training to provide for a mission-ready crew.

5.2 The system shall provide a TSTA that supports on demand individual training to the crew, on demand team (unit) training to the crew, on demand force level training to the crew, and mission rehearsal capability while in port.

5.3 The system shall provide a TSTA that supports on demand individual training to the crew, on demand team (unit) training to the crew, on demand force level training to the crew, and mission rehearsal capability while underway.

5.4 The acquisition program shall promote manpower and training cost savings to the greatest extent possible consistent with thorough identification and analysis of all associated knowledge, skills and abilities for all tasks allocated to humans required for the efficient operation and employment of the system.

5.5 HSI strategies will be implemented to realize system efficiency and establish point of departure for effective and efficient training. The program will promote training efficiencies consistent with thorough

analysis of all associated skill sets required for the efficient operation and employment of the system. All required training, fleet and individual skills will be documented in the Navy Training System Plan.

5.6 Intelligence training shall employ an intelligence training architecture that provides a seamless continuum of training supported by existing and specific training systems, and methodologies including onboard and distance support capabilities, which shall be in compliance with and shall augment the TSTA. The organic onboard training capability shall provide operational and proficiency training for members of the intelligence team.

6.0 Safety and Occupational Health (SOH) – The system shall provide a safe working environment and conditions for all personnel by incorporating design features that eliminate, reduce, and/or mitigate the potential for injury, illness, disability, or death.

6.1 The system shall meet safety requirements established in DOD standards.

6.2 If there are any known safety problems in the baseline system, they shall be described and goals shall be stated to eliminate the problems.

6.3 A System Safety Program Plan shall be established and integrated into the System Engineering Management Plan. It shall describe strategy and the approach for implementing system safety requirements into the systems engineering process to achieve acceptable mishap risk through hazard identification, analysis, risk assessment and risk management.

6.4 The SOH program shall be integrated into the design, development, manufacture, use, maintenance and disposal of the system.

6.5 The system shall provide safe working and living environments and conditions for all embarked personnel by incorporating design features that eliminate, reduce and/or mitigate the potential for injury, illness, disability or death of all assigned and embarked personnel, and minimize hazardous material usage, including reduction in quantity and variety.

7.0 Survivability – System design shall strive to ensure the integrity of the crew compartment and permit rapid egress when the system is damaged or destroyed. The system design shall clearly reduce the risks of fratricide, detectability, and probability of attack. Personnel shall be protected in the event of accident or damage to the weapon platform.

7.1 The system shall provide no less than two separate means (paths) of egress from each fire zone to either an adjacent personnel fire protection area or an area of safe refuge (adjacent zone/weather).

7.2 The system shall have capability to control the spread of damage, minimize crew casualties and restore the craft to safe operation or safely evacuate the crew.

7.3 The system shall have the capability to detect, classify and locate fire, smoke, toxic gases, flooding, structural damage and hull breach throughout the craft.

7.4 Damage control actions shall be automated to the most practical extent to support optimum manning level requirements to include automatic detection, location, classification and management of fire, heat, toxic gases and flooding; structural damage and hull breaching throughout the watercraft using the craft's damage control management system; and identification of hazardous material within spaces.

Appendix B: HSIP Requirements for Human Factors Engineering

The objective of requiring these reports is to provide the lead program system engineer with the information required to verify that appropriate Human Factors Engineering processes are being utilized by the subsystem managers and the actual developer. The format and requirements for these deliverables, referred to as Data Item Descriptions, can be found at the Defense Technical Information Center (<http://www.dtic.mil>), under Human Systems Standards and Guidance Documents.

1.0 Human Factors Engineering (HFE). The developer shall establish and conduct an HFE effort that conforms to American Society for Testing and Materials (ASTM) F 1337-91, MIL STD 1472F, MIL-HDBK-46855A, ISO 13407, and ISO TR 16982. The Developer shall develop and apply HFE to all areas of human machine integration, information flows, operator tasks, maintenance tasks, and installation tasks. The developer shall perform the HFE effort concurrently with the design of all elements of the system, both hardware and software, having an interface with the maintainer/system administrator.

1.1 Human Engineering Program Plan (HEPP). The developer shall develop an HEPP which describes the developer's entire human engineering program, identifies its elements, and explains how the elements will be managed.

1.2 Task Analysis/Task Allocation Report. The developer shall develop a report describing the results of analyses of tasks performed by the developer to provide a basis for evaluation of the design of the system, equipment, or facility. The evaluation will verify that human engineering technical risks have been minimized and solutions are in hand.

1.3 Human Engineering Design Approach Document (HEDAD). The developer shall develop an HEDAD for the operator/maintainer. This document describes design interface requirements of equipment that must be operated and maintained. This document provides a source of data to evaluate the extent to which equipment having an interface with operators and maintainers meets human performance requirements and human engineering criteria.

1.4 Human Systems Engineering Analysis Report (HESAR). The developer shall complete a HESAR that describes the HFE efforts conducted as part of the system analysis. The data are used by the procuring activity to evaluate the appropriateness and feasibility of system functions and roles allocated to operators and maintainers.

