
HSI* Test and Evaluation for Satellite Operations

Presented to:
***Space & Missile
Test & Evaluation Symposium***
Theme: Back to Basics

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**HSI- Human Systems Integration*

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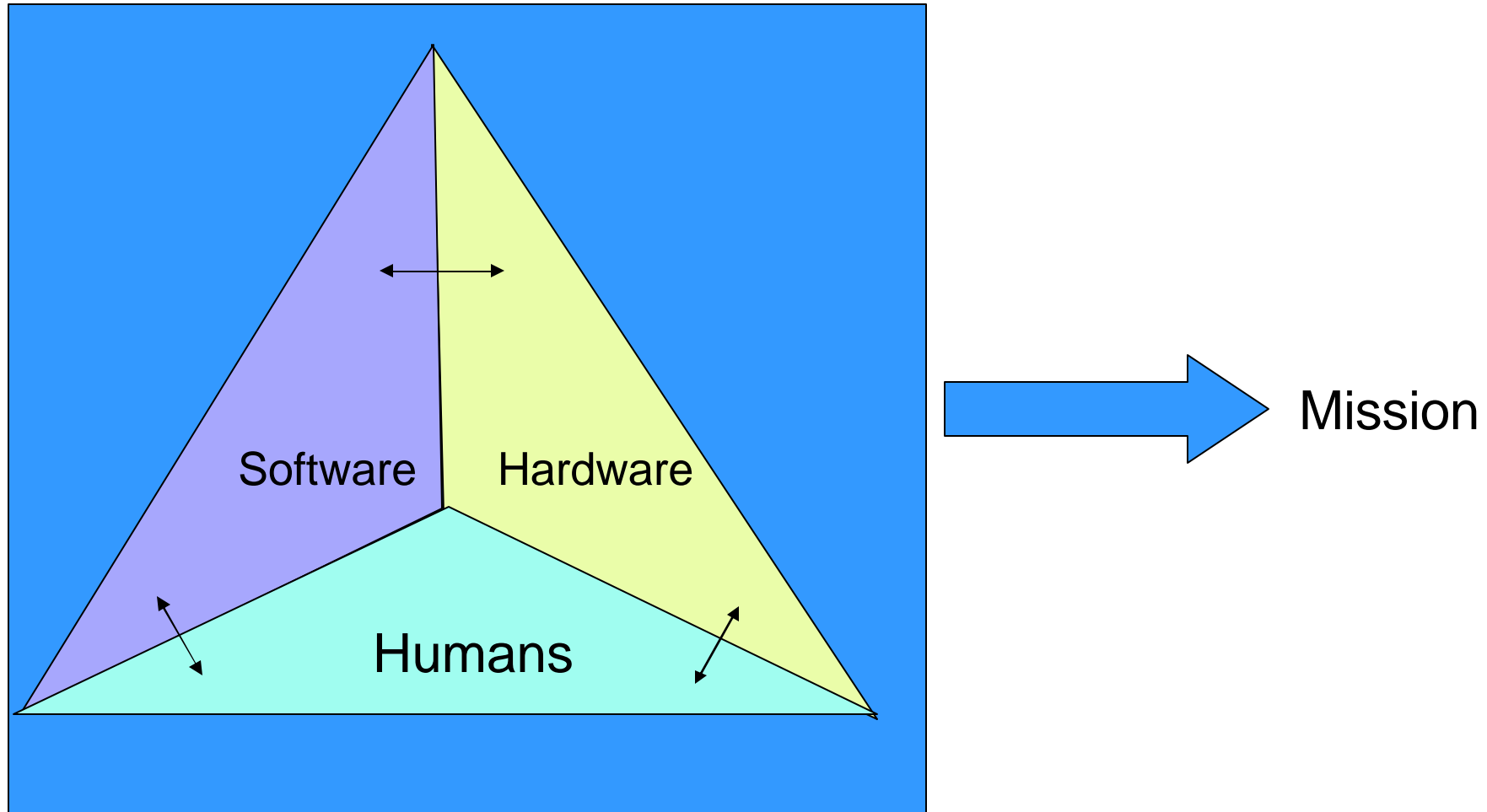
Humans in Unmanned Space Systems

- Early
 - Operators were primarily engineers and scientists
 - Highly trained experts with deep knowledge of the satellite
- Maturing
 - Evolved from engineers and scientists operating the system to less-experienced personnel.
 - Constant demands to decrease manpower (both skill level and number of personnel)
- Increasing demands on human users, operators and maintainers
 - Volume and complexity of information
 - Changing job demands, new ways of operating,
 - Manpower constraints
 - New technology (new sensors, increased communications bandwidth)
 - more information from more sources to contend with

