PANEL: NASA Human/Systems Integration (HSI)

Presentation: Human-Centered <u>Design</u> Capability
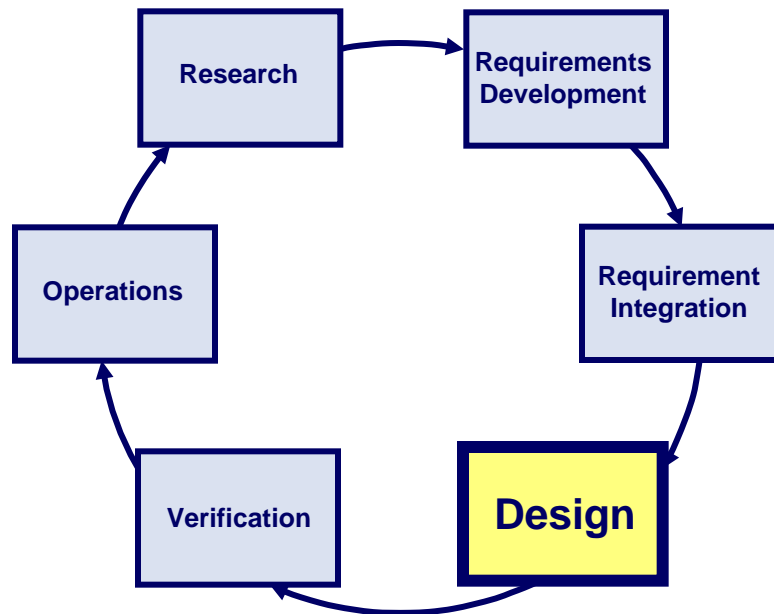
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Design

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

- Participation goes beyond describing intent by Requirements alone
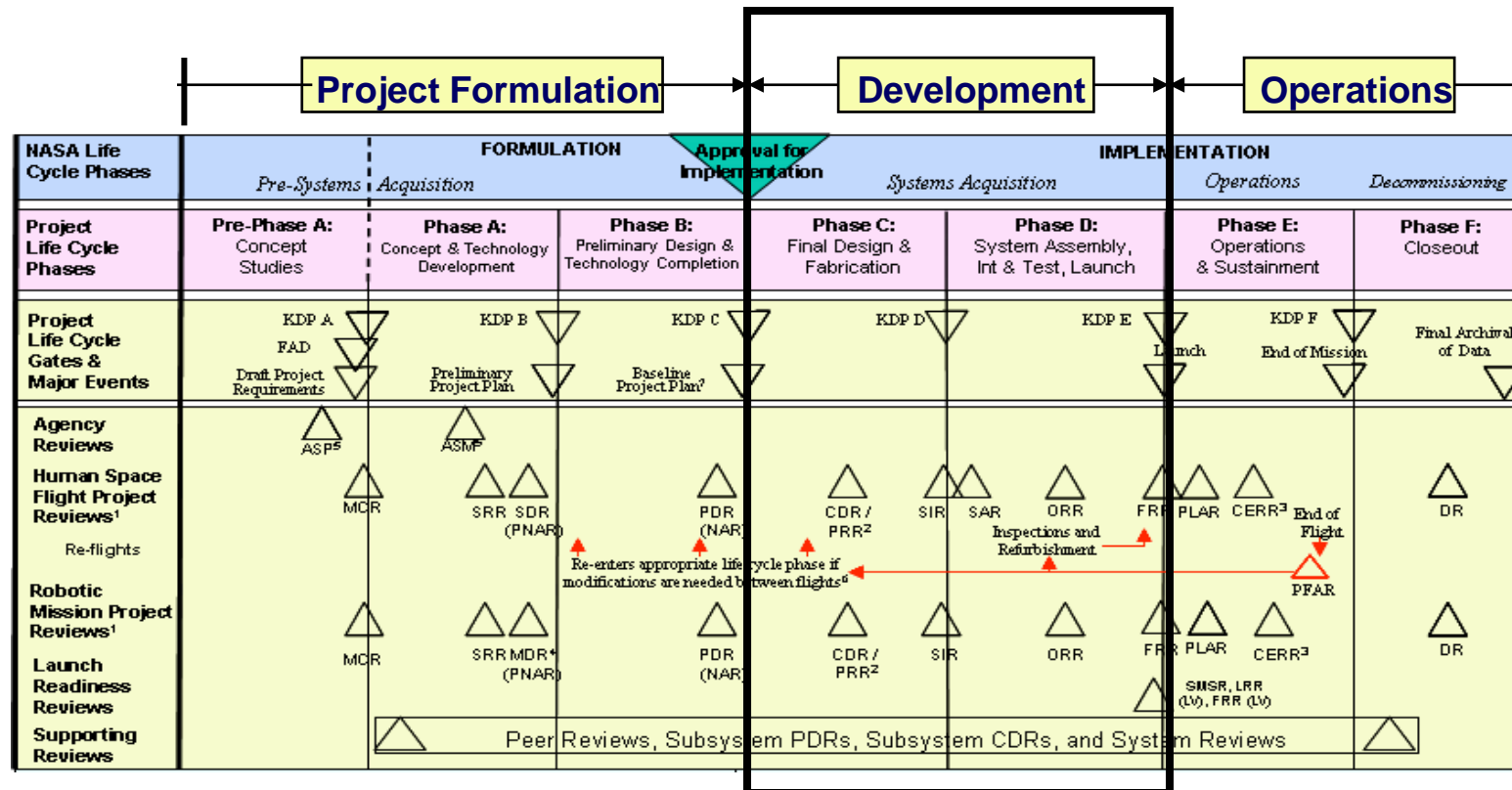- Not all Design issues can be foreseen during Requirements Development