1.5 Human Engineering Test Plan (HETP). The developer shall develop a Human Engineering Test Plan (HETP) identifying test requirements to ensure that human performance requirements for maintainers and system administrators are met and demonstrate that the personnel, equipment/software combination can accomplish the intended operational system, administration and maintenance functions. The HETP should identify the types of tests to be conducted, the test subjects to be used and how they compare to the user population, and the data collection and reporting methods to be used. To avoid duplication with other system test planning, the developer can reference where testing will be completed in other system test plans. The HETP should identify the types of tests to be conducted, the test subjects to be used and how they compare to the user population, and the data collection and reporting methods to be used.

1.6 Human Engineering Simulation Description. The developer shall provide a description of simulation use related to human engineering which details the developer's intended use of mockups and simulators in support of human engineering analysis, requirements definition/implementation, design support, and test and evaluation.

1.7 Human Engineering Test Report (HETR). The developer shall complete a Human Engineering Test Report that documents the compatibility of the human performance requirements, personnel selection criteria, training program, and design of the personnel equipment/software interfaces. The HETR confirms that human performance requirements have been met or defines the degree to which problems may exist. Again to avoid duplication with other test reports, the developer can reference where test reporting is completed in other system test reports.

1.8 Task Centered Design Considerations. Additional content will be required to document the task centered design (TCD) process. TCD requires a thorough task analysis to support the development of design features that improve system performance. Task analysis is at the center of a system engineering task centered design process. Human task centered design focuses on the human in the loop, making the human the independent variable in the systems engineering process. The task analysis includes two levels of integration for HSI to be effective: element versus element, and element versus design. Element versus element integration can be viewed as optimizing the mix of manpower, personnel, training, human engineering, safety, health hazards, habitability, and survivability. Element versus design integration optimizes the allocation of functions to hardware, software or the user when accomplishing system trade-offs in design. The ultimate goal of HSI is to optimize total system performance and reduce life cycle cost. Often these elements are approached independently within the same defense organizations and projects. HSI brings these elements together so that interdependencies can be highlighted and tradeoffs can be considered from a common frame of reference. The task analysis report will describe a defined set of tasks, subtasks and supporting procedures to enable (1) the development of human task-centered structures and (2) the identification of skill requirements for a given job or group of jobs.

Key Human System Integration Plan Elements for Command & Control Acquisition

Dr. Mike Cowen

Space and Naval Warfare Systems Center, Pacific (SSC Pacific)

mike.cowen@navy.mil

Dr. Jerry Kaiwi

Space and Naval Warfare Systems Center, Pacific (SSC Pacific)

jerry.kaiwi@navy.mil

2010 Command and Control Research and Technology Symposium

Space and Naval Warfare Systems Command

- The lead organization responsible for transforming information technology in the US military maritime domain.
- Development, testing and acquisition of systems for future Navy command, control, communications, computers, intelligence, surveillance and reconnaissance products.
- Create a highly adaptive, networked and distributed naval force with the increased speed, agility and security required to support constantly evolving mission needs.
- Provide the operational commanders the ability to make more timely and informed decisions based upon the best information and practices.

Human System Integration

- Human Systems Integration (HSI) is a formal acquisition process that accounts for human performance in capability definition and system development.
- It is a system engineering practice designed to ensure that human performance related issues are identified early in the acquisition lifecycle and mitigated during system development and testing.
- HSI integrates human capabilities and limitations into system definition, design, development and evaluation to optimize total system performance in operational environments.

What is Human System Integration?

Human Factors Engineering	Personnel	Habitability	Manpower	Training	Safety & Occupational Health	Survivability
Interface Design Workload Situation Awareness Decision-Support Usability Maintainability	Knowledge, Skills & Abilities Personnel Classification Selection Recruiting Retention	Quality of Work Quality of Life Environmental Limits and Controls	Officer, Enlisted, Civilian Billets Wartime Requirements Peacetime Requirements	Initial, Follow-on, & Refresher Delivery Systems Embedded Training Distance Learning Individual Team	Accident Avoidance Health Hazards Risk Mitigation Medical	Damage Control Personnel Protection Fratricide

HSI For Command & Control

Human Factors Engineering

- Tasks
 - Top-down functional analysis and allocation
 - Task-centered design
- Knowledge Engineering
 - Human information requirements & access (mapping)
 - Cognitive engineering

Human Factors Engineering - Tasks

Top-Down Functional Analysis and Allocation

System functions are identified and then decomposed to tasks. Tasks can be allocated to users or be automated. User roles are defined and skill sets are determined.

Task-Centered Design

Takes into account relevant human performance issues and objectives. Task-centered design attempts to optimize the user interface around the capabilities of the user, rather than forcing the user to accommodate the system or function.

Human Factors Engineering - Knowledge

Human Information Requirements & Access

Requires a full understanding of what users need to know to perform their jobs and designing the system to customize information access and representation.

