To travel to the moon, establish a moon base and prepare for future mars missions NASA must produce reliable systems.

**Total system reliability** is more than just hardware and software performance. It includes human performance in space and on the ground.
Human Reliability

The **probability** that the human elements will function as intended over a specified period of time under specified environmental conditions
Why is Human Reliability Important?

Human errors are a significant contributor to system failures, and they have measurable safety and monetary consequences.

Human Errors contribute to loss of:
• Human life;
• One-of-a-kind hardware;
• Government equipment & facilities;
• Scientific knowledge; and
• Public confidence
Human Error Causes Mishaps

**NASA**

- **57% of Type A mishaps** caused by human error (1996-2005)
  - *Does not include auto accidents or death by natural causes*

- **78% of the Shuttle ground-support operations incidents resulted from human error** (Perry, 1993).

**Percentage of Type A Mishaps Occurring During Each Type of Activity 1996-2005**

- **Space** 41%
- **Ground Test** 27%
- **Flight Test** 12%
- **Earth Flight** 8%
- **Ground Maintenance** 8%
- **Ground Process** 4%

**Outside NASA**

- **75% of all US military aircraft losses involve sensory or cognitive errors** (Air Force Safety Center, 2003).

- **63% of approach & landing accidents involve inadequate monitoring and cross-checking** (Air Force Safety Center, 2003).

- **83% of 23,338 accidents involving boilers and pressure vessels were a direct result of human oversight or lack of knowledge** (National Board of Boiler and Pressure Vessel Inspectors, 2005).

- **41% of mishaps at petrochemical plants were caused by human error** (R.E. Butikofer, 1986).
Managing Human Reliability

Build “Error-Tolerant Systems” - systems that reduce the potential for errors and manage the effects of the errors that do occur.

- Mitigation limits the negative effects of error
- System provides feedback to detect errors and controls to correct errors
- System includes redundancy
- System design reduces the potential for error/rate of error
- System design prevents errors (incorporates barriers)

Design Characteristics That Address Error

Nominal rate of human error

Nominal system reliability

% of Perfect Performance

0%

100%

Poor Good Excellent

Order of Precedence
Sample of Human Reliability Activities

Human Reliability Assessment
- Human Reliability Methodology Study
- Human Reliability Database Development
- HF Process Failure Modes and Effects Analysis (HF PFMEA)
- Training and Software

Human Reliability in Design: Building Error Tolerant Systems
- Human Modeling Simulation – Launch Control
- Human Rating & Human System Integration Requirements
- MIDAS Tool Development (CAD Tool)
For More Information

Human Reliability Web Site

Faith Chandler
202-358-0411
Faith.T.Chandler@NASA.gov
Man-Machine Design Analysis System (MIDAS)
Components of a Human Performance Model

Psychological Models
Sensory Models
Anthropometric Models
Biodynamic Models
Team/Org Models
Vehicle Models
Equipment Models
Environment Models
Procedural Models

Model Architecture, Library, Tools

Timeline
Task Network
Performance: WL
Performance: Time
Performance: SA
Performance: Errors
Visualization
FoV/Reach Envelope