Measure Name: Identify and monitor hotspots

Definition: Review past grade crossing incidents, including close calls, to identify locations on the rail system where incidents are occurring at unexpectedly high rates.

Tags:

Type of Incident:

- ☐ Non-Motorized Users Only
- ☐ Motor Vehicles Only
- ☒ Both

Intervention Strategy:

- ☒ Data: application and planning
- ☐ Education: outreach and messaging
- ☐ Enforcement: policy development and rulemaking
- ☐ Engineering: technological and physical deterrents

Type of Problem:

- ☒ Non-Motorized Users Violating Warning Devices
- ☒ Motor Vehicles Violating Warning Devices
- ☒ Vehicle ROW Incursion
- ☒ Vehicle Congestion
- ☒ Blocked Crossing
- ☒ Vehicle Hang-up

Measure Category:

- ☒ Risk Assessment
- ☐ Policy and Enforcement
- ☐ Collaboration, Training, and Education
- ☐ Public Communication
- ☐ Physical Barriers
- ☐ Detection and Lighting
- ☐ Infrastructure Modification
- ☐ Post-Incident Management
- ☐ Warning Devices

Description

Hotspots are generally thought of as locations where incidents occur at a higher rate than expected. It is often beneficial to use mathematical modeling [1], geospatial data, and/or visualization software to help identify hotspots. These locations should then be monitored regularly, including before and after mitigations are implemented to see if the problem is reduced or moves to another location within the rail system.

Hotspot data is useful for prioritizing locations for allocating resources to support the implementation of countermeasures [2]. Research also shows value in identifying the common characteristics and risk factors of hotspots in preventing future incidents [3]. These characteristics can include many different types of information (but are not limited to):

- Location – Grade crossings near stations or businesses, presence of a shortcut, landscape, roadway configuration, etc.
- Community information – Distance from the hotspots to schools, shopping or other commercial area, elder care facilities, mental health facilities, or other areas with populations potentially at risk, etc.
- Timing – Time of day, season, etc.
- Rail and roadway system information – Passenger/freight train, train frequency, train speed, track length, number of crossings, active/passive warnings, number of stations, roadway traffic, roadway design, distance from traffic signals, etc.
- Information about the individuals involved – Age, intent (i.e., suicide, non-suicide), gender, distraction, intoxication, socioeconomic status, familiarity with the rail system, past suicide attempts, etc.
- Census information of location – Population density, unemployment rate, average income, etc.

Additional search terms: *analysis, copycat, data, risk*

Advantages

- Identifying and monitoring hotspots can be a low-cost effort.
- Commercial off-the-shelf software can assist in visualizing hotspots.
- Maximizes effective allocation of resources by focusing mitigation strategies on hotspot locations.
- Identifying common incident characteristics can help to mitigate future hotspots.
- National grade crossing data starting from 1975 is readily available from the FRA Highway/Rail Grade Crossing Incidents Dashboard (see Additional Resources). This can be useful for communities and others interested in identifying problem areas or implementing mitigations.

Drawbacks

- Some data are highly sensitive and not easily shared between stakeholders without collaboration.

Notable Practices

- When collecting data, include a variety of factors for incidents, close calls and violation activity in order to gain a more comprehensive understanding of hotspot characteristics. Examples include train frequency, train speed, roadway traffic and historical traffic flow patterns, proximity of the crossing to areas with heavy foot or vehicle traffic, etc. (e.g., 1).
- Consider including close-call data and violation activity when identifying future and developing hotspots, if available. This can provide important information about safety risks, allowing rail carriers to act before an incident occurs.
- Include a variety of data sources for analysis of hotspots in order to better understand the factors that contribute to grade crossing incidents, for example violation data reported by local law enforcement, locomotive crew observations, roadway driver observation, and video recording of specific locations.
- Continue to monitor hotspot data before and after the implementation of mitigations to assess the impacts and changes over the short and long term.

References:

[1] Stanchak, K. and daSilva, M. (2014). *Trespass Event Risk Factors*. Technical Report No. DOT/FRA/ORD-14/32. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

Abstract: The Volpe Center has used three sources of data—the Federal Railroad Administration's required accident reports, locomotive video, and U.S. Census data—to investigate common risk factors for railroad trespassing incidents, the leading cause of rail related deaths in the U.S. Risk factors found include (1) a disregard for grade crossing warning signs, (2) trespasser intoxication, (3) use of distracting electronic devices, and (4) right-of-way proximity to stations, bridges, and rail yards. This research report offers several suggestions for improved data availability to support future studies.