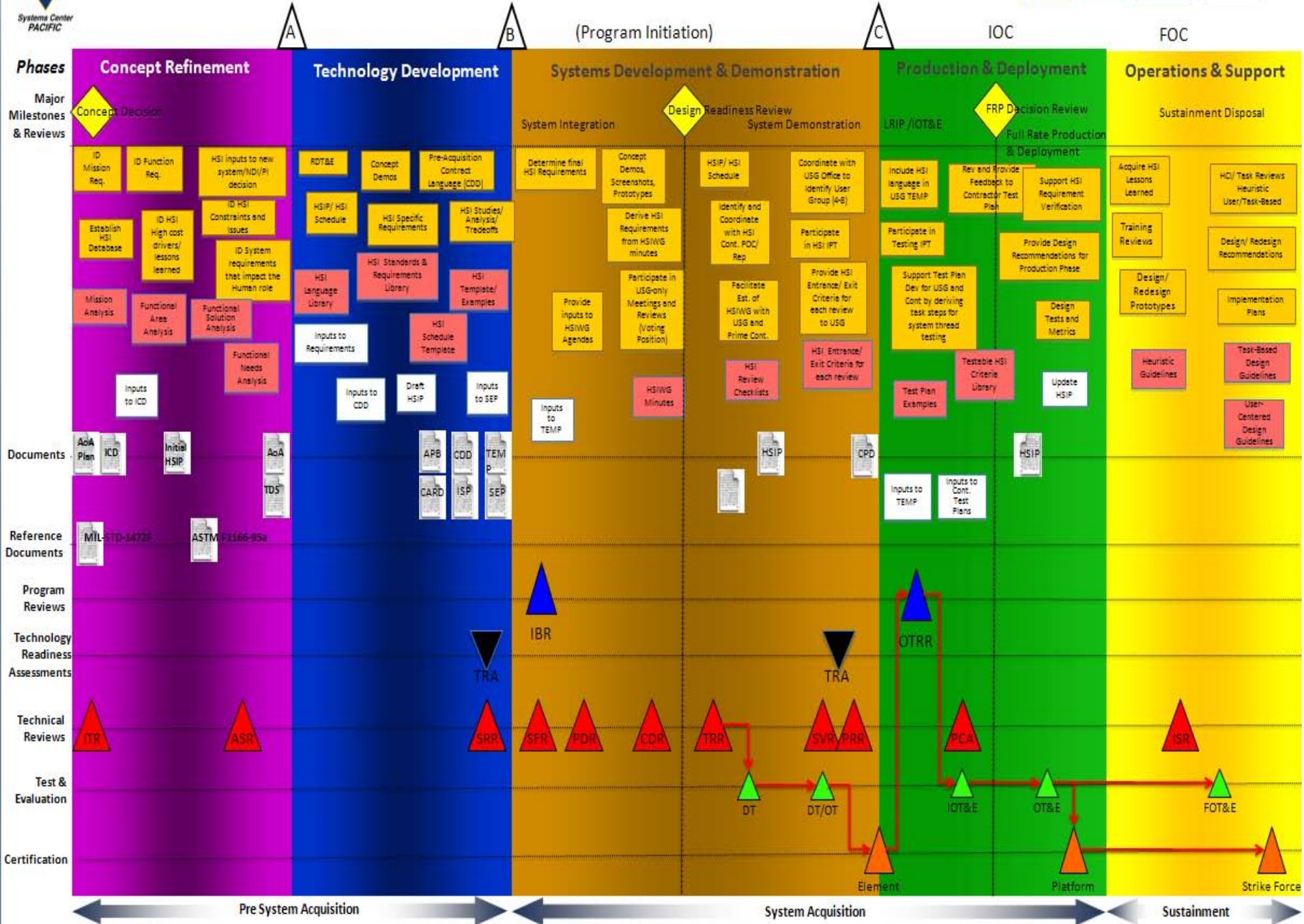
Cognitive Engineering

Individual users at various levels need access to critical information related to their assigned jobs, with the ability to access more detail as required. Development of a concept of operations must be focused on the tasks that the operational users have to perform.