Design and the Systems Engineering Life-Cycle

In Programs, direct Design participation during <u>Development</u> is difficult

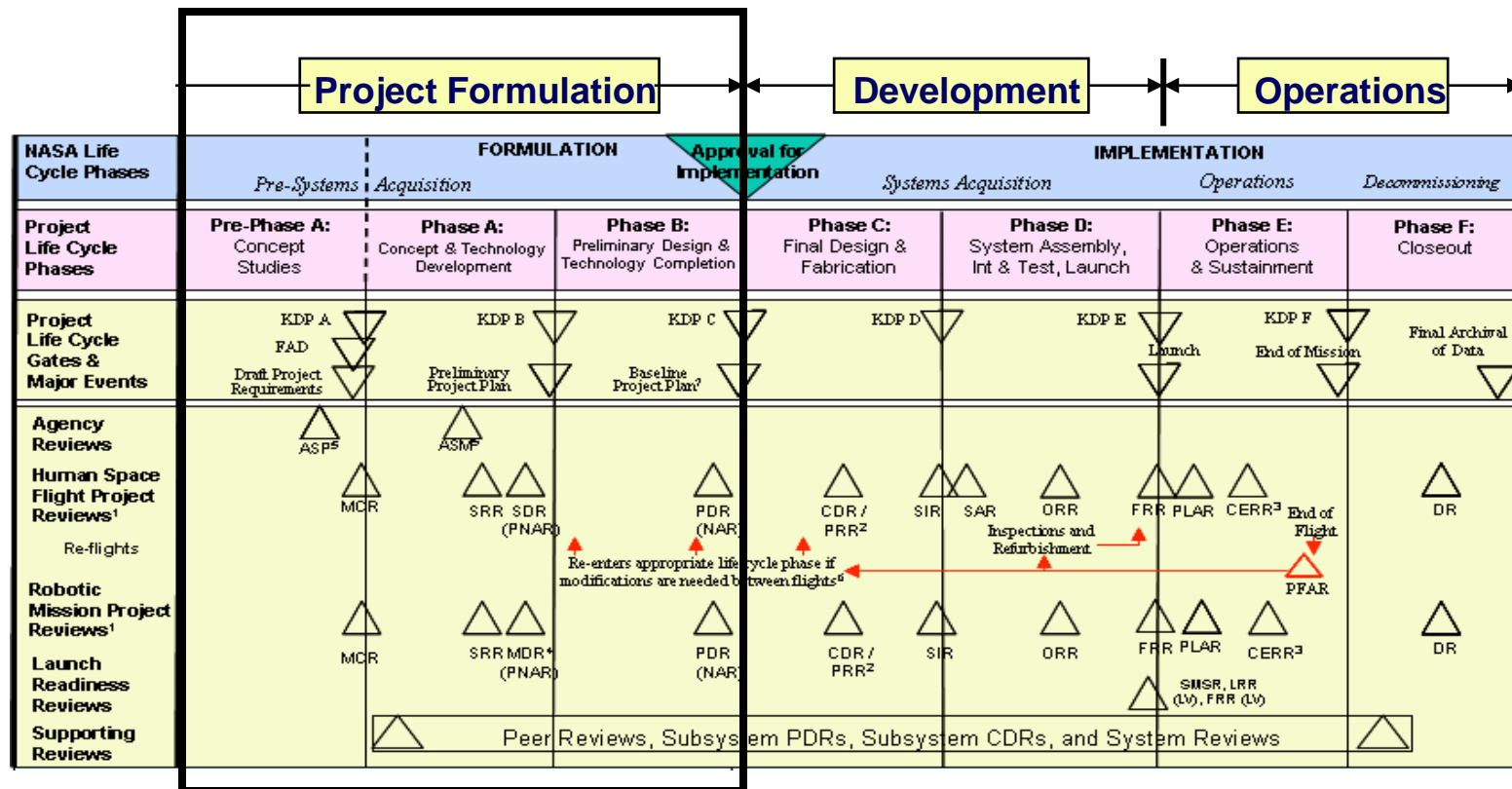- Design responsibility is typically relegated to the Prime Contractor

