# Railroad Considerations for the Future Connected and Automated Vehicle Environment

Texas A&M Transportation Institute

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SAFE-D
SAFETY THROUGH DISRUPTION

# Presentation Overview

- Outline of Initial Safe-D Project Goals
- Look at Highway-Rail Grade Crossings/Known Safety Issues in Light of Automated and Connected Vehicle Development
- Review 2018 Rail Industry/Research Developments
- Examples of Problem Cases for C/AVs
- Impacts of Potential Rail Automation

# Railroad Considerations for Future C/AV Environment

Safe-D University Transportation Center

Planning for the future of Connected and Automated Vehicles has been highly focused from the vehicle/highway perspective. Need to better understand how rail systems will interface with C/AVs.

**Initial Project Goals:**

- Look at Highway-Rail Grade Crossing (HRGC) from the perspective of railroad operations.
- Identify information/sources of information that might be shared between highway and rail to improve HRGC safety.
- Identify impediments, barriers, and additional research needs in this area.

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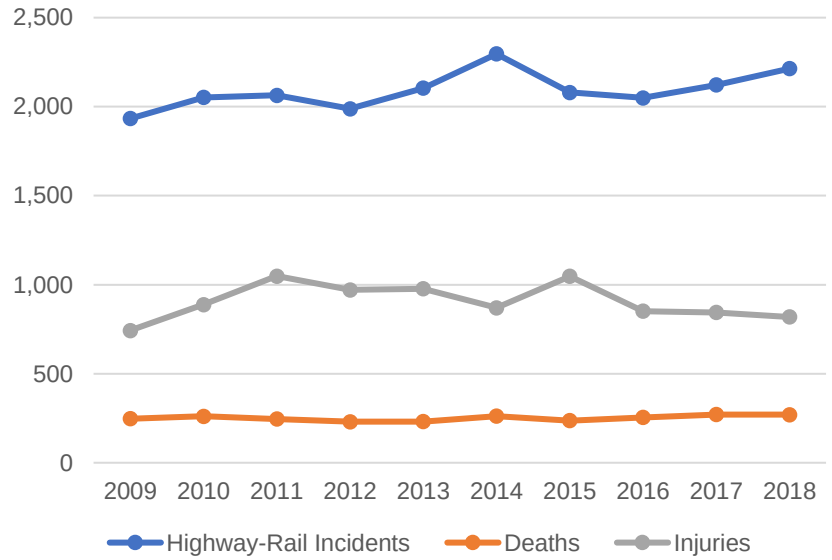
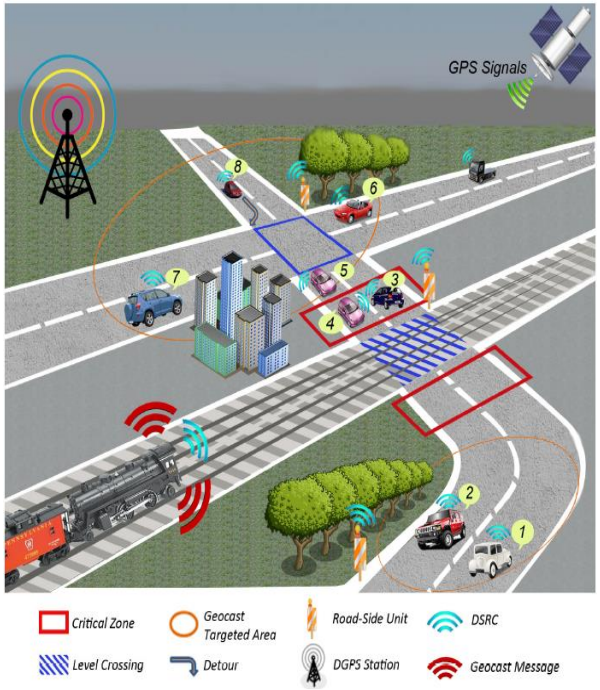
# Safety Challenges at Highway-Rail Grade Crossings




- The majority of issues relevant to highway-rail operations/infrastructure in the future C/AV environment are in highway-rail at-grade crossings
- 94% of train-vehicle collisions pertain to driver behavior or poor judgement
- More than 60% of collisions occur at active crossings (FRA)

# Common/Known Safety Factors/Scenarios at Highway-Rail Grade Crossings




*Source: Ansari, K. (April 2014)*
*https://core.ac.uk/download/pdf/33491241.pdf*

- Complicated Intersection Type(s)
- Train Visibility/Sight Distance
- Driver Error/Human Behavior
- Second Train Coming
- Congested HRGC/Traffic Storage
- Large Trucks/Longer Vehicles/Humped
- ? Potential for Rail Automation

**How are these known safety factors impacted by the introduction of C/AVs?**

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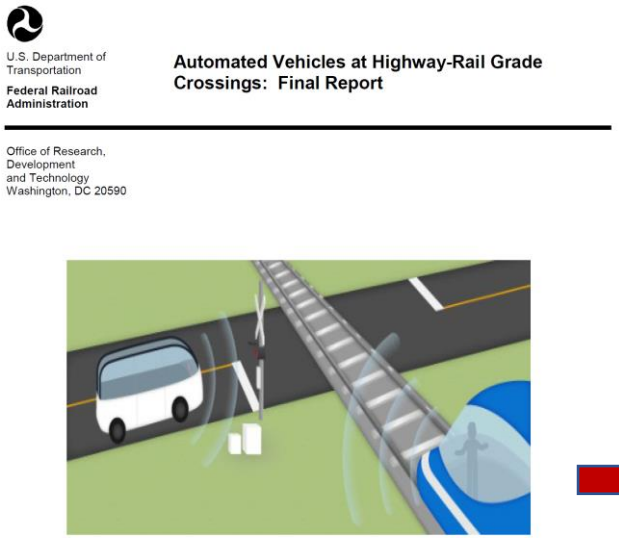
# Autonomous Trucks and Highway-Rail Grade Crossings

