Human Systems Integration

Human Systems Integration (HSI) is an interdisciplinary technical and management process for integrating human considerations with and across all system elements, an essential enabler to systems engineering practice. Human activity considered by HSI includes operating, maintaining, and supporting the system. HSI also considers training and training devices, as well as the infrastructure used for operations and support (DAU 2010). HSI incorporates the following domains as integration considerations: manpower, personnel, training, human factors engineering, occupational health, environment, safety, habitability, and human survivability.

Please note that not all of the generic below sections have mature content at this time. Anyone wishing to offer content suggestions should contact the SEBoK Editors in the usual ways.

Contents

1 Overview
2 System Description
3 Discipline Management
4 Discipline Relationships
   4.1 Interactions
   4.2 Dependencies
5 Discipline Standards
6 Personnel Considerations
7 Metrics
8 Models
9 Tools
10 Practical Considerations
   10.1 Pitfalls
   10.2 Proven Practices
   10.3 Other Considerations
11 References
   11.1 Works Cited
   11.2 Primary References
   11.3 Additional References

Overview

Human Factors Engineering is primarily concerned with designing human-machine interfaces consistent with the physical, cognitive, and sensory abilities of the user population. Human-machine interfaces include: • functional interfaces (functions and tasks, and allocation of functions to human performance or automation); • informational interfaces (information and characteristics of
information that provide the human with the knowledge, understanding, and awareness of what is happening in the tactical environment and in the system); •environmental interfaces (the natural and artificial environments, environmental controls, and facility design); •co-operational interfaces (provisions for team performance, cooperation, collaboration, and communication among team members and with other personnel); •organizational interfaces (job design, management structure, command authority, and policies and regulations that impact behavior); •operational interfaces (aspects of a system that support successful operation of the system such as procedures, documentation, workloads, and job aids); •cognitive interfaces (decision rules, decision support systems, provisions for maintaining situational awareness, mental models of the tactical environment, provisions for knowledge generation, cognitive skills and attitudes, and memory aids); and •physical interfaces (hardware and software elements designed to enable and facilitate effective and safe human performance such as controls, displays, workstations, worksites, accesses, labels and markings, structures, steps and ladders, handholds, maintenance provisions, etc.) (DAU 2010).

System Description

HSI is more than human factors, human-computer interaction, or systems engineering. It is a technical and managerial set of processes that involves the consideration and integration of multiple domains. Various organizations represent the HSI domains differently as the number and names of the domains are aligned with existing organizational structures. Booher (2003) presents the seven US Army domains. The Canadian Forces have a different number of domains while the UK Ministry of Defense has another. All the technical work of the domains is present while the number and names and the domains is the same. According to the Defense Acquisition University, the HSI domains are Manpower: Manpower describes the number and mix of personnel required to carry out a task, multiple tasks, or mission in order to operate, maintain, support, and provide training for a system. Manpower factors are those variables that define manpower requirements. These variables include job tasks, operation/maintenance rates, associated workload, and operational conditions (e.g., risk of operator injury) (DAU 2010).

Environment: Environment includes the physical conditions in and around the system, as well as the operational context within which the system will be operated and supported. Environmental attributes include temperature, humidity, noise, vibration, radiation, shock, air quality, among many others. This "environment" affects the human's ability to function as a part of the system (DAU 2010).

Habitability: Habitability factors are those living and working conditions that are necessary to sustain the morale, safety, health, and comfort of the user population. They directly contribute to personnel effectiveness and mission accomplishment and often preclude recruitment and retention problems. Examples include: lighting, space, ventilation, and sanitation; noise and temperature control (i.e., heating and air conditioning); religious, medical, and food services availability; and berthing, bathing, and personal hygiene. Habitability consists of those characteristics of systems, facilities (temporary and permanent), and services necessary to satisfy personnel needs. Habitability factors are those living and working conditions that result in levels of personnel morale, safety, health, and comfort adequate to sustain maximum personnel effectiveness, support mission performance, and avoid personnel retention problems (DAU 2010). Safety: The design features and operating characteristics of a system that serve to minimize the potential for human or machine errors or failure that cause injurious accidents (DAU, 2010). Safety also encompasses the administrative procedures and controls associated with the operations, maintenance, and storage of a system.