Development phase influence is typically via Requirements & Verification

Design and the Systems Engineering Life-Cycle

During <u>Project Formulation</u>, 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
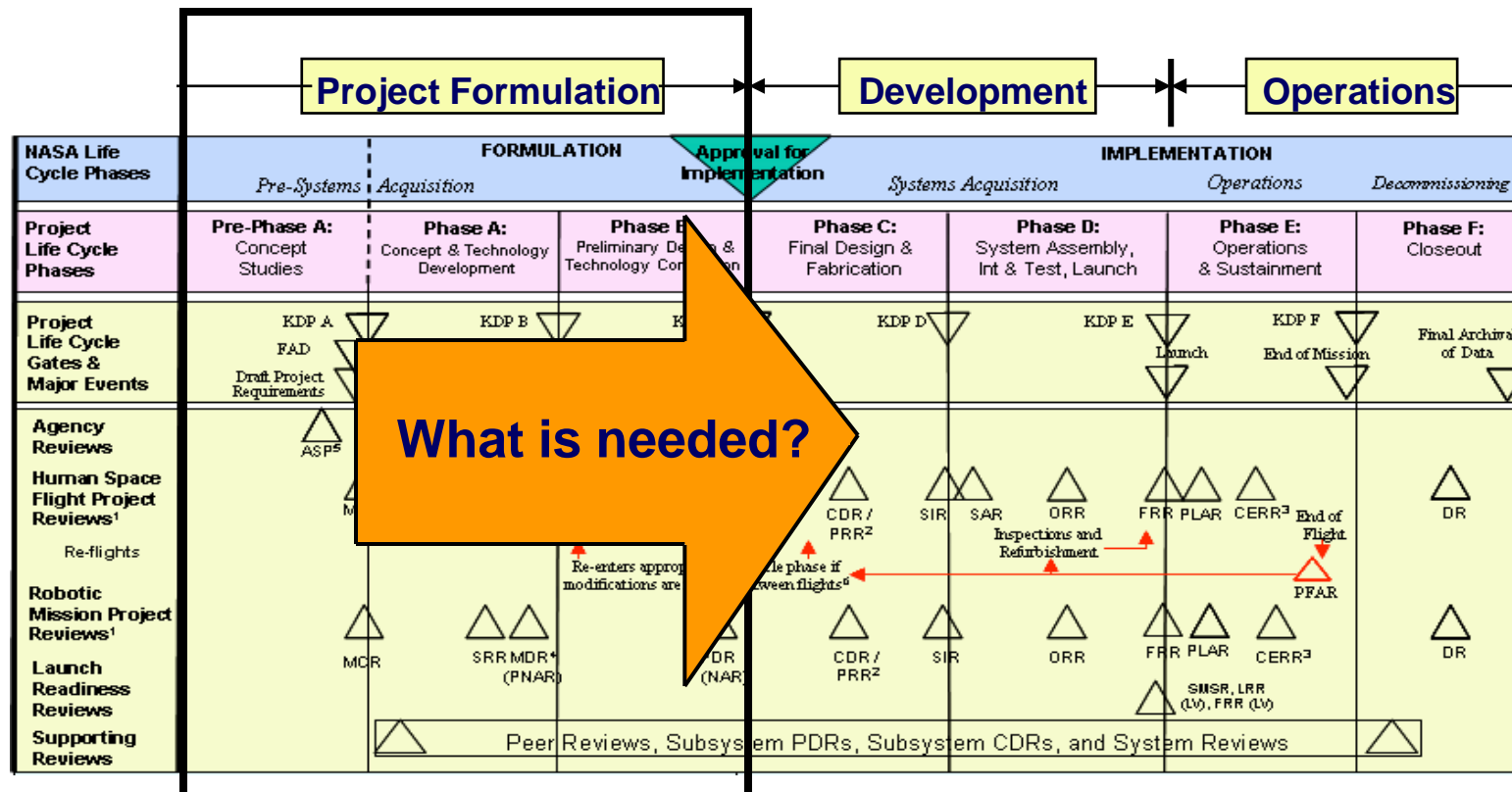
Human Centered Design (HCD) Definition