Issues in the National Security Space Environment

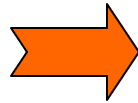
- Humans not always considered an element in system development of space systems.
 - Acquisition Reform made progress more difficult
- Recent increase in interest in addressing humans in design
 - Scientific Advisory Board Panel Quick Look Study on Human Systems Integration, 2004
 - The study focused on usability as an attribute of the weapon systems provided to the warfighter and the practices that are needed to assure that the human interface does not limit system performance
 - Increased emphasis in National Security Space Acquisition Policy (03-01) 27 December 2004, Paragraph AP 1.1.7 – Human Systems Integration
 - The PM shall have a comprehensive plan for Human Systems Integration (HSI) in place early in the acquisition process...
 - Recent SMC Policy on Human Systems Integration (Feb 2006)

Mission Requirement: Hardware, Software and Humans Work Together

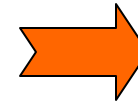


Human Factors in Space Systems Design

Can these warfighters?



With this training?



Using this equipment?



Under these conditions?

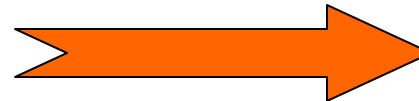
TIME PRESSURE 24/7 ops



STRESS



Weather



Accomplish their mission?



T&E- Can Measure System Performance

Many Tests Can Incorporate Human Testing

- Operational Test
- Development Test
- System Test and Evaluation
- Days-in-the-Life Testing
- Operational Suitability and Effectiveness Test and Evaluation
- Early on Orbit Testing

Meeting the Mission: Testing specific to the human contribution can be synergistic with other T&E.

Common System-Level HSI Issues/Problems

- Incomplete/Ignored Requirements
 - Specified vs. required skill levels incompatible
 - Human performance criteria - rarely specified
 - Requirements ignored/Contractor expects to receive waiver
- Standards inappropriate or not properly specified
 - Out of date or not specified
 - Applied inappropriately to commercial, COTS products
 - Standards referenced as guides not requirements
- HSI and the design process
 - Lack of rapid prototyping and iterative design
 - Lack of user review and input throughout the design and development process
 - Minimal workload/usability test and assessment
- Lack of qualified HSI oversight throughout the system design process
 - Contractor often does not have qualified HSI personnel
- Training
 - No Instructional Systems Development process used
 - Lack of consideration for cross-training or follow-on training
 - Training development deferred

Common Design-Level HSI Issues/Problems

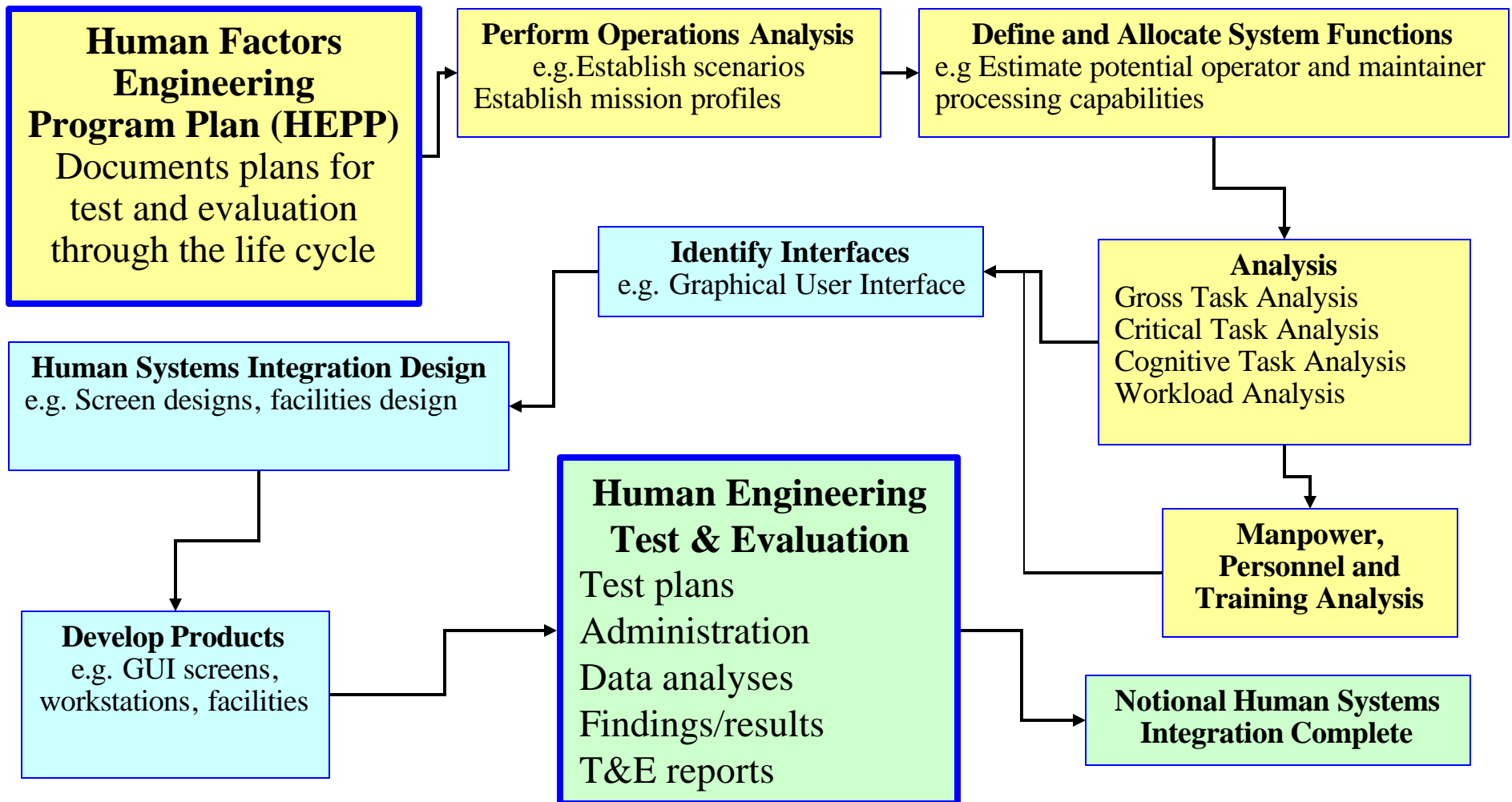
- No indication to operator of system status
- Incorrect use of color
- Critical commands sent after only one action
- Use of cryptic commands/mnemonics
- Ergonomic (workspace design) problems
- Systems testing of displays incomplete
- Racked equipment too heavy/ no handles
- Display formats inconsistent

