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EECE499 Computers and Nuclear Energy
Howard University
Dr. Charles Kim

Human Error and Risk

D'Angelo R. Woods | November 21, 2013

Human error is often defined as behavior that is inconsistent with normal, programmed patterns and that differs from prescribed procedures.

Titanic: The Unsinkable Ship that Sank

On April 15, 1912, the British passenger liner *Titanic*, struck an iceberg and eventually sank, killing at least 1,500 of its 2,278 passengers. The ship was said to have been “unsinkable” prior to its maiden voyage.

Design flaw or overconfident captain?

Concordian Discord

On January 13, 2012, the ocean liner known as *Costa Concordia* collided with a rock off the coast of Italy's Giglio Island. A 50m gash was torn into the ship's side which ultimately led to the death of 32 of its 4,200 passengers.

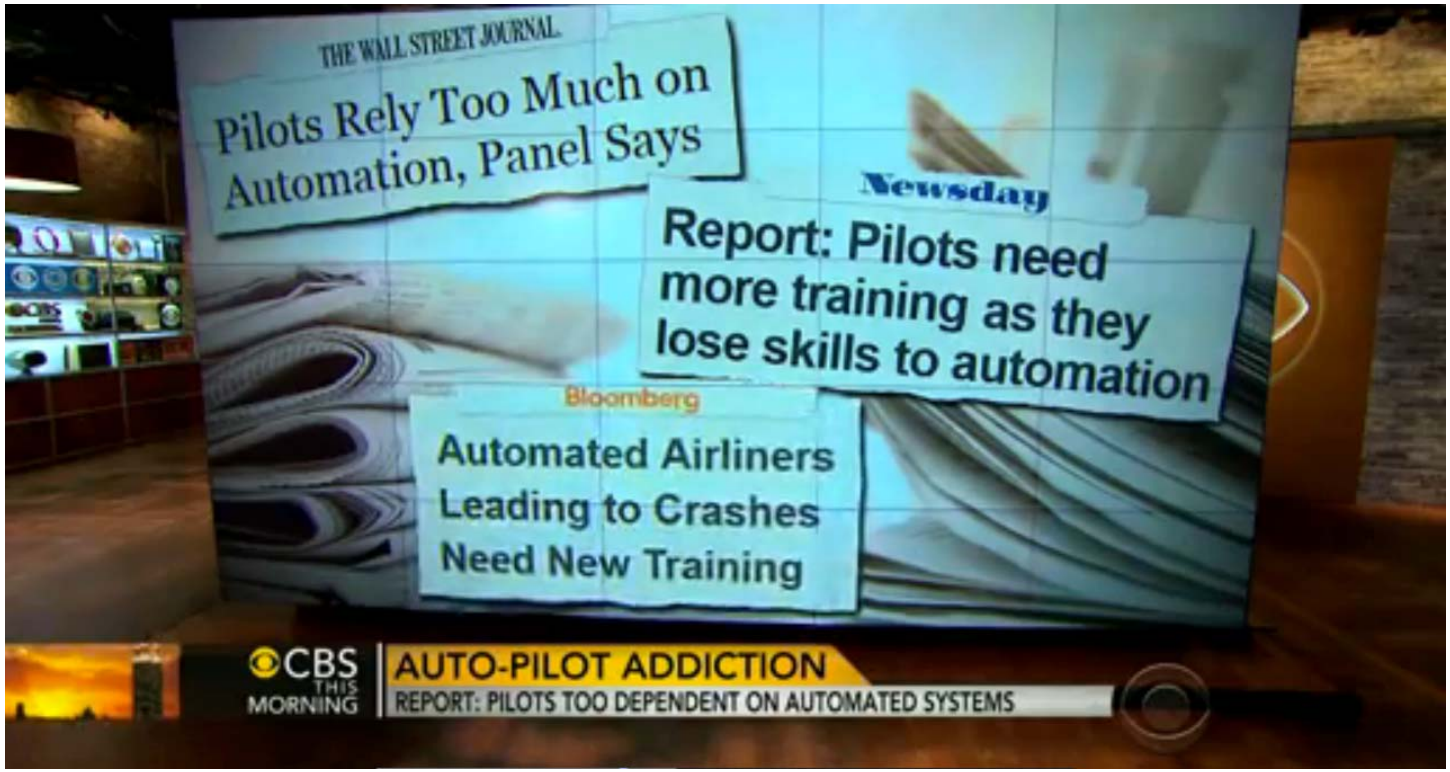
Hard-of-hearing helmsman or overconfident captain?

What We'll Cover

- Do Humans Cause Most Accidents?
- The Need for Humans in Automated Systems
- Human Error as Human-Task Mismatch
- Relationship Between Experimentation and Error
- A Final Word

Race Against the Machines

According to wired.com, 70 % of our current jobs will be replaced by robots by the end of the century.

