



NTSB National Transportation Safety Board

Transportation Research Board Human Factors Workshop: Automation

Robert Sumwalt
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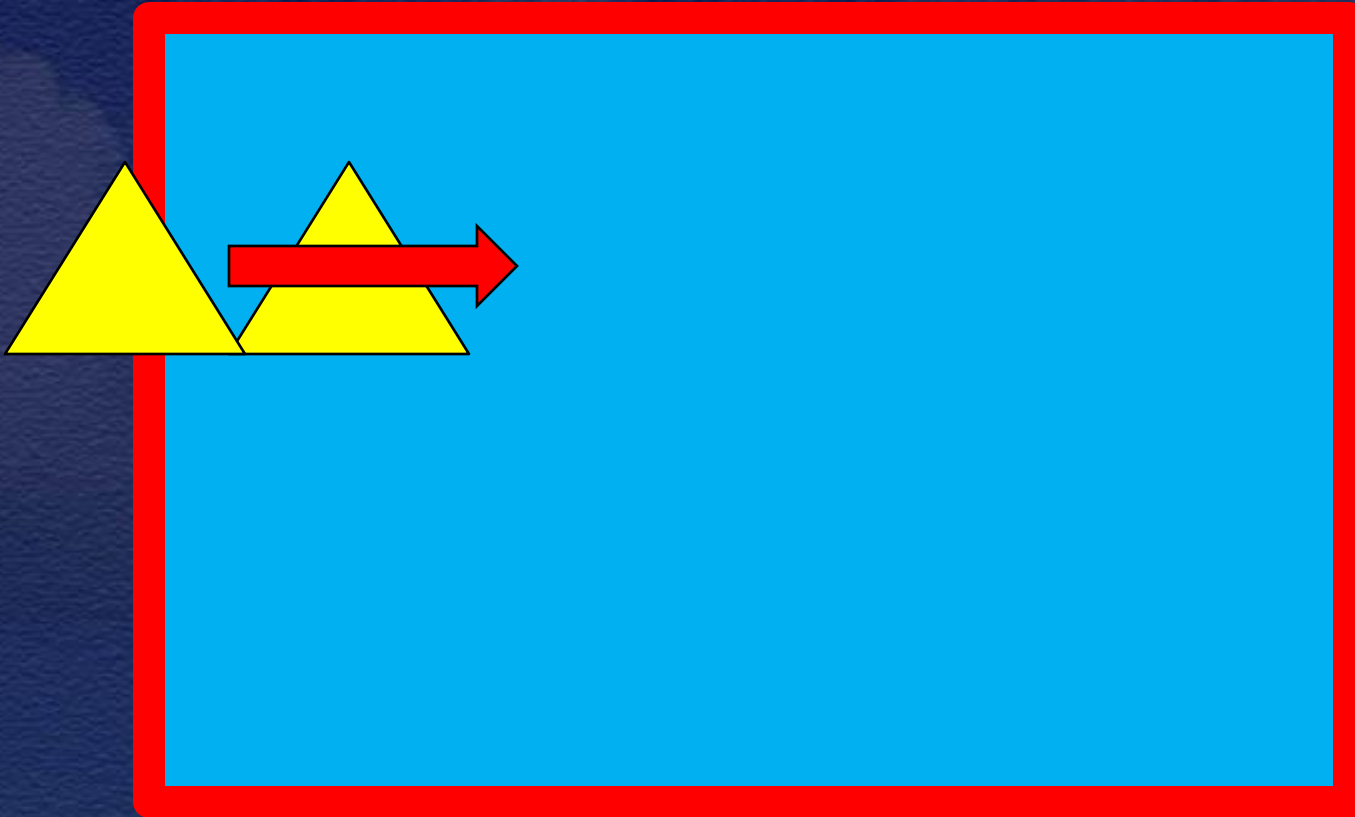
Principles of Human-Centered automation

- To command effectively, the human operator must be involved.
- To be involved, the human operator must be informed.
- The human operator must be able to monitor automated systems.
- Automation systems must be predictable.
- The automated system must also be able to monitor the human operator.
- Each of the elements of the system must have knowledge of the other's intent.

Source: Charles E. Billings

- Basically, the automation is there to support the human, and not the other way around.

Human-Centered Automation



If the operator attempts to operate outside of “the box,” the automation informs, cautions, or warns, the operator to return to within the box, or automatically takes over to place vehicle back within the box.

Human-Centered Automation

Advantages

- Allows/requires operator to remain actively engaged in control loop.
- System will intervene if operator attempts to take the vehicle “outside of the box.”

Disadvantages

- ??

Non Human-Centered Automation



- The human operator is removed from the control loop.
- The operator's involvement is limited to monitoring the system.
- He/she may be passively engaged, or not engaged at all.



Washington DC Subway (WMATA)



Dr. Tom Sheridan

- “The human is seen as an essential element in the system for monitoring the automation, to act as a supervisory controller over the [automation], and to be able to step in when the automation fails.”
- “But it has become evident that the human, when put in the role of monitor, supervisor, and automation backup in the case of failure, may not perform well.”
- Reference: “Human centered automation: oxymoron or common sense?”

Colgan Air flight 3407

- February 12, 2009
- 10:17 pm Eastern Standard Time
- Colgan Air, Inc.
 - Operated as Continental Connection
- Bombardier DHC-8-400
- On approach to Buffalo, New York
- 50 fatalities
 - 2 pilots
 - 2 flight attendants
 - 45 passengers
 - 1 home resident killed

History of flight

- Approximately 3 miles from outer marker:
 - power was reduced to slow for approach
 - gear extended
 - props to max RPM
- Airspeed decreased 50 kts in 21 seconds

Non Human-Centered Automation

Advantages

- ??

Disadvantages

- The human operator is removed from the control loop.
- The operator's involvement is limited to monitoring the system.
 - Humans aren't good monitors
- The operator be may be passively engaged, or not engaged at all.
- The operator may rely totally on the automation not monitor/control.
 - Primary/backup inversion

Positive Train Control



System Safety Order of Precedence

1. Design for Minimum Risk (engineering solution)
 - Hazard is corrected and eliminated
2. Control/Guard Solution
 - Guards put up to decrease exposure
3. Personnel Warning System
 - Warn personnel if you can't eliminate or control the hazard
4. Develop Procedures and Training

Ref: MIL-STD-882D, "DOD Standard Practice for System Safety"

Dr. David Woods

“One of the myths about the impact of automation on human performance is as investment in automation increases, less investment is needed in human expertise.

“In fact, many sources have shown increased automation creates new knowledge and skill requirements.”

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Crown Princess



Contributing to the cause of the accident:

- the captain's and staff captain's inappropriate inputs to the vessel's integrated navigation ...
- and the inadequate training of crewmembers in the use of integrated navigation systems.



Summary

- Automation needs to support the operator, not the other way around.
- Humans are not good monitors of highly automated, highly reliable systems.
- Human operators need to be actively engaged in the control loop.
 - No cats watching TV
- Don't forget the need for training