Human Systems Integration Resources Relative to the DoD Acquisition Cycle

Legend

- Actions
- Tools
- Documents
- References



HSI Objectives for Technical Reviews

Technical Review	Description	HSI Objective
Initial Technical Review (ITR)	The ITR is a multi-disciplined technical review to support a program's initial Program Objective Memorandum submission. This review ensures that a program's technical baseline is sufficiently rigorous to support a valid cost estimate (with acceptable cost risk), and enable an independent assessment of that estimate by cost, technical, and program management subject matter experts. The ITR assesses the capability needs and conceptual approach of a proposed program and verifies technical challenges and risks.	Ensure the technical baseline supports a valid cost estimate for HSI resources and HSI program requirements.
Alternative Systems Review (ASR)	The ASR is a multi-disciplined technical review to ensure that the resulting set of requirements agrees with the customers' needs and expectations and that the system under review can proceed into the Technology Development phase. Generally this review assesses the alternative systems that have been evaluated during the Materiel Solutions Analysis phase, and ensures that the preferred system alternative is cost effective, affordable, operationally effective and suitable, and can be developed to provide a timely solution to a need at an acceptable level of risk.	Ensure that the preferred concept and resulting set of HSI requirements agree with the customers' needs and the trade-offs with alternative systems are an acceptable risk.
System Requirements Review (SRR)	The SRR is conducted to ascertain progress in defining system technical requirements. The SRR is a multi-disciplined technical review to ensure that the system under review can proceed into the Engineering & Manufacturing Development phase, and that all system requirements and performance requirements derived from the Initial Capabilities Document or draft Capability Development Document are defined and are consistent with cost (program budget), schedule (program schedule), risk, and other system constraints.	Ensure both HSI domain requirements and HSI-related system requirements are established and sufficiently derived and decomposed to support system function allocation.
System Functional Review (SFR)	The SFR is a multi-disciplined technical review to assess the system functional requirements as captured in system specifications (functional baseline), and ensures that all required system performance is fully decomposed and defined in the functional baseline. The SFR determines whether the systems functional definition is fully decomposed to a low level, and whether the IPT is prepared to start preliminary design.	Ensure the design process properly allocates system requirements and defines system functions between the <u>human</u> , hardware, and software in the functional baseline and is consistent with personnel KSA's, system performance objectives, infrastructure, and support requirements.
Preliminary Design Review (PDR)	The PDR is a multi-disciplined technical review to ensure that the system under review can proceed into detailed design, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints. This review assesses the system preliminary design as captured in performance specifications for each configuration item in the system (allocated baseline), and ensures that each function in the functional baseline has been allocated to one or more system configuration items.	Ensure that the preliminary design, processes used to support the design rationale, and allocated baseline adequately address the HSI domain requirements and HSI-related system requirements within acceptable cost, schedule, risk, or other constraints.

Critical Design Review (CDR)	The CDR is a multi-disciplined technical review to ensure that the system under review can proceed into system fabrication, demonstration, and test; and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints. This review assesses the system final design as captured in product specifications for each configuration item in the system (product baseline), and ensures that each product in the product baseline has been captured in the detailed design documentation.	Ensure the detailed design and product baseline can satisfy the HSI domain requirements and HSI-related system requirements and the design is mature to proceed into system fabrication and testing.
Test Readiness Review (TRR)	The TRR is a multi-disciplined technical review to ensure that the subsystem or system under review is ready to proceed into formal test. The TRR assesses test objectives, test methods and procedures, scope of tests, and safety and confirms that required test resources have been properly identified and coordinated to support planned tests. The TRR verifies the traceability of planned tests to program requirements and user needs. The TRR determines the completeness of test procedures and their compliance with test plans and descriptions.	Ensure that the HSI tests and metrics exist to adequately verify compliance with HSI domain requirements, HSI-related system requirements, user needs, and operational mission objectives and adequate training plans and resources exist to support Developmental Testing (DT)/Operational Testing (OT).
System Verification Review (SVR)	The SVR is a multi-disciplined product and process assessment to ensure that the system under review can proceed into Low-Rate Initial Production and Full-Rate Production within cost (program budget), schedule (program schedule), risk, and other system constraints. This review is an audit trail from the Critical Design Review. It assesses the system final product, as evidenced in its production configuration, and determines if it meets the functional requirements (derived from the Capability Development Document and draft Capability Production Document) documented in the Functional, Allocated, and Product Baselines. The SVR establishes and verifies final product performance.	Ensure that the system is compliant with HSI-related specifications and verify human and system performance is acceptable to proceed into production phases.
Production Readiness Review (PRR)	The PRR examines a program to determine if the design is ready for production and if the producer has accomplished adequate production planning. The review examines risk; it determines if production or production preparations incur unacceptable risks that might breach thresholds of schedule, performance, cost, or other established criteria. The review evaluates the full, production-configured system to determine if it correctly and completely implements all system requirements. The review determines whether the traceability of final system requirements to the final production system is maintained.	Ensure that the HSI risks and trade-offs associated with human performance, requirement non-compliance, Program Trouble Reports (PTRs), and Engineering Change Proposals (ECPs) have been resolved or accepted.
Operational Test Readiness Review (OTRR)	The OTRR is a multi-disciplined product and process assessment to ensure that the "production configuration" system can proceed into Initial Operational Test and Evaluation with a high probability of successfully completing the operational testing. Successful performance during operational test generally indicates that the system is suitable and effective for service introduction. The Full Rate Production Decision may hinge on this successful determination.	Ensure that the system has satisfactorily demonstrated compliance with HSI domain and HSI-related system performance objectives and can proceed into the Operational Test phase with a high probability of success.
In-Service Review (ISR)	The ISR is a multi-disciplined product and process assessment to ensure that the system under review is operationally employed with well-understood and managed risk. This review is intended to characterize the in-service technical and operational health of the deployed system. It provides an assessment of risk, readiness, technical status, and trends in a measurable form.	Ensure that the human performance risks of the deployed system have been identified and contribute to the assessment for modernization.

Preliminary Design Review (PDR)

HSI Objective

Ensure that the preliminary design, processes used to support the design rationale, and allocated baseline adequately address the HSI domain requirements and HSI-related system requirements within acceptable cost, schedule, risk, or other constraints.

