AEROSPACE
Assuring Space Mission Success

GSAW Workshop

Flight Software Effects on the Ground
Human Error & Automation

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What are we trying to accomplish?

Can these warfighters?

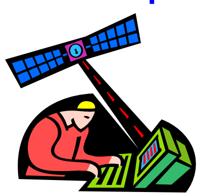
With this training?

Using this
equipment?

Under these conditions?

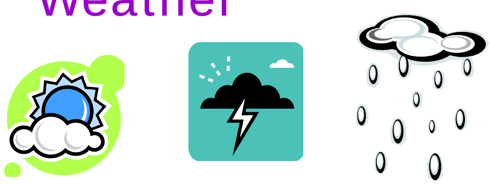
TIME PRESSURE

24/7 ops



STRESS

Weather



Accomplish
their mission?

Images courtesy of United States Air Force

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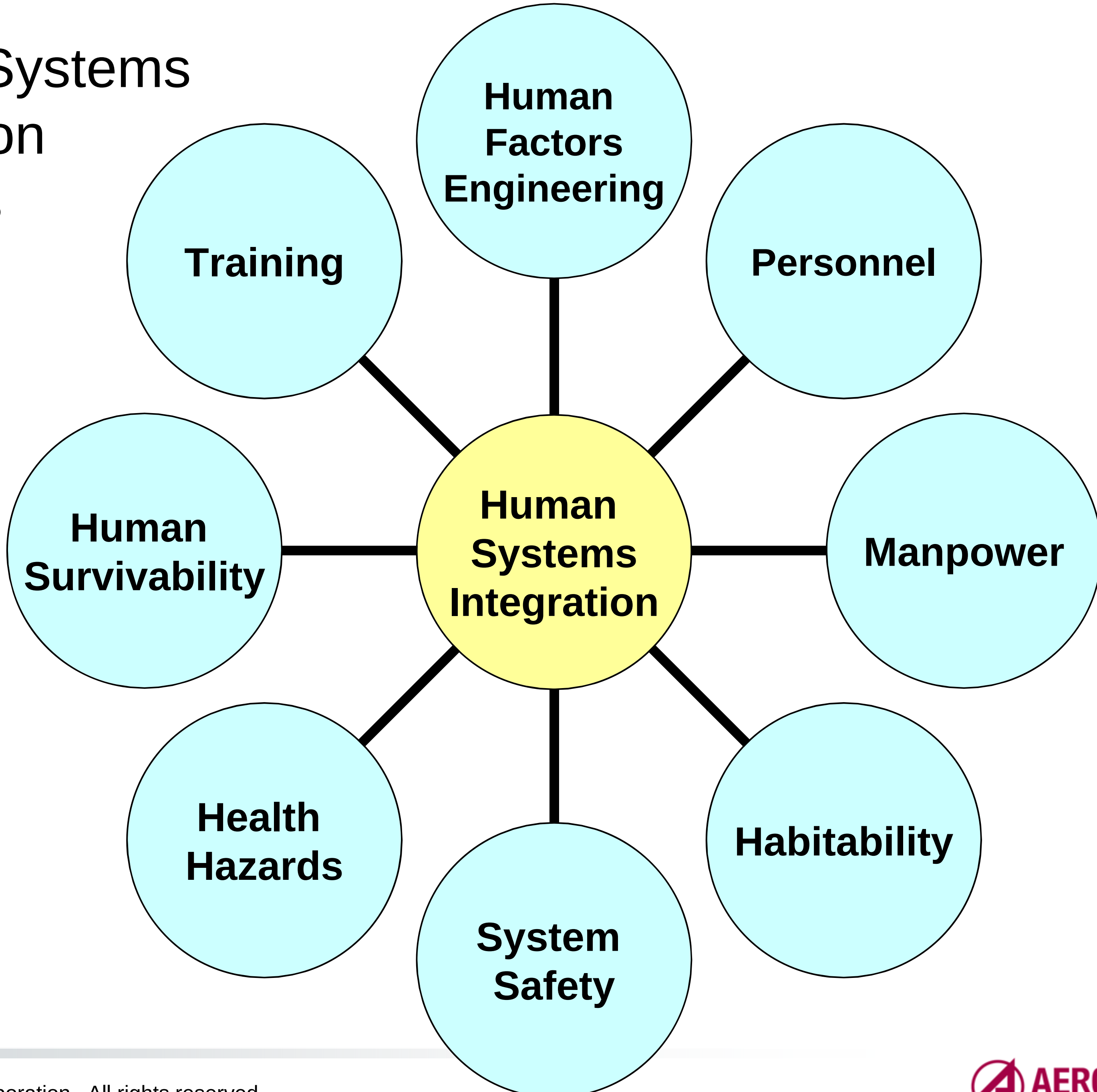
Human Systems Integration Domains



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How pervasive is human error?

