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
Human Systems Integration Domains

- Human Factors Engineering
- Personnel
- Manpower
- Habitability
- System Safety
- Health Hazards
- Human Survivability
- Training
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”
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?

<table>
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<tr>
<th>Integration of users across system lifecycle represents 40-60% of life-cycle costs</th>
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<tr>
<td>* Increased demands on operators – new missions, CONOPS, tactics</td>
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<tr>
<td>* Increased volume and rate of information</td>
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<td>* Reduced manpower projections - number and experience</td>
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<td>* Changing human roles – control of multiple platforms, multi-mission tasking</td>
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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
Automated 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)
References


[www.af.mil](http://www.af.mil)
References


References


Ernst Mach (1905), Erkenntnis und Irrtum (Knowledge and Error, English edition, 1976), Netherlands: Dordrecht, Reidel


References


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