PANEL: NASA Human/Systems Integration (HSI)

Presentation: Human-Centered Design Capability

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Direct participation of HSI in the Design Process is the ideal...

- Participation goes beyond describing intent by Requirements alone
- Not all Design issues can be foreseen during Requirements Development
In Programs, direct Design participation during Development is difficult

- Design responsibility is typically relegated to the Prime Contractor

Development phase influence is typically via Requirements & Verification
During Project Formulation, however, a Human Centered Design approach can lead to better, more cost-effective products:

- Clarifies product/user intent before a Prime Contract is written
- Cost-effective because product/user goals are more likely to be met
Human Centered Design (HCD) is an approach that grounds product design and development in information about the capabilities and limitations of the product’s users

- For human spaceflight, “Users” includes the crew, but also sustaining engineers, ground maintenance personnel, and ground controllers
- For NASA, HCD seeks opportunities to mitigate the challenges of living and working in space in order to enhance human productivity and well-being
HCD can help a Program enter Development with a **CLEAR VISION** for product acquisition.

### Human Centered Design (HCD) Process

#### What is needed?

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#### Agency Reviews
- Human Space Flight Project Reviews
- Robotic Mission Project Reviews
- Launch Readiness Reviews
- Supporting Reviews

#### Key Points
- Human Centered Design can be a **cost-saving process**!
- Can lead to clearer definition of Development Contracts
Example HCD Tools for clarifying Design intent:

- Operations Concepts
- Operations Scenarios
- Task Analyses
- Functional Allocation – Human / Machine
- Functional Allocation – Manual / Automation
- Functional Allocation – Human-in-the-Loop / Autonomy
- User Population Assessment and Characterization
- Training Constraints, Allocation, and Bounding
- Workload Constraints, Allocation, and Bounding
- Concept Development
- Concept Prototyping
- Concept Evaluation – Visualization
- Concept Evaluation – Human-in-the-Loop Testing
- Concept Definition
To infuse Human Centered Design into the spaceflight life-cycle, SLSD developed the Habitability Design Center (HDC)

- **HDC Mission Statement**: “The mission of the HDC is to create and lead innovative, collaborative, human centered design for living and working on Earth and in space.”

HDC has collaborated successfully with Program/Project design teams and with JSC’s Engineering Directorate

- HDC has supported projects for ISS, Orion, Lunar Lander, Lunar Surface Systems, & others

**Experience**: Project Managers with a strong sense for the value of Design value HDC participation

- Particularly where iterative concept design & evaluation are planned in the Project Life-Cycle

**Iterative Design must** be coupled with user evaluation to proceed into the Development phase with objective data on Operational usability
HDC example activity:
  • International Space Station (ISS) Concept Design:

HDC architects designed a wardroom table for the ISS which integrated a restraint system, vacuum system, and promoted crew teaming by bringing the crew to a central location for communication.
HDC example activity: (cont’d)

• ISS Concept Design:

Temporary Early Sleep Station (TESS)

HDC helped design the Temporary Early Sleep Station (TESS) for the ISS. From initial layout, folding concepts, and drawings to evaluation and testing, HDC was involved in all phases of product development.
HDC example capability:

• Graphic prototyping:

• Physical prototyping:
HDC example capability: (cont’d)

• User Evaluations:
HSI participation in Design helps...

...Improve acquisition life-cycle cost of deliverables
- Through clearer definition of acquisition deliverables, it’s more likely the right product will be delivered the first time
- Requires defining acquisition goals in terms of successful human/system performance

...Ensure mission goals and objectives are met
- Tools delivered to support mission goals are evaluated to maximize human/system performance

...Program Managers deliver better products that support Operations