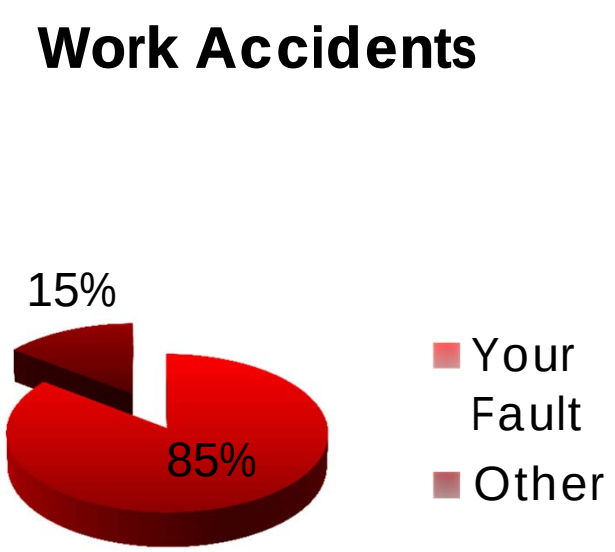


Do Humans Cause Most Accidents?

"Aerospace studies show that 80 percent of pilot-error accidents are due to poor training or neglect of human engineering in controls and instruments, not to stupidity or panic."

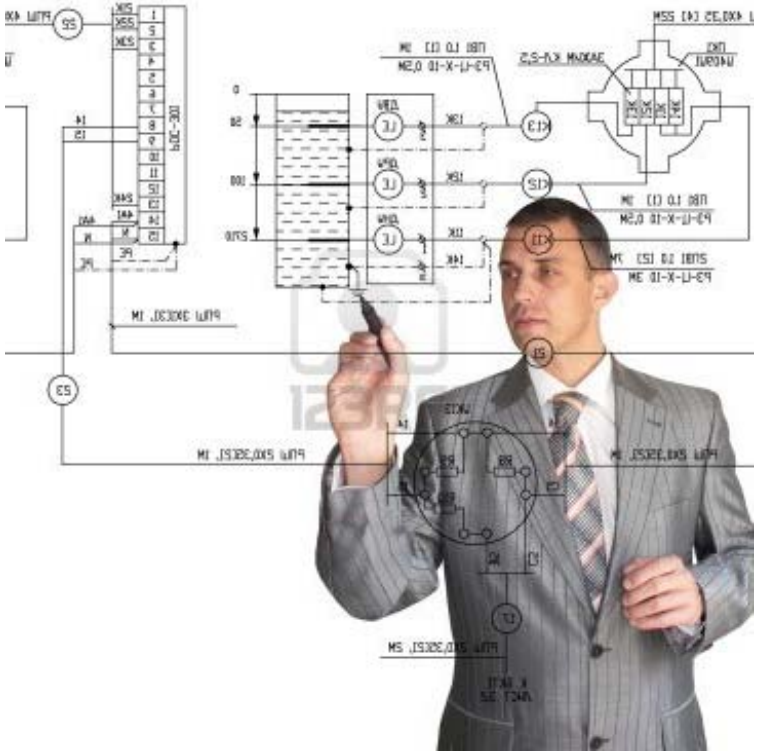
The Numbers

- 85% of work accidents are due to unsafe acts by humans rather than unsafe conditions
- 88% of all accidents are caused primarily by dangerous acts of individual workers
- 60-80% of accidents were the direct result of the operator's loss of control of energies in the system
- 75 % of the above 60-80% of accidents were due to system and production malfunctions that preceded operator actions