#	Domain	Category	Question	G	Y	R	NA	Events	Reference	Relevant Document	Comments
1	HSI	HSI-HFE	1. Are there Human Factors Engineering (HFE) issues left over from previous reviews?				x	PDR			
2	HSI	HSI-HFE	2. Has HFE design factors/requirements/processes been included in the preliminary design?				X	PDR		ICD, CDD, ISP, SEP/HSIP, System Functional Baseline, Acquisition Strategy, Exit Criteria, Sys Performance Spec, APB, TEMP, Risk Assessment	COTS system
2.a.	HSI	HSI-HFE	2.a. Have the CONOPS, design reference scenarios (use cases), user tasks, and operational workflows been developed and used to support a user-centered design process?			x		PDR	DoDI 5000.2, SECNAV 5000.2D, GIG MA ICD, MIL-STD-1472F		
2.b.	HSI	HSI-HFE	2.b. Have preliminary design been reviewed and/or evaluated by HFE personnel to assess human performance, workload, safety, error and the system's ability to meet mission objectives, requirements, and user needs?			x		PDR			Even though COTS, the system should have been evaluated by HFE personnel to assess and address potential human performance issues in the current design.
2.c.	HSI	HSI-HFE	2.c. Is function and task analyses that includes allocation of tasks to hardware, software, and humans being considered in the preliminary design?			x		PDR			Not conducted.
2.c.i.	HSI	HSI-HFE	2.c.i. Have user tasks been defined and documented in the preliminary design?			x		PDR			Not conducted.
2.c.ii.	HSI	HSI-HFE	2.c.ii. Have team tasks been identified and documented in the preliminary design?					PDR			Unable to determine if team tasks is a requirement.
2.d.	HSI	HSI-HFE	2.d. Is human performance and usability addressed in the preliminary design?			x		PDR			See above.
2.d.i.	HSI	HSI-HFE	2.d.i. Have HFE metrics been developed?			x		PDR			Not developed

HSI Plan (HSIP) for Human Factors Engineering

- Human Engineering Program Plan (HEPP)
- Human Systems Engineering Analysis Report (HESAR)
- Task Analysis/Task Allocation Report
- Human Engineering Design Approach Document (HEDAD)
- Human Engineering Test Plan (HETP)
- Human Engineering Simulation Description
- Human Engineering Test Report (HETR)
- Task Centered Design Considerations

Human Engineering Program Plan (HEPP)

- Describes the developer's entire human engineering program, identifies its elements, and explains how the elements will be managed.

- **DI-HFAC-81742**

DATA ITEM DESCRIPTION

Title: HUMAN ENGINEERING PROGRAM PLAN

Number: DI-HFAC-81742

AMSC Number: N7715

DTIC Applicable : N/A

Office of Primary Responsibility: N/AIR 4.6

Applicable Forms:

Approval Data: 20070404

Limitation: N/A

GIDEP Applicable: N/A

Use/relationship: The Human Engineering Program Plan (HEPP) describes the contractor's Human engineering program, identifies, and explains how the elements will be managed.

a. This Data Item Description (DID) contains the format and content preparation instructions for the HEPP resulting from applicable tasks delineated in the SOW.

b. This DID supersedes DI-HFAC-80740A.

Requirements:

1. Reference documents: The applicable issue of the documents cited herein, including their approval dates and dates of any applicable amendments, notices, and revisions shall be as cited in the current issue of the DODISS at the time of the solicitation.

2. Format. The HEPP format shall be contractor selected but must contain all elements discussed in below. Unless effective presentation would be degraded, the initially used format arrangement shall be used for all subsequent submissions.

Human Systems Engineering Analysis Report

- The HESAR describes all the HFE activities conducted as part of the system analysis. The data are used by the procuring activity to evaluate the appropriateness and feasibility of system functions and roles allocated to operators and maintainers.
- **DI-HFAC-80745B**

DATA ITEM DESCRIPTION

Title: Human Engineering System Analysis Report

Number: DI-HFAC-80745B

AMSC Number: A7319

Approval Date: 19980708

DTIC Applicable:

Limitation:

Office of Primary Responsibility: A/AMCOM

GIDEP Applicable:

Applicable Forms:

Use/Relationship: The Human Engineering System Analysis report describes the human engineering efforts conducted as part of system analysis and presents results. The data are used by the procuring activity to evaluate the appropriateness and feasibility of system functions and roles allocated to operators and maintainers.

a. This data item description (DID) contains the format and content preparation instructions for the Human Engineering System Analysis Report resulting from applicable tasks delineated in the SOW.

b. This DID supersedes DI-HFAC-80745A.

Requirements:

1. Format. The Human Engineering System Analysis Report format shall be contractor selected. Unless effective presentation would be degraded, the initially used format arrangement shall be used for all subsequent submissions.

2. Content. The Human Engineering System Analysis Report shall contain the following:

a. System objective(s). In accordance with information provided by the procuring activity or contractor studies, the system objective(s) shall be described. If the objective(s) are to be met by the system operating in conjunction with other systems not within the scope of the contract, the following shall also be described.

(1) The overall (or higher level) objective(s) to be met through combined operation of systems.

(2) The sub-objective(s) to be met by the system being developed under the contract.

(3) Interactions required between systems to meet the objective(s).

