HUMAN FACTORS in HUMAN-SYSTEMS INTEGRATION

Human Research Program - Space Human Factors & Habitability
Space Human Factors Engineering Project
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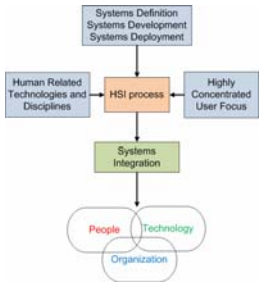
ABSTRACT

Any large organization whose mission is to design and develop systems for humans, evaluate systems for humans, and train humans needs a well-developed integration and process plan to deal with the challenges that arise from managing multiple subsystems. Human capabilities, skills, and needs must be considered early in the design and development process, and must be continuously considered throughout the development lifecycle. This integration of human needs within system design is typically formalized through a Human-Systems Integration (HSI) program. By having an HSI program, an institution or organization can reduce lifecycle costs and increase the efficiency, usability, and quality of its products because human needs have been considered from the beginning.

BENCHMARKING HSI PRACTICES

INTRODUCTION

Human-Systems Integration (HSI) emphasizes human considerations as the top priority in systems design to optimize the fully integrated system's (i.e., human and machine's) performance and often to reduce lifecycle costs. HSI at NASA is a multidisciplinary field of study composed of several user-related areas, including: Human Factors Engineering (HFE), System Safety, Health Hazards, Manpower & Personnel, Training, and Habitability.



RESEARCH METHODS

One purpose of the project is to benchmark DoD and other organizations' HSI practices. This is being accomplished by organizing meetings with DoD representatives who use MANPRINT (Manpower and Personnel Integration), SEAPRINT (Systems Engineering, Acquisition and Personnel Integration), and AIRPRINT (Airman Performance Integration), meeting with other organizations (e.g., industry), studying their processes, reviewing their documents, and meeting with contractors who implement these HSI requirements. The purpose of these activities is to learn how the requirements are implemented in the final products. Agency and Johnson Space Center (JSC) programmatic and Systems Engineering documented processes and practices will also be reviewed, and a gap analysis will be developed to identify where HSI should be a part of the process.

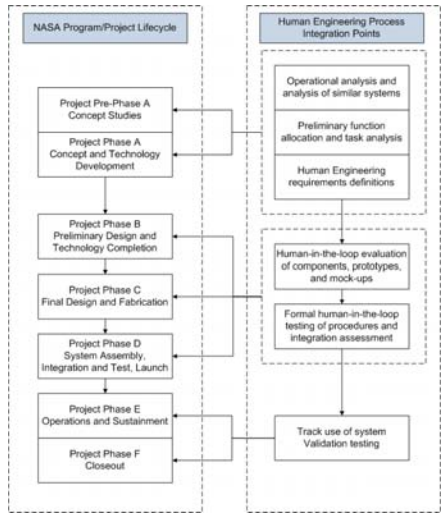
INTERVIEWS AND DISCUSSIONS

Interviews and discussions will be conducted with personnel involved in HSI practices in other organizations to learn about their processes. An interview questionnaire has been put together covering the different topics.

FUTURE RESEARCH DIRECTIONS

Directed research must specifically investigate lifecycle costing and identify the contributions that HSI can make in this arena for the Agency. For example, in the DoD, HSI was advocated on the basis of cost savings, not on the promise alone of producing superior user-interfaces. It is essential that DoD and NASA work together to develop metrics that can be used during development that provide indications of operational efficiencies and inefficiencies, preferably using lifecycle cost as one of the desired output metrics. Our research should pursue identification of a forward plan for integration of lifecycle costing into the Agency for the sake of demonstrating HSI's usefulness in this area.

The Human Factors Engineering processes have to be inserted into the NASA project lifecycle to ensure a Human Centered Design process. Below is a flowchart that illustrates possible insertion points:



HUMAN PERFORMANCE METRICS

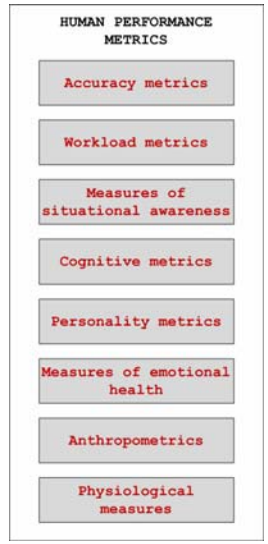
Human-in-the-loop evaluation

A human-in-the-loop evaluation is any evaluation that includes a human, whether in an active or passive capacity in the participant role. The active human-in -the -loop means that the human's actions are being evaluated in some capacity. The passive human-in-the-loop means that the human is providing passive data (waste, or other physiological outputs). The human as participant means that the human is providing the data in which case human performance can be captured. Using standardized metrics helps to use data collected across evaluations.

From an HSI point of view, for humans to be truly included as a "system", designers and evaluators must be able to quantify their performance. To attain this, human performance metrics have to be defined and also standardized within an organization so that data can be shared across systems.

Human performance metrics

Human factors metrics depend on context, phase, and cost. Performance measures can be used in formative or summative evaluations, and these are determined by the research goal. Human factors performance measures can be usage or predictive metrics and these define the method used.



Human performance measures database

A database is being developed that will contain all the metrics with recommendations for users. The purpose of the Human Performance Metrics database is to address the need for standard metrics to be collected whenever humans are included in testing. It is always advantageous to collect human performance measures no matter how small the number of participants per test. This data can become part of an archive of data which may be later combined with other archives to be correlated, and compared.