Human Factors Engineering in System Design for Operationally Responsive Ground Systems

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Human Factors Engineering

- Human Factors Engineering (HFE) is the essential link between System Design Engineering and End Users/Operators. The field of human factors engineering uses scientific knowledge about human behavior in specifying the design and use of a human-machine system. The application of human factors engineering will “create a human-system interface that will operate within human performance capabilities, meet system functional requirements, and accomplish mission objectives.”

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Human System Integration
Challenges – What they are

- Human Perceptual, Cognitive and Performance Characteristics
- Display and Control Design
- Design of Equipment, Vehicles, and Other Systems
- Workplace, Crew Station, and Facilities Design
- Automation and Human-Machine Integration
- Work Design
Human System Integration Challenges – What they are

- Human Perceptual, Cognitive and Performance Characteristics
  - Sensory processes in vision, hearing and other senses.
  - Spatial awareness and perceptual organization
  - Attention, Cognition, Decision-making and Problem Solving
  - Attention, Workload and Situational Awareness
  - Learning and Memory
  - Performance, Speed, Accuracy and Reliability
  - Stress, fatigue, and other psychological and physiological states
  - Individual differences
Human System Integration
Challenges – What they are

• Display and Control Design
  • Input Devices and Controls
  • Grouping and Arrangement of Controls
  • Process Control and System Operation
  • Control/Display Integration
  • Information Presentation
Human System Integration
Challenges – What they are

- Design of Equipment, Vehicles, and Other Systems
  - Portable Systems and Equipment
  - Remote Handling Equipment:
  - Command and Control Systems
  - Manpower and Crew Size Requirements
  - Maintainability
  - Usability
Human System Integration
Challenges – What they are

• Workplace, Crew Station, and Facilities Design
  • Anthropometry
  • Console and Workstation Dimensions and Layout
  • General Workplace and Building Design
  • Design of Non-Work (service) facilities
  • Design of self-contained working/living environments
Human System Integration
Challenges – What they are

• Automation and Human-Machine Integration
  • Allocation of Functions between Human and Machine
  • Automation of Human Tasks
  • Aiding of operators, maintainers, and teams
  • Artificial Intelligence
  • Virtual Environments
Human System Integration Challenges – What they are

- **Work Design**
  - Task Description, Task Analysis, and Task Allocation
  - Job skill, structure, and organization
  - Work Duration, Shift Work, and Sustained and Continuous Operations
  - Job Attitudes, Job Satisfaction, and Morale
  - Training, Instructional Manuals, and Job Support
Meeting the Challenges - Implementing and Integrating Human Factors

- Program Proposals, Definition, and Planning
  - Definition of System Operation and Usage
  - High Level Requirements and Verification Criteria
  - HFE Level of Effort
- Design and Development
  - Detailed Requirements and Verification Criteria
  - Design Contributions
  - Preliminary/Predictive Assessments
- Testing
  - Incremental/Interim Assessments
  - Final Verification and Acceptance
- Tools
  - Operability Database
  - Human Engineering Plan Documents
Meeting the Challenges - Implementing and Integrating Human Factors

- Program Proposals, Definition, and Planning
  - Baseline Scenario Development
  - High-Level definition of expected involvement of the human in the overall system
  - Requirements and Verification
  - Scope of HFE effort
Meeting the Challenges - Implementing and Integrating Human Factors

• Design and Development
  – Detailed Requirements and Verification Criteria
  – Human System Interface Design Style Guidance
  – Preliminary/Predictive Assessments
    • Task Analysis
    • Predictive Workload Analyses
    • Manning and Crew Construction
  – Collaboration with Development Engineers
    • Operability Design Team Meetings
– Reports
– Collaboration with Training and Operations Group
Meeting the Challenges - Implementing and Integrating Human Factors

• Testing
  – Incremental/Interim Assessments
    • Individual Performance
    • Crew Performance
    • Design Implementation
  – Final Verification and Acceptance Testing
    • Repetition of Incremental/Interim Assessments
    • Operational Environment Assessments
Meeting the Challenges - Implementing and Integrating Human Factors

- **Tools**
  - Operability Database
  - Human Engineering Plan Documents
    - Human Engineering Program Plan – HEPP
    - Human Engineering Test Plan – HETP
Meeting the Challenges - Human Factors Programmatic Activities

- Program Lifecycle Engagement
- Total System Approach
- Concurrent Engineering Approach
- Operator Involvement
- Coordination
- Detailed Plan
Summary

• Ground Systems are challenging to HFE
• Sound Human Factors Engineering principles and practices will enable a program to successfully respond to and conquer the challenges
Questions?
References

- All Imagery obtained from NASA website
  - [http://visibleearth.nasa.gov/view_rec.php?id=12759](http://visibleearth.nasa.gov/view_rec.php?id=12759)