<u>**Human Centered Design**</u> **(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 Process

HCD can help a Program enter Development with a <u>CLEAR VISION</u> for product acquisition

Human Centered Design can be a <u>cost-saving</u> process!
- Can lead to clearer definition of Development Contracts

HCD Tools

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**

SLSD's Habitability Design Center (HDC)

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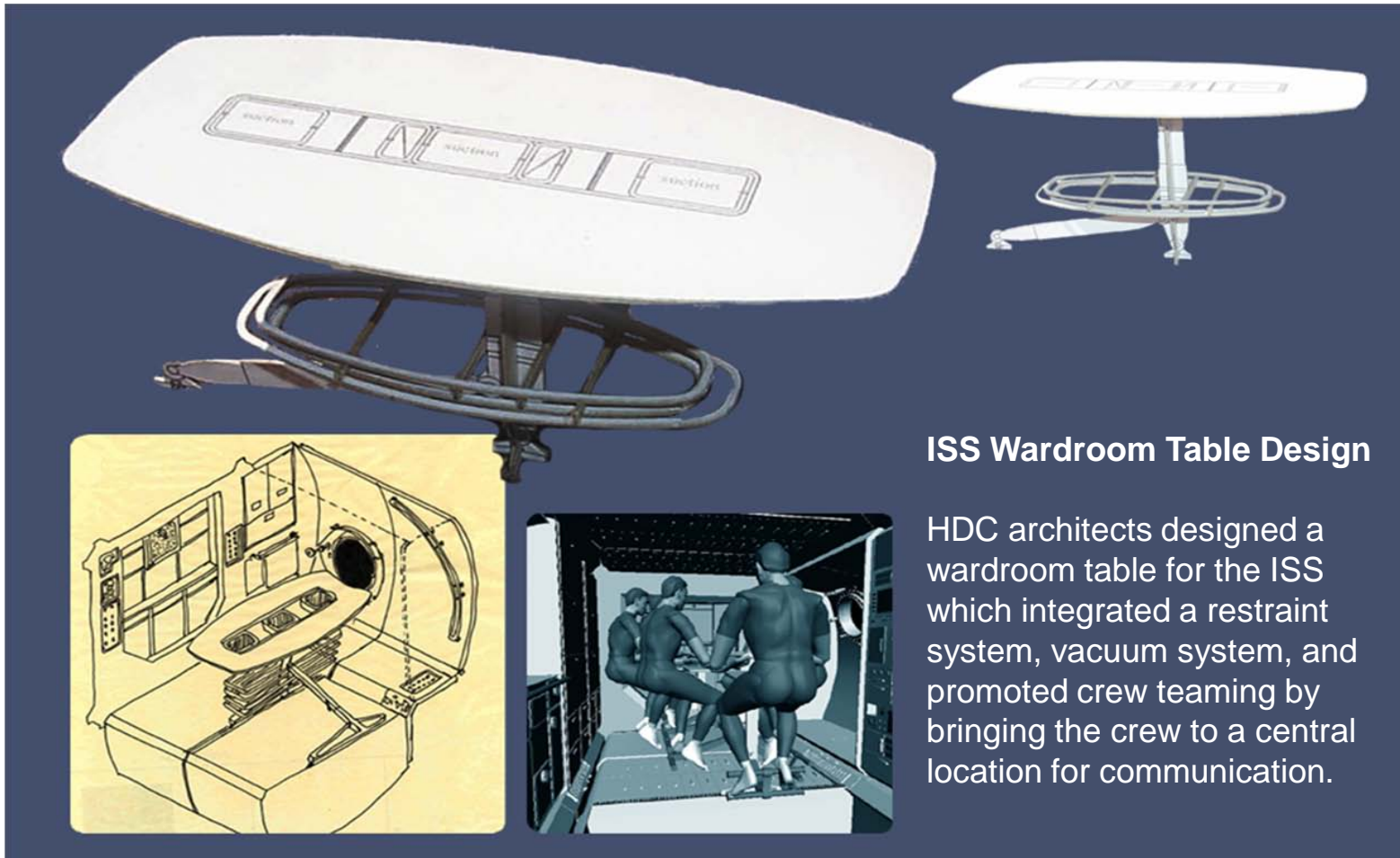
- Particularly where iterative concept design & evaluation are planned in the Project Life-Cycle

