Opportunities and Challenges of Automation

Christopher A. Hart, Member
Outline

– NTSB Basics
– Automation Benefits and Downsides
– Opportunities to Learn from Aviation
– Need for Graceful Exit
– Ethical Issues
NTSB 101

- Independent federal agency, investigate transportation mishaps, all modes
- Determine probable cause(s) and make recommendations to prevent recurrences
- Primary product: Safety recommendations
  - Favorable response > 80%
- SINGLE FOCUS IS SAFETY
- Independence
  - Political: Findings and recommendations based upon evidence rather than politics
  - Functional: No “dog in the fight”
The Theory

Automation can eliminate human error by removing the driver from the loop.
Potential Benefits

- Significantly reduce more than 37,000 deaths a year in the US alone, and more than 1M deaths per year worldwide
- Considerably fewer motor vehicles
- More effective use of infrastructure, e.g.,
  - Platooning
  - Less need for parking
- Major environmental benefits
- Less petroleum consumption
- Probably others, conceived and unconceived
Potential Downsides

- Today, with drivers
  - Human factors not adequately considered

- Tomorrow, no drivers
  - What if automation encounters unanticipated circumstances
  - What if automation fails
With Drivers: Human Factors Inadequately Considered

- Numerous examples in airline crashes

- Examples in cars
  - Expecting driver to remain engaged while using automation
  - Measuring driver engagement while using automation
  - Relying upon driver to read and follow owner’s manual
Example: Williston, FL, May 2016

- First fatal crash of a Tesla in automated mode
- Driver was using “Autopilot,” not paying attention
- Car submarined under left-turning tractor trailer, no skid marks
- Owner’s Manual warned to use Autopilot “only on highways and limited access roads.”
- Driver overreliance on Autopilot
- Tesla overreliance on driver reading and following Owner’s Manual
- Use of name “Autopilot” misleading?
Lesson Learned

- As long as drivers are still involved, automation must be “human-centric” by considering both the technology and the human element.

- Technology
  - Challenging, but predictable and usually reliable

- Human Element
  - Much more difficult due to variability, unpredictability, unreliability
Unanticipated Circumstances

- Recent airliner example (with pilots): Landing in the Hudson River

- Unanticipated circumstances will be abundant on our streets and highways

- Recent example: Collision in Las Vegas between autonomous bus and tractor-trailer
Las Vegas

- NTSB investigating
- Driverless shuttle on fixed route
- Shuttle stopped for tractor trailer backing up
- Tractor struck shuttle, minor damage, no injuries
- Media immediately blamed truck driver
  - NTSB investigation will determine cause, not blame
  - Conclusion re cause premature
  - Regardless of cause, driverless shuttle must be able to respond to environment that includes unanticipated circumstances such as human error (and worse)
Failure of Automation

− No recent example of crash caused by automation failure in airliner
  • Systems very reliable
  • Robust warning of failure so pilots can take over
  • Note need for pilots to “save the day”

− Recent non-aviation example (with operator): DC Metro train collision with stopped train near Fort Totten
  • No warning of automation failure to operator of striking train
Replacing Driver: Need for “Graceful Exit”

- If automation replaces the driver, what happens if the automation:
  - Fails, or
  - Encounters situations that were not anticipated by the designers
No Graceful Exit (Yet) for Airliners

Airliners will have pilots for the foreseeable future because designers have not yet developed a graceful exit for automation
- failing, or
- encountering unanticipated circumstances
Motor Vehicle Example

- Graceful exit re nonresponsive driver on limited access (interstate) highways?

- Extreme solutions, both with major downsides
  - Allow vehicle to continue until finding suitable off-road place to stop
  - Stop vehicle on the highway

- Possibility of less extreme solution?

- Without graceful exit, is idea ready for deployment?
Another Challenge: Ethical Issues

- Protect vehicle occupants or protect bystanders outside the vehicle?

- Select option re bystanders outside the vehicle that minimizes injury and damage?

- Who decides?
How to Decide When Automation is Ready?

- Perfection?
  - Unattainable
  - Makes perfect the enemy of the good
- Fewer fatalities than without automation?
- Some metric in between, perhaps evolving with experience?
Conclusion

Introducing automation
onto our streets and highways:
Significant potential benefit –
Save more than 37,000 lives per year in the U.S. alone!

but . . .

Much more challenging than many people think!
- Complete absence of human drivers unlikely in the near future
due to possibility of failure and unanticipated circumstances
Thank You

Questions?

Christopher A. Hart, Member
National Transportation Safety Board
490 L’Enfant Plaza, SW
Washington, DC  20594
202-314-6145
chris.hart@ntsb.gov