[2] Chaudhary, M., Hellman, A., and Ngamdung, T. (2011). *Railroad Right-of-Way Incident Analysis Research*. Technical Report No. DOT/FRA/ORD-11/09. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

Abstract: Locations of railroad right-of-way incidents in this research were identified as hotspots. These can be defined as highway-rail grade crossings or locations along the railroad right-of-way where collision or trespassing risk is unacceptably high and intervention is justified because the potential safety benefits exceed the cost of intervention. This project categorizes the hotspots as grade crossing and trespass incident hotspots. Mathematical models and theories are researched to see which ones may be used in identifying the hotspots. For the analysis of grade crossing incident hotspots, the Transport Canada model is modified to accommodate U.S. data and is applied to a sample of grade crossing incidents from 2003 to

2007 in the San Joaquin corridor in California. In analyzing trespass incident hotspots, the theory of cluster analysis, a type of spatial analysis, was researched. It appears that cluster analysis, used in conjunction with a geographic information system platform, would be a beneficial way of analyzing and predicting trespass hotspots.

[3] Chase, S. and Hiltunen, D. (2020). *Fatal Trespasser Strikes in the United States: 2012-2017*. Research Results, RR 20-01. Washington, DC: U.S. Department of Transportation, Federal Railroad Administration.

Abstract: The results of the analysis show that California, New York, Florida, and Texas consistently had the highest number of fatal trespasser strikes, regardless of intent. Fatal suicide strikes most often occur during the spring, while non-suicides occur most often in the summer. Suicides tend to take place during later evening hours (8:00 p.m. to 12:00 a.m.) on both weekdays and weekends, while non-suicides tend to occur during weekday evening commute hours (4:00 p.m. to 8:00 p.m.), and during early morning hours on weekends (12:00 a.m. to 4:00 a.m.). Individuals are most likely to be between age 15 and 34 for all fatal strikes. At the time of the strike, fatal suicides most often involve an individual lying down, while for non-suicides, individuals are most often walking/stepping. Suicides and non-suicide strikes both involve freight trains more often than passenger trains.

Additional Resources

FRA Office of Safety Data – Website

Description: FRA database that contain railroad safety information including accidents and incidents, inventory and highway-rail crossing data.

FRA Highway/Rail Grade Crossing Incident Dashboard – Website

Description: Presents interactive grade crossing incident data, including a map of incidents across the United States. This website allows users to view data in multiple forms, including location, crossing type, vehicle type, type of highway user, user action, and more.

Confidential Close Call Reporting System (C^3RS) – Website

Description: The Confidential Close Call Reporting System (C^3RS) is a partnership between the National Aeronautics and Space Administration (NASA), the Federal Railroad Administration (FRA), in conjunction with participating railroad carriers and labor organizations. The program is designed to improve railroad safety by collecting and analyzing reports which describe unsafe conditions and events in the railroad industry. Employees will be able to report safety issues or "close calls" voluntarily and confidentially.

Long Island Rail Road (LIRR). *Hazardous Assessment Approach to Trespass Management – High Security Fence.*

Description: Presentation describes an algorithm used for prioritizing the implementation of high security fencing.

Oswald Beiler, M. R., Miller, G., & Varley, D. (2018). Railway Trespass Prevention: Spatial Analysis of Incidents to Connect to Countermeasures. Journal of Transportation Engineering, Part A: Systems, 145(2), 04018086.

Abstract: Railway incidents continue to be a safety concern for transportation agencies throughout the United States. In particular, trespasser incidents, which are the most frequent cause of railway fatalities in

the United States, are those that involve a person whose presence is prohibited or actions are unlawful involving railway property. By analyzing past data on trespassing incidents, recommendations for future improvement through countermeasures can be made. This research investigates historical trespasser incidents throughout national Amtrak data from 2011–2017. The data were analyzed at the national as well as megaregional levels in order to determine trends using 14 factors, including both incident (such as time of day, precrash activity, and gender) as well as geographic (such as population density and average income based on the census level in which the incident occurred) factors. A case study on a segment of Amtrak's northeast corridor alignment is provided in order to serve as an example of connecting to countermeasure recommendations.

Related Measures

- Collaboration with local government and communities
- Improved data collection after an incident
- Rail corridor risk assessment
- Risk assessment using CCTV
- Safety patrols to deter grade crossing violations

Images

No image available