Human factors engineering: Human factors engineering is primarily concerned with designing human-machine interfaces consistent with the physical, cognitive, and sensory abilities of the user population. Human-machine interfaces include: •functional interfaces (functions and tasks, and allocation of functions to human performance or automation); •informational interfaces (information and characteristics of information that provide the human with the knowledge, understanding, and awareness of what is happening in the tactical environment and in the system); •environmental
interfaces (the natural and artificial environments, environmental controls, and facility design); operational interfaces (provisions for team performance, cooperation, collaboration, and communication among team members and with other personnel); organizational interfaces (job design, management structure, command authority, and policies and regulations that impact behavior); operational interfaces (aspects of a system that support the successful operation of the system such as procedures, documentation, workloads, and job aids); cognitive interfaces (decision rules, decision support systems, provisions for maintaining situational awareness, mental models of the tactical environment, provisions for knowledge generation, cognitive skills and attitudes, and memory aids); and physical interfaces (hardware and software elements designed to enable and facilitate effective and safe human performance such as controls, displays, workstations, worksites, accesses, labels and markings, structures, steps and ladders, handholds, maintenance provisions, etc.) (DAU 2010).

**Human survivability:** Survivability factors consist of those system design features that reduce the risk of fratricide, detection, and the probability of being attacked, and that enable personnel to withstand man-made hostile environments without aborting the mission, objective, or suffering acute chronic illness, disability, or death. Survivability attributes are those that contribute to the survivability of manned systems (DAU 2010).

**Occupational health:** Occupational health factors are those system design features that serve to minimize the risk of injury, acute or chronic illness, or disability, and/or reduce job performance of personnel who operate, maintain, or support the system. Prevalent issues include noise, chemical safety, atmospheric hazards (including those associated with confined space entry and oxygen deficiency), vibration, ionizing and non-ionizing radiation, and human factors issues that can create chronic disease and discomfort such as repetitive motion diseases. Many occupational health problems, particularly noise and chemical management, overlap with environmental impacts. Human factors stresses that creating a risk of chronic disease and discomfort overlaps with occupational health considerations (DAU 2010).

**Personnel:** Personnel factors are those human aptitudes (i.e., cognitive, physical, and sensory capabilities), knowledge, skills, abilities, and experience levels that are needed to properly perform job tasks. Personnel factors are used to develop occupational specialties for system operators, maintainers, trainers, and support personnel (DAU 2010). The selection and assignment of personnel is critical to the success of a system, as determined by the needs set up by various work-related requirements.

**Safety:** The design features and operating characteristics of a system that serve to minimize the potential for human or machine errors or failure that cause injurious accidents (DAU, 2010). Safety also encompasses the administrative procedures and controls associated with the operations, maintenance, and storage of a system.

**Training:** Training is the learning process by which personnel individually or collectively acquire or enhance pre-determined job-relevant knowledge, skills, and abilities by developing their cognitive, physical, sensory, and team dynamic abilities. The “training/instructional system” integrates training concepts and strategies, as well as elements of logistic support to satisfy personnel performance levels required to operate, maintain, and support the systems. It includes the “tools” used to provide learning experiences, such as computer-based interactive courseware, simulators, actual equipment (including embedded training capabilities on actual equipment), job performance aids, and Interactive Electronic Technical Manuals (DAU 2010).

**Discipline Management**

Information to be supplied at a later date.
Personnel Considerations

Personnel factors are those human aptitudes (i.e., cognitive, physical, and sensory capabilities), knowledge, skills, abilities, and experience levels that are needed to properly perform job tasks. Personnel factors are used to develop occupational specialties for system operators, maintainers, trainers, and support personnel (DAU 2010). The selection and assignment of personnel is critical to the success of a system, as determined by the needs set up by various work-related requirements.

Manpower describes the number and mix of personnel required to carry out a task, multiple tasks, or mission in order to operate, maintain, support, and provide training for a system. Manpower factors are those variables that define manpower requirements. These variables include job tasks, operation/maintenance rates, associated workload, and operational conditions (e.g., risk of operator injury) (DAU 2010).

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Metrics

Information to be supplied at a later date.

Models

Information to be supplied at a later date.

Tools

Information to be supplied at a later date.
Practical Considerations

Information to be supplied at a later date.

Pitfalls

Information to be supplied at a later date.

Proven Practices

Information to be supplied at a later date.

Other Considerations

Information to be supplied at a later date.

References

Works Cited


Primary References


Additional References