Human Systems Engineering Analysis Report

- Top-Down Functional Analysis – Machine Behaviors
- Allocation of Functions to Human
- User Enabling the Capability within Mission Context and Constraints

Task Analysis/Task Allocation Report

- Describes the results of analyses of tasks performed, including a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment. Provides a basis for evaluation of the design of the system, equipment, or facility.
- **DI-HFAC-81399A**

DATA ITEM DESCRIPTION

Title: Critical Task Analysis Report

Number: DI-HFAC-81399A

AMSC Number: A7322

Approval Date: 19980708

DTIC Applicable:

Limitation:

Office of Primary Responsibility: A/AMCOM GIDEP Applicable:

Applicable Forms:

Use/relationship: The Critical Task Analysis Report describes the results of analyses of critical tasks performed by the contractor to provide a basis for evaluation of the design of the system, equipment, or facility. The evaluation will verify that human engineering technical risks have been minimized and solutions are in hand.

a. This data item description (DID) contains the format and content preparation instructions for the data product generated by the specific and discrete task requirement as delineated in the contract.

b. This DID supersedes DI-HFAC-81399.

Requirements:

1. Format. The Critical Task Analysis Report format shall be contractor selected. Unless effective presentation would be degraded, the initially used format arrangement shall be used for all subsequent submissions.

2. Content. The Critical Task Analysis Report shall describe and analyze each critical task including:

a. Information required by and available to personnel which is relevant to the critical task assigned to them.

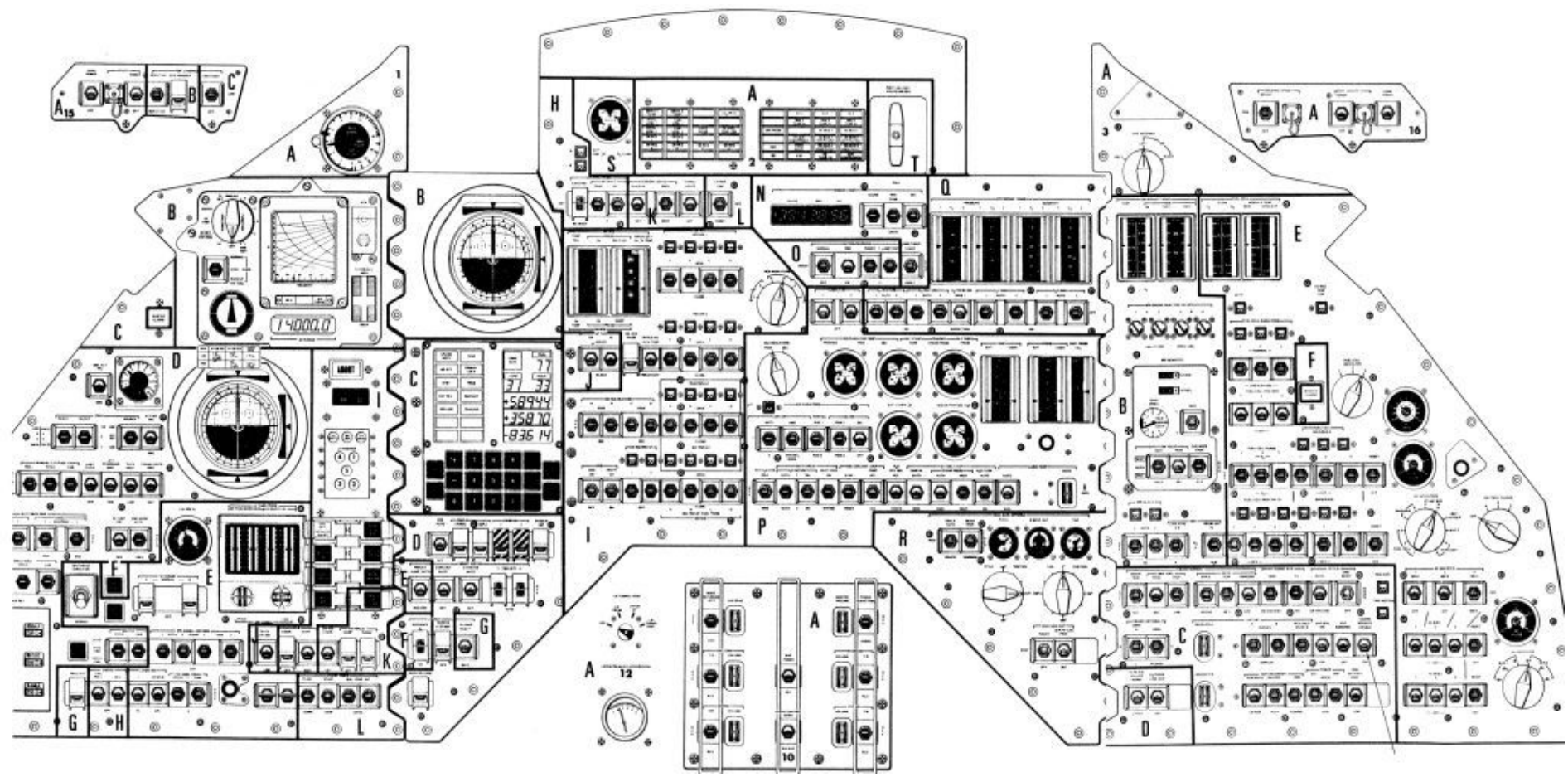
b. Actions which each performer shall complete to accomplish the critical task, including responses to specific information, responses to combinations of information; and self-initiated responses.

