Government Best Practices in System Usability:
## A Brief History and Status

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Human Factors in Design of Safety Critical Systems

- Advanced technology and engineering leads to greater system capability and complexity

- Human limits are exceeded without consideration of how humans process information

- Systems with safety and mission criticality that rely on humans to execute tasks become the focus of the new "Human Factors and Ergonomics" discipline

THE CHAPANIS CHRONICLES

50 Years Of Human Factors Research, Education, and Design
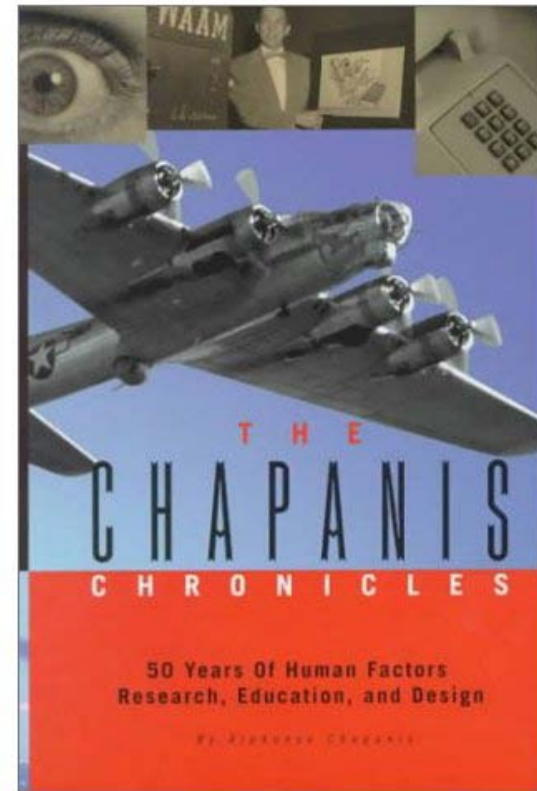
Safety Critical Systems Affected by Human Interface Design

- Advanced technology and engineering leads to greater system capability and complexity

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- Systems with safety and mission criticality that rely on humans to execute tasks become the focus of the new "Human Factors and Ergonomics" discipline founded in 1950s

Some Notable UI Related Incidents

- **NORAD:** Design of user interfaces with no human factors considered caused system failures and false alarm instances (1979)

- **TMI:** operators judged the level of water in the core by the level in the pressurizer, and since it was high, they assumed that the core was properly covered with coolant and no clear signal that the pilot-operated relief valve was open resulting in a series of actions that made conditions worse by simply reducing the flow of coolant through the core.

- **Flight 965, Cali, Columbia**: "The evidence suggests several explanations for this deficiency in the flightcrew's situational awareness and <u>inadequate use of automation</u>: Terrain information was not shown on the electronic horizontal situation indicator (EHSI) or graphically portrayed on the approach chart.

NIST Advanced Technology Program for Refinery User Interfaces

Petrochemical plant disasters traced to poor information design for operators including:

- Inadequate precision of chronological information

- Too many unnecessary alarms due to weak conditional alarming capabilities

- Inadequate system anticipation of disturbances; symptom-based alarms, rather than real-time, root-cause analysis

- Lack of distinction between instrument failures and true process deviations

- Limited capability to view interrelated process data
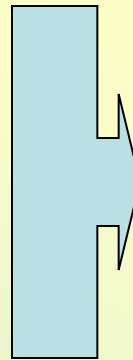
Abnormal Situation Management Consortium Led by Honeywell, Inc with oil companies:

- Has Reduced annual plant incidents by over one-third

- Focused on reorganizing operator information on control room displays

American Petroleum Institute (API)

- **API PUBL 770: Manager's Guide to Reducing Human Errors Improving Human Performance in the Process Industries**
  - Establish a basic vocabulary (Glossary) needed to discuss human factors engineering and HRA with experts in the field
  - Identify factors affecting human performance, especially those that managers can control
  - Suggest ways to reduce human errors
  - Describe how Human Reliability Analysis (HRA) can be incorporated in process safety management activities

Federal Aviation Administration Human Factors Certification

- **Source of Authority: FAA order 9550.08*:**
  - Human factors shall be systematically integrated into the planning and execution of the functions of all FAA elements and activities associated with system acquisitions and system operations. FAA endeavors shall emphasize human factors considerations to enhance system performance and capitalize upon the relative strengths of people and machines.
- **Scope of HF Program**
  - Ensure fulfillment of the applicable human performance and safety requirements
  - Demonstrate conformance of system, equipment, and facility design to human engineering design criteria
  - Confirm compliance with system performance and safety requirements where human performance is a system performance determinant;
  - Secure quantitative measures of system and safety performance which are a function of the human interaction with equipment
  - Determine whether undesirable design or procedural features have been introduced.

    *This material taken from FAA Systems Safety Handbook, Ch. 17, Human Factors Engineering

Federal Aviation Administration Human Factors Certification

QuickTime™ and a
decompressor
are needed to see this picture.

Nuclear Regulatory Commission (NRC)

- **Source of Authority:** NRC AP 1000
- **Safety related User Interface Issue Tracking System**
  - Addresses human factors issues that are known to the industry and/or identified throughout the life cycle of the human factors engineering/human system interface design, development, and evaluation.
  - Enables documentation and tracking of issues that need to be addressed
  - Accomplished within the framework of the overall plant design process. Thus, issues are addressed in the same way as those for other disciplines.
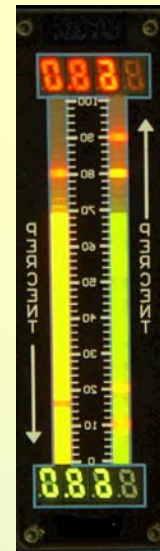
Nuclear Regulatory Commission (NRC)

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Department of Defense: Human System Integration/MANPRINT

- **MANPRINT, Manpower Personnel Integration**
  - Systematic consideration of human capabilities in system design for Army systems acquisition process
  - Addresses: (1) Manpower required, (2) Personnel aptitudes, (3) Training Requirements, (4) Application of Human Factors Engineering principles in design, (5) System Safety and prevention of human error, (6) Health Hazards, and (7) Soldier Survivability.
  - Requires formal deliverables from vendors showing iterative testing and evaluation of user interfaces at all stages of system development
  - **Success Story:** The Modernized Target Acquisition Sight / Pilot NightVision Sensor (MTADS / PNVS) underwent rigorous MANPRINT analysis(co-conducted by Army and vendor) and identified 73 user interface issues then addressed and resolved by the vendor

Department of Defense:
Navy Human System Integration (HSI)

- **Authority:** SECNAV 5000.2D requires Resource Sponsors and Program Managers (PMs) to initiate an Human Systems Integration (HSI) effort as early in the acquisition process as possible and address HSI throughout all phases of the acquisition process to optimize total system performance, minimize total ownership costs, and ensure that the system is built to accommodate the characteristics of the user population.

- **Areas of consideration** and deliverables same as MANPRINT

- **Success:** OSD report to Congress entitled, *Human Systems Integration Activity in DoD Weapons Systems Programs: Part III (March, 2008)*, the E2-D Hawkeye and MH-60R/S were identified as HSI success stories. OSD concluded that HSI practices saved the Navy over $2,000,000.00. By instituing HSI practices through usability Test/Evaluation, formal HSI assessments, and modeling and simulation techniques.