Root-Cause Analysis of Railway Crash in the USA

Charles Oyewumi[1,2], Dr. Elena Sidorova,[1] Dr. Md Rashad Islam P.E.[1,2], Dr. Saqib Gulzar[1]

[1]*Southern Colorado Institute of Transportation Technology,* [2]*Colorado State University Pueblo*

Introduction

- Understanding the root causes of railway crashes is crucial for several reasons:

  - Safety Enhancement: By identifying the underlying factors contributing to these accidents, targeted strategies can be developed to prevent future incidents, thereby safeguarding lives and property.

  - Policy Development: Insights from this analysis can lead to more effective safety regulations and standards.

  - Resource Allocation: Knowing the primary causes of accidents helps in prioritizing investments in infrastructure, technology, and training to address the most critical issues.

- Key objectives:
  - Identify trends and factors contributing to railway crashes.
  - Provide insights and recommendations for improving railway safety.
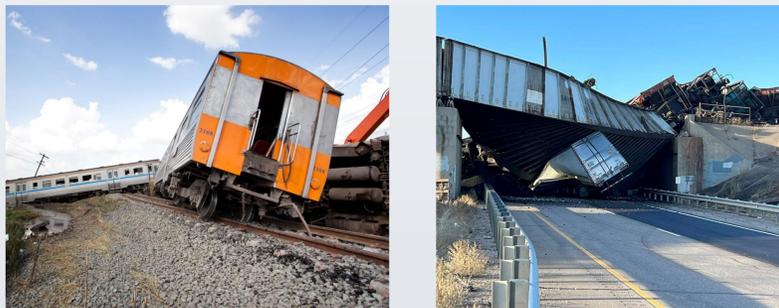
Background

- The safety that the railway system provides to its users can be defined with the aid of the two approaches: the first one based on risk level, the second one based on incident indicators.

- Indicators related to accidents include the distribution of accidents per accident category.

- During this work were considering following categories:

  - Human Factors: Operator errors, misjudgments.
  - Track Conditions: Poor track maintenance, defective infrastructure.
  - Mechanical Failures: Faulty vehicles or equipment.
  - Miscellaneous Causes: Weather, environmental factors, or other unspecified issues.

Methodology

- **Data Collection:** Railway Crash data from 2015–2023 (Federal Railroad Administration (FRA) databases, state reports, and accident record).

- **Two Approaches to Analysis:** State-Based Analysis, Comparing of crash trends.

- **Accident Cause-Based Analysis:** Analyze causes of accidents using four categories (Human Factors, Track Conditions, Mechanical Failures, Miscellaneous Causes).

- **Graphs and tables to show trends for each cause over time:** Frequency of crashes by cause and by state, comparative analysis between states for crash patterns and the leading causes of accidents.
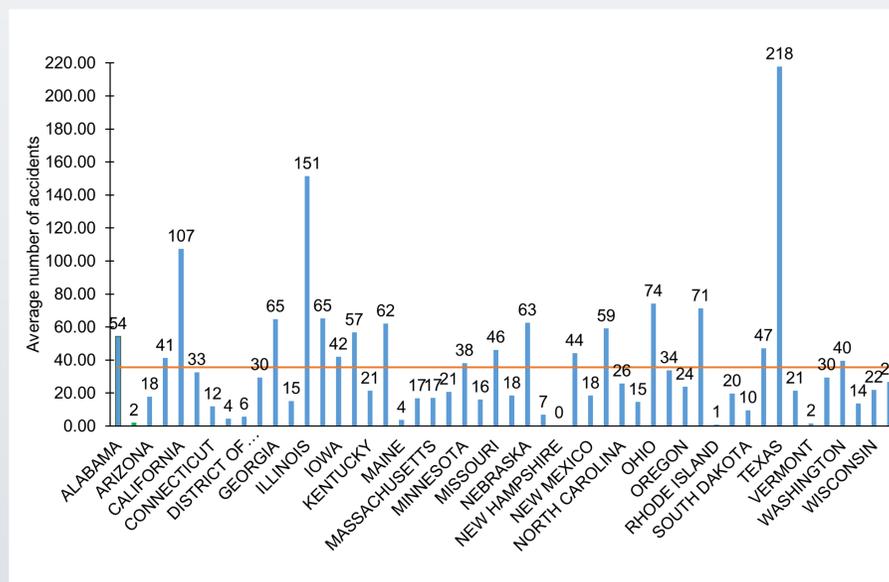
Analysis and Results

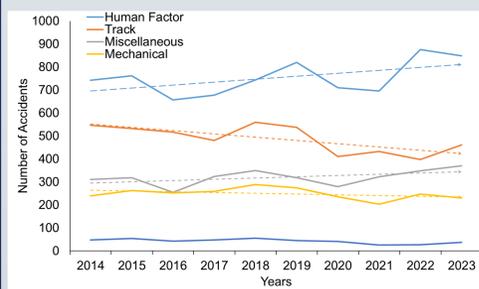*Figure 1. A chart of average railway crash by states*

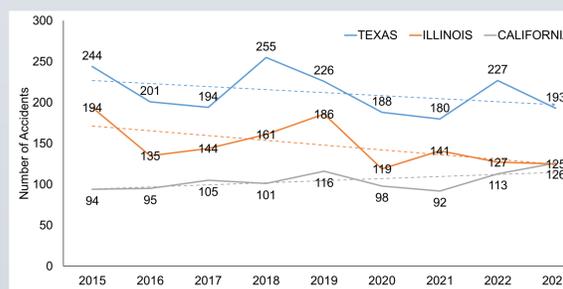*Figure 2. Accident cause summary*

Figure 3. Railway crash of Texas, Illinois and California

Discussion

- **Analysis by states:**

  California: Fewer crashes overall but showing a gradual increase, likely due to its diverse geography impacting track and mechanical issues.

  Texas: Highest number of crashes due to its extensive network and freight traffic. Human factors are the primary cause.

  Illinois: Showing improvement with a reduction in crashes, but human errors remain a key issue.

- **Analysis by causes of accidents:**

  Human Factors: The leading cause of accidents across all states, with a steady increase in recent years. Improved training and safety measures are needed.

  Track Conditions: Overall decline, but a slight increase in 2023 suggests continued investment in maintenance is essential.

  Mechanical Failures: Less frequent but still a concern, especially as equipment ages.

  Miscellaneous Causes: Rising trend in recent years, indicating the need to address new and emerging risks.

Conclusions

- California, Texas, and Illinois had 4x the average railway crash reflecting their respective challenges.

- Human factors remain the leading cause across all states, while track and mechanical issues show signs of improvement.

- Future research will be focused on detailing accident causes for every summary cluster, investigating the impact of human factors on railway safety, and comparing analysis of methods preventing railway accidents.

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