c. The functional consequences of each operator or maintainer critical task with respect to the effects upon both the immediate subsystem functions and the overall system mission.

d. All affected missions and phases including degraded modes of operation. Information on each critical task shall be

Task Analysis/Task Allocation Report

- Job Analysis - Roles & Responsibilities
- Critical Task Identification & Description
- Work Domain & Workload Analysis
 - Traditional Job-Task Analysis
 - Cognitive Work Analysis (CWA) - example
 - Cognitive Task Analysis (CTA)
- DODAF: OV-4 by OV-5 (Roles by Activities)



Human Engineering Design Approach Document

- The HEDAD describes design interface requirements of equipment that must be operated (HEDAD-O) and maintained (HEDAD-M). This document provides a source of data to evaluate the extent to which equipment having an interface with operators and maintainers meets human performance requirements and human engineering criteria.
- **DI-HFAC-80746B & DI-HFAC-80747B**

DATA ITEM DESCRIPTION

Title: Human Engineering Design Approach Document-Operator

Number: DI-HFAC-80746B

AMSC Number: A7320

Approval Date: 19980708

DTIC Applicable:

Limitation:

Office of Primary Responsibility: A/AMCOM

GIDEP Applicable:

Applicable Forms:

Use/Relationship: The Human Engineering Design Approach Document - Operator (HEDAD-O) describes equipment which interfaces with operators. This document provides a source of data to evaluate the extent to which equipment having an interface with operators meets human performance requirements and human engineering criteria.

a. This data item description (DID) contains the format and content preparation instructions for HEDAD-O resulting from applicable tasks delineated in the SOW.

b. This DID supersedes DI-HFAC-80746A.

Requirements :

1. Reference documents. The applicable issue of the documents cited herein, including their approval dates and dates of any applicable amendments, notices, and revisions shall be as cited in the current issue of the DODISS at the time of the solicitation.

2. General. The HEDAD-O shall describe the layout, detail design, and arrangement of crew station equipment having an operator interface; it shall also describe operator tasks (see below) associated with equipment. The HEDAD-O shall describe the extent to which human performance requirements and applicable human engineering design criteria (e.g., MIL-STD-1472) have been incorporated into the layout, design, and arrangement of equipment having an operator interface. Findings from analysis of operator tasks shall be presented as part of the rationale supporting the layout, design, and integration of crew station equipment.

3. Format. The HEDAD-O format shall be contractor selected. Unless effective presentation would be degraded, the initially used format arrangement shall be used for all subsequent submissions.

Human Engineering Design Approach Document

- Describe all equipment that has a user interface – Enablers
- **Maintainer** - Installation & Sustainment
- **Operator** –
 - Layout & Arrangement
 - Control & Display
 - Vision of
 - Environmental (Noise, Heat, Vibration, etc)
 - Ingress/Egress
 - Lighting
 - Alerts
 - User Posture
 - Access to Comms
 - Unique Mission Features and use of Multiple Workstations

Human Engineering Test Plan (HETP)

- Identifies test requirements to ensure that human performance requirements for maintainers and system operators are met and demonstrate that the personnel, equipment/software combination can accomplish the intended operational system, administration and maintenance functions. The HETP should identify the types of tests to be conducted, the participants to be used and how they compare to the user population, and the data collection and reporting methods to be used. To avoid duplication with other system tests, the developer can reference other system test reports.
- **DI-HFAC-80743B**

DATA ITEM DESCRIPTION

Title: Human Engineering Test Plan

Number: DI-HFAC-80743B

AMSC Number: A7317

DTIC Applicable:

Office of Primary

Responsibility: A/AMCOM

Applicable Forms:

Approval Date: 19980708

Limitation:

GIDEP Applicable:

Use/Relationship: The Human Engineering Test Plan details the proposed testing to demonstrate that the personnel-equipment/software combination can accomplish the intended operation and maintenance functions in accordance with system specifications. This plan serves as the principal means of planning for validating human performance requirements, accuracy of personnel selection criteria, adequacy of training, and acceptability of design of the personnel-equipment/software interface.

a. This data item description (DID) contains the format and content preparation instructions for a Human Engineering Test Plan resulting from applicable tasks delineated in the SOW.

b. This DID is related to DI-HFAC-80744B, "Human Engineering Test Report". This plan serves as the principal means of planning for validating human performance requirements, accuracy of personnel selection criteria, adequacy of training, and acceptability of design of the personnel-equipment/software interface.

c. This DID supersedes DI-HFAC-80743A.

Requirements:

1. General. The Human Engineering Test Plan shall detail the contractor's plan for gathering and analyzing data to show that the system, when fielded, will satisfy four criteria:

a. All human performance requirements for operations and maintenance can be performed to an acceptable level or standard under conditions of expected use.

b. The human performance requirements for operations and maintenance can be performed reliably by personnel reasonably representative of the military personnel who will ultimately perform them.