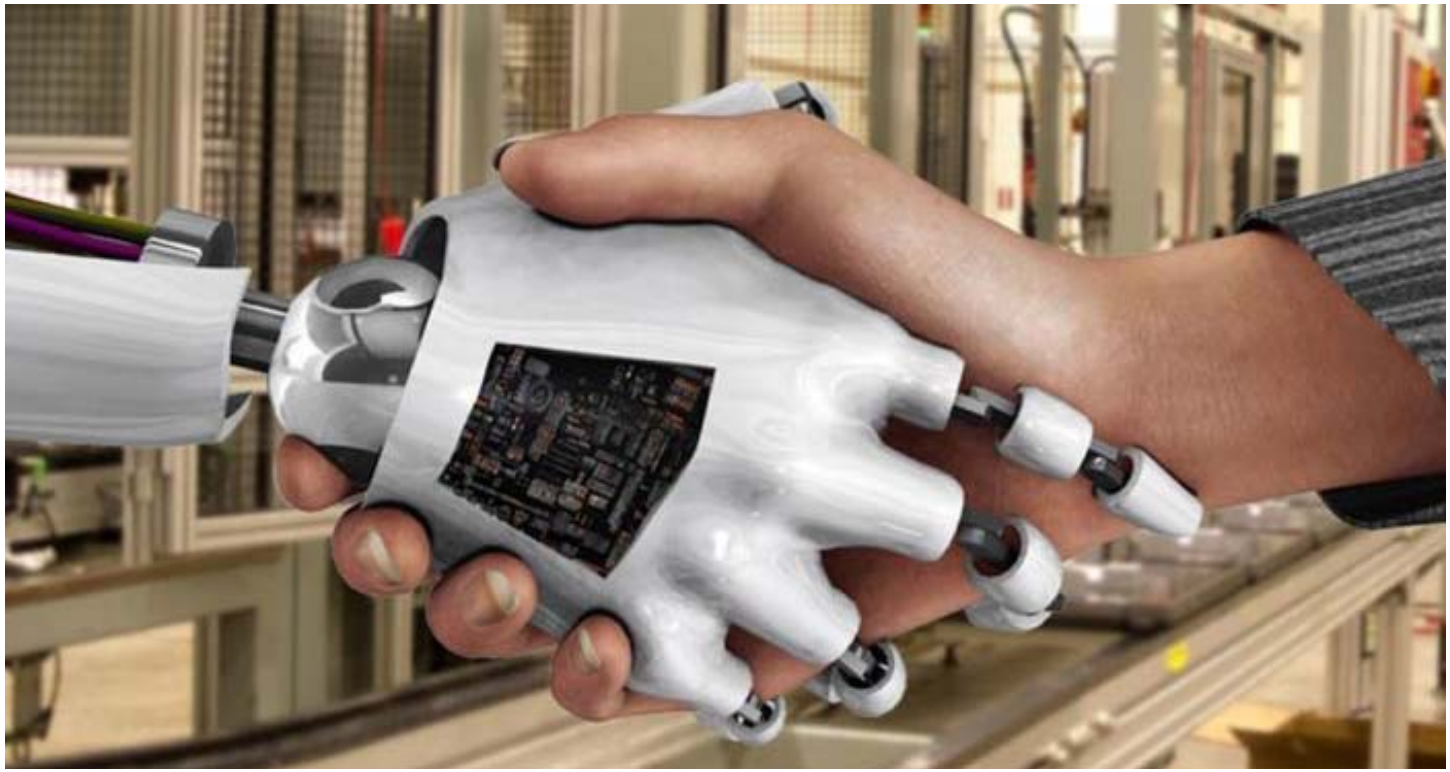


A Closer Look

- Data may be biased and incomplete
- Positive actions are usually not recorded
- Based on the premise that operators can overcome every emergency
- Operators often have to intervene at the limits
- Hindsight is always 20/20



Operator error or design flaw?



The Need for Humans in Automated Systems

"…they are able to use problem solving and creativity to cope with unusual and unforeseen circumstances."

Why We Need Us

- We are adaptable and flexible
- We develop skills and performance patterns to fit the peculiarities of a system
- We can exercise judgment
- We can operate outside the prescribed regulations, procedures, or algorithms to get the job done safely and effectively
- Note that deviating from the rules may often lead to human error

Human Error as Human-Task Mismatch

"The tasks in modern automated systems involve problem solving and decision making that in turn require adaptation, experimentation, and optimization of procedures."

~~Human Error~~ Human-Task Msmatch

- Researcher Jens Rasmussen suggests replacing the term “human error” with “human-task mismatch”
- Three tasks required in modern automation
  - Adaptation
  - Experimentation
  - Optimization
- He identifies three levels of cognitive control to explain the relationship between these three behaviors

Three Cognitive Levels of Performance

- Skill-Based Behavior
  - Unconscious performance of routine tasks
  - Sensory-motor inputs (signals)
  - Example: Concordia
- Rule-Based Behavior
  - Performance based on previous experience and/or signs
- Knowledge-Based Behavior
  - Performance is based on planning that is built upon an analysis of the environment and goal-setting
  - Experimentation

Relationship Between Experimentation and Error

"Early detection of problems depends on an ability to monitor the process using an understanding of the underlying processes."

Relationship Between Experimentation and Error

Designer

- Relies on knowledge-based behavior
- Supplied with experimental rigs, simulation packages, and computational aids

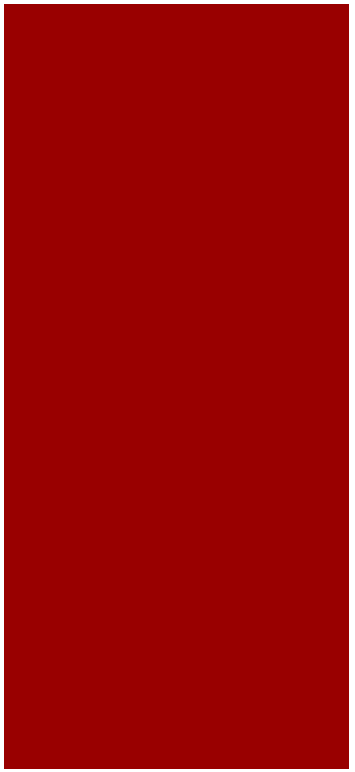
Operator

- Employs skill-based, rule-based, and knowledge-based behavior
- Supplied with their minds and the plant itself

As familiarity with work stations develops, control moves from knowledge- or rule-based behavior to skill-based behavior.

A Final Word

Removing dependence on an operator by installing an automatic device to take over the operator's functions only shifts that dependence onto the humans who design, install, test, and maintain the automatic equipment—who also make mistakes.



Thank You