Iterative Design must be coupled with user evaluation to proceed into the Development phase with objective data on Operational usability

HDC Design Examples

HDC example activity:

- International Space Station (ISS) Concept Design:

ISS Wardroom Table 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:
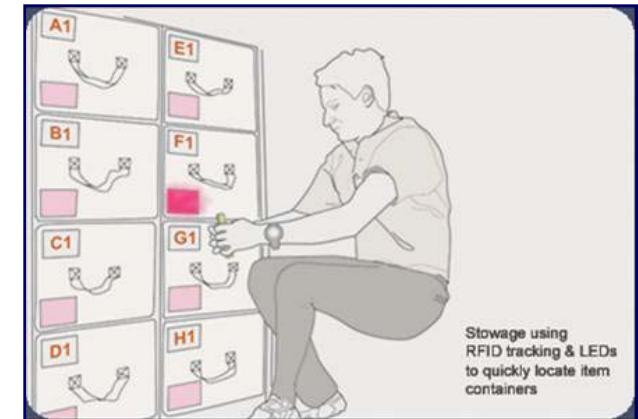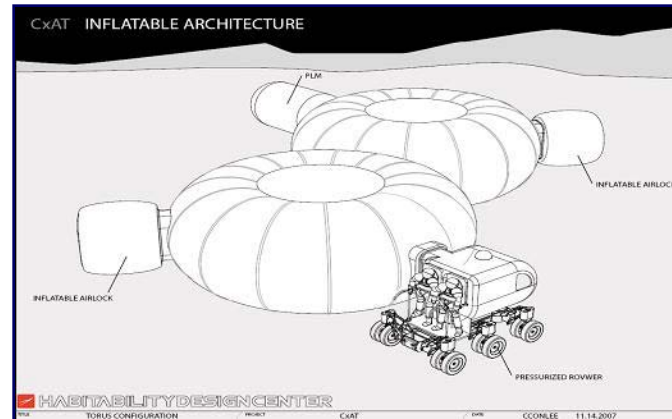

Temporary Early Sleep Station (TESS)

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.
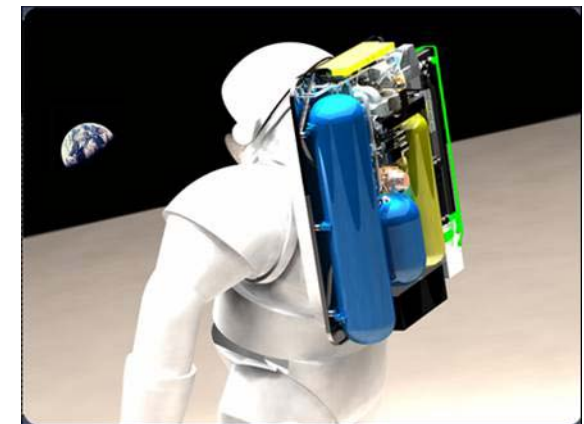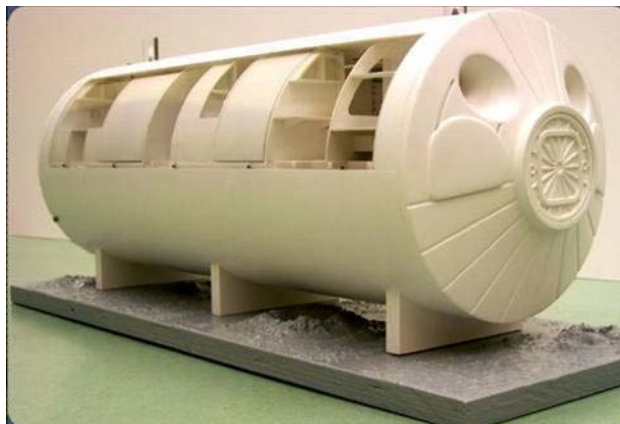
HDC Design Capabilities

HDC example capability:

- Graphic prototyping:

- Physical prototyping:

HDC example capability: (cont'd)

• User Evaluations:

Early Concept

Iteration

Prototype

CAD Study

User Evaluation

Review & Summation

HSI participation in <u>Design</u> 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 <u>Operations</u>**