Human Engineering Test Plan (HETP)

- Can user operate and maintain the equipment?
- Identify equipment to-be-tested and descriptions of participants.
- List of tasks to-be-performed, under what conditions.
- Performance measures, data collection & analysis.
- Leverage on-going system tests.
- Will you need a simulation or mockup?

Human Engineering Simulation Description

- Describes simulation use related to human engineering which details the developer's intended use of mockups and simulators in support of human engineering analysis, requirements definition/implementation, design support, and test and evaluation.
- Describe scenarios & conditions.
- **DI-HFAC-80742B**

DATA ITEM DESCRIPTION

Title: Human Engineering Simulation Concept

Number: DI-HFAC-80742B

AMSC Number: A7316

Approval Date: 19980708

DTIC Applicable:

Limitation:

Office of Primary Responsibility: A/AMCOM GIDEP Applicable:

Applicable Forms:

Use/Relationship: The Human Engineering Simulation Concept describes the contractor's intended use of mockups and simulators in support of human engineering analysis, design support, and test and evaluation.

a. This data item description (DID) contains the format and content preparation instructions for the Human Engineering Simulation concept resulting from applicable tasks delineated in the SOW.

b. This DID is related to DI-HFAC-80741B, "Human Engineering Progress Report." This document may be used by the procuring activity to assist in and assess simulation approaches when there is a need to resolve potential critical human performance problems, particularly where government facilities, models, data or participants are required.

c. This DID supersedes DI-HFAC-80742A.

Requirements:

1. Format. The Human Engineering Simulation Concept format shall be contractor selected. Unless effective presentation would be degraded, the initially used format arrangement shall be used for all subsequent submissions.

2. Content. The Human Engineering Simulation Concept shall contain the following information:

a. Rationale and general description. The need for a mockup or simulation program shall be described. The overall simulation concept shall be described. Benefits to be derived shall be stated. The interrelationships between mockups, simulators, and other human engineering analysis, design support, and test and evaluation techniques shall be described.

Human Engineering Test Report (HETR)

- Documents the compatibility of the human performance requirements, personnel selection criteria, training program, and design of the personnel equipment/software interfaces. The HETR confirms that human performance requirements have been met or defines the degree to which problems may exist. The developer can reference other system test reports.
- **DI-HFAC-80744B**

DATA ITEM DESCRIPTION

Title: Human Engineering Test Report

Number: DI-HFAC-80744B

AMSC Number: A7318

Approval Date: 19980708

DTIC Applicable:

Limitation:

Office of Primary Responsibility: A/AMCOM

GIDEP Applicable:

Applicable Forms:

Use/Relationship: The Human Engineering Test Report provides evidence that the human-system interface requirements for the operation, maintenance, and support of the system have been met. This report serves as the principal means of assessing the compatibility of the human performance requirements, personnel selection criteria, training program, and design of the human-equipment/software interfaces. This report will be used to determine whether and to what level or standard(s) each trained individual can perform in the specified sequence all assigned systems tasks, to determine whether and to what extent each individual's performance is affected by equipment configuration, the performance of other system personnel, or both; and to assess the impact of the measured human performance on the attainment of task, task group, and mission requirements.

a. This data item description (DID) contains the format and content preparation instructions for a Human Engineering Test Report resulting from the work task delineated in the SOW.

b. This DID is related to DI-HFAC-80743A, "Human Engineering Test Plan".

c. This DID supersedes DI-HFAC-80744A.

Requirements:

1. General. The Human Engineering Test Report shall be prepared for each personnel position in the system being developed. All of the operations and maintenance tasks required of the individual assigned to a personnel position shall be referred to as the "task group" of the position.

2. Format. The Human Engineering Test Report format shall be contractor selected. Unless effective presentation would be degraded, the initially used format arrangement shall be used for all subsequent submissions.

3. Content. The Human Engineering Test Report shall contain the following:

Human Engineering Test Report (HETR)

- Evidence that the user can operate & maintain equipment attaining mission requirements.
 - Summary Description of your Test Plan
 - Results & Findings & Analysis of Errors
 - Findings from other Relevant Test Reports
 - Implications of Findings
 - Recommend Solutions, Work-Arounds, Job Aids, & Training

Task Centered Design (TCD) Considerations

- TCD is a user-interface design process which systematically identifies and takes into account relevant human performance issues and objectives. Task-centered design attempts to optimize the user interface around the capabilities of the user, rather than forcing the user to accommodate the system or function.
- Human task centered design focuses on the human in the loop, making the human the independent variable in the systems engineering process.
- Additional content will be required to document the TCD process.
- The task-centered analysis report will describe a defined set of tasks, subtasks and supporting procedures to enable (1) the development of human task-centered structures and (2) the identification of skill requirements for a given job or group of jobs.

Summary

Human System Integration and Command & Control

- HSI is a vital ingredient in the acquisition of Command & Control systems.
- HSI is part of the total systems engineering approach to concept refinement, design, development and testing.
- HSI integrates user capabilities with system definitions, designs, development, and deployment to operational environments.
- Key HSI elements for Command & Control evolve around situational awareness, distributed decision-making, and action.
- These elements should be documented, guided by the requirements specified in the Defense Acquisition Framework.