- Human error is the primary cause of 60 to 90 percent of major accidents and incidents in complex systems…
  - *Many errors people commit in operating systems are the result of poor system design or poor organization structure*
  - *Usually the error was only one of a lengthy and complex chain of breakdowns*
  - *A lot of effort goes into producing procedures but it seems a lot of effort goes into ignoring them*
- An accident is an "error with sad consequences"
  - *Human performance "guts of every accident"*
  - *Human Error is a causal factor in 60-80% of aviation accidents*
  - *Human Factors deficiencies significantly contributed to Bhopal, Chernobyl and Three Mile Island accidents*

Historical View of Human Error

- Oftentimes when dealing with human error, we are tempted to ask –
  - *Why didn't they pay more attention?*
  - *How could they not have noticed?*
  - *Why didn’t they know how to do xx?*
- The proposed solution is to
  - *telling people to be more careful,*
  - *by punishing those that made the mistake,*
  - *or by adding new rules or procedures*
- This is sometimes considered the “Bad Apple Theory” (Dekker, 2006)
  - *if it just wasn’t for that person, the system would work just fine.*
- Perrow (1984) calls this “blaming the victim”

Assume the source of the failure is “human error” → Analyze the system or “event” to determine where a person is involved → Stop analysis when a person is found

Recent views of human error

- Looks at human error from a systems perspective including the human, organization and technology
- Examines the balance between safety and other goals (including production)
- Move from blame the victim to preclude-detect-mitigate
- Shift from error as a cause to error as a consequence

Procedures

- In many design situations procedures are considered the last line of defense between successful or unsuccessful completion of a task.
- Key attributes of procedures include, quality, relevance, accuracy, availability, usability
- A lot of effort goes into producing procedures but it seems a lot of effort goes into ignoring them
  - *A common theme in accidents and incidents in which casual factors are identified*
- Example: American 191 (DC-10 in 1979)
  - *Incorrect maintenance procedures*
    - Pylon and engine removed and refitted as one assembly
    - Failed during take-off a few weeks later
    - All 273 on board were killed
    - Latent failures such as design and certification also causal factors

Are the procedures even used?

- In a survey of procedure usage in a large petrochemical plant, the following was found
  - *80% of the safety-critical and quality-critical jobs were associated with procedure usage*
  - *Only 58% had the procedures open and in front of them while they were actually completing their jobs*
- Some of the reasons for not using the procedures include:
  - *If followed to the letter, the job wouldn't get done*
  - *People are not aware that the procedure exists*
  - *People prefer to rely on their own skills and experience*
  - *People assume that they know what is in the procedure (Reason, 2008, p.59)*
- Execution of written procedures depends primarily on two factors
  - *The accuracy of the information contained in the procedure*
  - *The usability of the procedure document.*

What drives the decision to automation?

Integration of users across system lifecycle represents 40-60% of life-cycle costs

* Increased demands on operators – new missions, CONOPS, tactics
* Increased volume and rate of information
* Reduced manpower projections - number and experience
* Changing human roles – control of multiple platforms, multi-mission tasking

Is Automation the Answer?

Automation and Human Operator Role

- The human operator's role in modern high-technology systems is, increasingly that of a systems monitor, systems manager and decision maker
- Automation is a double-edged sword, it has eliminated some sources of error but introduced new sources
  - *In some cases these new errors result in consequences that are more severe than those eliminated by the automation (Weiner and Nagel, 1988)*
  - *In some cases, automation has created the situation where small errors are tuned out, but opportunities for large errors are created*
  - *As Weiner states, "some glass cockpits have clumsily used automation that creates bottlenecks where pilots are least able to deal with them – during high workload periods" (Weiner 1988, Hughes and Dornheim, 1995, p. 52)*

Automation

Advantages:

- Eliminates human error and limitations
- Capitalize capabilities of human operator and machine

Disadvantages:

- Computer cannot make judgments
- Computer systems not always reliable to issue alert
- Alerts may be misinterpreted
- De-skill the operator
- Isolates operator from control process
- May lead to degraded failure-recovery

Automation in Complex Technological Systems

- Paradoxically automation can often increase the impact of human error
  - *automation merely shifts the location of human error from the 'operator' to the designer, the maintenance personnel, and the supervisor who must deal with automation problems and failures. (Reason, 1990)*
- Automation can help complex technological cope with human error, but it alone will not prevent human error occurrences
- Providing insight into the human error consequences resulting from a particular system design enables designers to choose between alternative designs that includes levels of automation

The goal is a system design that reduces the frequency of human errors,
reduces the severity of the consequences of human error,
and enables recovery from human errors (error-tolerant systems)

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