The Basic Approach to Prevent These Problems

- This inherently requires a multi-disciplinary approach
 - Operators/Maintainers: Knowledge of the mission and operational environment
 - HW & SW Engineers: Understand capabilities and limitations of the technology
 - Human Factors Specialists: Understand capabilities and limitations of people
- Include humans as an integral part of the system.
 - Many programs treat humans as if they are external to the system (HW & SW are deliverable products) This can lead to ...
 - Less than optimum allocation of functions between humans and automation/system
 - Poorly designed user interface (SW, HW, Procedures)

The Practice of HSI Includes T&E

*Described in the Human Engineering Program Plan (HEPP)
Required by the Request for Proposal*



Purpose of Human Performance Testing

- Purpose of human performance testing is to assess the operational effectiveness and suitability of the products to meet system requirements.
- Human Factors in system testing provides evidence of the degree to which the system can be operated and maintained by the members of the target population in its intended operational environment.
- Human performance has a direct impact on things we care about
 - Accuracy and timeliness of decisions
 - Safety and mishap prevention
 - Both life cycle and acquisition cost (expensive and time consuming-to-fix mistakes)
 - Quality of the execution of the mission

Human Factors Testing in a Nutshell

- **Objective:** To ensure that human factors testing gets an early start and is a continuous process through the life cycle
- **Coordinate** human factors test planning early in the acquisition program.
- **Measure** human performance during testing in terms of time, accuracy, and operational performance.
 - Conduct front-end analysis
 - Develop human factors testing requirements
 - Include assessment of both nominal and off-nominal scenarios
 - Use validated techniques appropriate for the application
- Leverage human factors **data collection** by integrating efforts with other system performance data collection efforts
- Make **recommendations** for human factors design and implementation changes and human performance improvements

How Might We Start Applying HSI Tools and Methods to Space Systems

- For new systems, ensure the necessary requirements, specifications and standards, and data items are included in the acquisition from the beginning
 - Ensure there is a systematic way to include operational input into the design without overburdening the operational community.
 - Ensure that the requirement for testing and evaluation of the entire system includes the humans
- For existing systems, use existing, planned testing activities to collect human performance data prior to delivery of system.
 - Resolve as many problems prior to delivery.
 - Have a plan for how to address deficiencies not corrected prior to delivery.
- For existing systems, post-delivery
 - Use testing and evaluation to identify modifications and upgrades

Summary: HSI Across the Life Cycle

- NSS 03-01 requires program managers to have a comprehensive plan for Human Systems Integration.
- The developers need to incorporate the requirements of the users/operators/maintainers
- The user/operators/maintainers need to be able to get testing and evaluation performed to show the systems meets all requirements, including those for humans

GOAL: Systems that meet the needs, limitations and capabilities of the users, operators and maintainers

References

1. National Security Space Acquisition Policy 03-01, Guidance for DoD Space System Acquisition Process, December 2004
2. AFI 63-1203, Human Systems Integration (HSI), Attachment 5, July 2007 29
3. <http://www.af.mil/photos>
4. USAF Space and Missile Systems Center Policy Letter, Human Systems Integration, Feb 2006
5. U.S. Air Force Scientific Advisory Board. (2004). Report on Human Integration in Air Force Weapon Systems Development and Acquisition (SAN-TR-04-04). Washington, D.C.: Scientific Advisory Board