- Truck-involved collisions: 36%
- Single accident could cause huge losses in both life and property
- Trucks transporting hazardous materials
- Truck routing issues (incomplete GPS info)
- High gate violation rate (University of Nebraska)
- Short storage & High-profile/humped crossings

# Rail Industry/Research Developments Impacting this area during 2018


U.S. Department of Transportation
Federal Railroad Administration

Automated Vehicles at Highway-Rail Grade Crossings: Final Report

Office of Research, Development and Technology
Washington, DC 20590



- FRA Rail Automation Request for Information (RFI) & Replies (March-May 2018)
- USDOT AV 3.0 Release (October 2018)
- AAR Response to AV 3.0 Docket (December 2018)
- FRA/Battelle Report on AV at Highway-Rail Grade Crossings: Final Report (December 2018)
- Rail Positive Train Control (PTC) Implementation Deadline (December 2018)

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# SAE Levels of Vehicle Automation

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

Full Automation

| 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **No Automation** | **Driver Assistance** | **Partial Automation** | **Conditional Automation** | **High Automation** | **Full Automation** |
| Zero autonomy; the driver performs all driving tasks. | Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design. | Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times. | Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice. | The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle. | The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle. |

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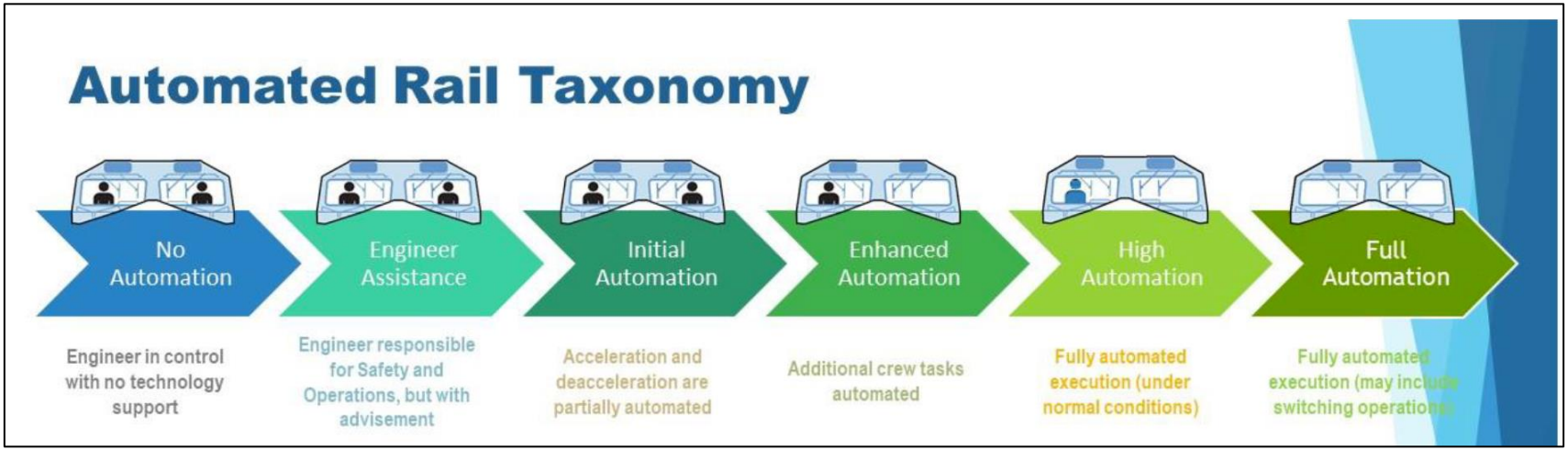
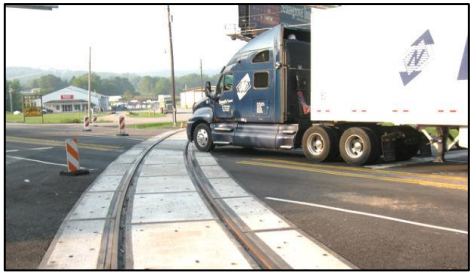
# AAR Proposed Rail LoA Taxonomy (May 2018)




May 2019: FRA rescinded two-person crew mandate for freight rail operations potentially opening the door for exploring the use of automation to reduce crew size in some operations

# Next Steps/Additional Needed Research

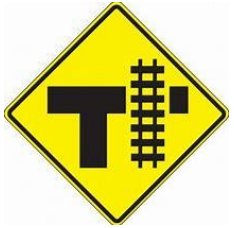
- Short Term
  - Better incorporate rail operations and HRGC safety into roadway C/AV planning
  - Monitor RR experience with PTC/potential for data sharing in the future
  - Seek methods for involving freight & passenger rail representatives into C/AV system architecture development
  - Evaluate safety of AV trucks/longer vehicles near HRGCs



- Longer Term
  - Examine HRGC scenarios in more complex configurations
  - Address need for more C/AV safety features for passive crossings
  - Review interoperability of rail and AV automation equipment as both systems mature
  - Explore impacts of potential reduced crew size on HRGC safety/ C/AV use
  - Conduct research into policy and legal issues associated with HRGCs and C/AVs
  - Conduct research on standardization of equipment associated with HRGCs and C/AVs

# Conclusions





- SafeD project was an initial scoping study- much more research needed
- FRA and Battelle/others are working on additional research/HRGC interface
- Sharing of PTC info is not supported at this time
- PTC information is not the “silver bullet” needed for train location information on a system-wide basis
- C/AV and rail automation are evolving technology areas and their interfaces need to be monitored and studied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