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Evaluation of Louisiana's Commercial Vehicle Operations (CVO) – Example of Performance Measurement of Transportation Systems

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ABSTRACT

This paper presents an analytical framework for evaluating safety goals for statewide commercial vehicle operations (CVO). The framework was used to evaluate the reduction in commercial vehicle crash rates on major freight routes between 2016-2020 within the state of Louisiana. Data from the Louisiana Crash Database were used. Though the annual frequency of crashes remained relatively constant, the ratio of commercial vehicles saw an increasing trend between 2016 and 2020. This assessment methodology helps to identify freight-related transportation improvement needs for any state and ensures targets and measures are based on data and objective information.

Keywords: Freight; Operations; Performance Measures; Commercial Vehicle Operations; Crash Rate; Data-Driven; Assessment

1. BACKGROUND

State departments of transportation typically emphasize the importance of safety and efficiency in commercial vehicle operations (CVO) by establishing a set of goals that are aimed at increasing freight mobility, facilitating freight and economic growth, and reducing commercial vehicle crash rates [1, 2]. For example, the state of Louisiana's Department of Transportation and Development (DOTD), has has iterated these goals through different reports and documents. However, there is dearth of tools that are useful in evaluating the effectiveness of these goals and objectives

1.1 Study Objective

This paper presents an analytical framework for evaluating safety goals for statewide commercial vehicle operations (CVO); and uses crash data from Louisiana to evaluate Louisiana's goal to reduce commercial vehicle crash rates on freight-significant highways.

The freight-significant highways in Louisiana are shown in **Figure 1** [1], with the mileage of the interstate highways shown in **Table 1** [3]. From **Figure 1**, I-10, I-12, and I-20 provide much of the east-west (EB/WB) movement, while I-49, I-55, and I-59 facilitate north-south (NB/SB) movements.

1.2 Scope of Study

The freight-significant highway considered for evaluation is the Louisiana interstate highway system. The selection of the interstate highway for the safety evaluation was notwithstanding that the highest number of crashes involving commercial vehicles in Louisiana occurred on rural state roadways [4].

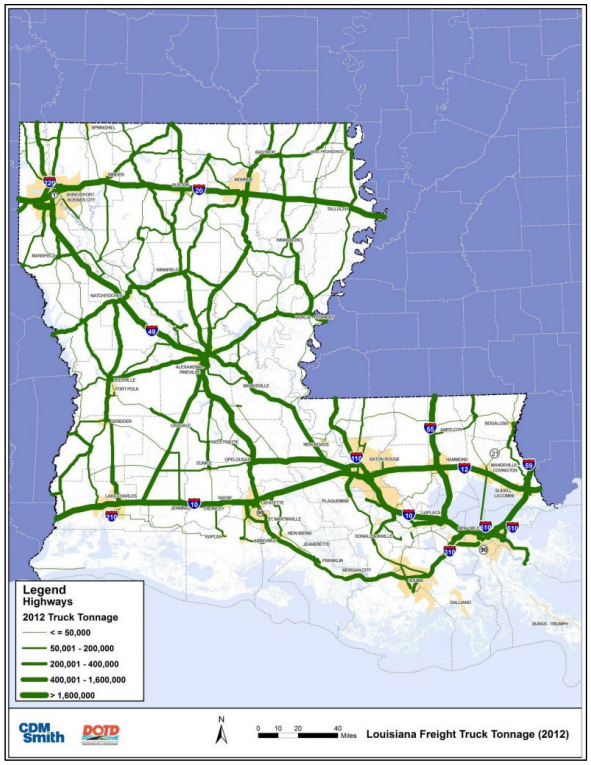


Figure 1. Freight significant highways in Louisiana [1]

Table 1. Mileage of interstate highway corridors in Louisiana

Interstate Highway	I-10	I-12	I-20	I-49	I-55	I-59	I-110	I-210	I-220	I-310	I-510	I-610
Mileage in Louisiana	274.00	85.00	189.00	247.00	66.00	11.00	9.00	12.50	18.00	11.5	3.00	4.90
Direction	WB/EB	WB/EB	WB/EB	NB/SB	NB/SB	NB/SB	NB/SB	WB/EB	WB/EB	NB/SB	NB/SB	WB/EB

2. METHODOLOGY

2.1 Performance Measures

Commercial Vehicle Crash Rate Calculation

The number of commercial vehicle crash rates on each segment of the interstate highway system was calculated for every 100 million vehicle-mile of travel (100 MVMT) using the expression in **Equation 1** [5]:

$$R = \frac{100{,}000{,}000 * C}{365 * N * ADT * L} \quad \ldots (1)$$

Where:

R = Commercial vehicle crash rate for road segment; expressed as crashes per 100 MVMT.
C = Total number of commercial vehicles involved in crashes in the study period.
N = number of years of data.
ADT = Average Daily Traffic Volume (both directions).
L = Length of roadway segment in miles (refer to **Table 1**).

Since there were different ADT counts on different segments of a particular interstate highway, the ADT reported with each crash on an interstate highway was averaged for each year and used to estimate the commercial vehicle crash rate per year on the segment of interstate highways.

2.2 Data Source and Scope of Collection

Commercial Vehicle Crashes in Louisiana

Only crashes that involved 2-axle single-unit truck, 3-axle single-unit truck, truck trailer, truck tractor, tractor semi-trailer, and truck double configurations (vehicle configurations L, M, N, P, Q, and R, respectively) were considered as commercial vehicles on the Louisiana Uniform Motor Vehicle Traffic Crash Report in this paper. This selection aimed at limiting the scope of evaluation to goods-carrying vehicles, though both trucks and buses are considered commercial vehicles in Louisiana [4].

A total of 101,716 crash reports were retrieved from the Louisiana Crash Database for all crashes between 2016 and 2020 on the interstate highway system to assess the number of commercial vehicles involved in crashes. This statewide repository of crash reports offered a comprehensive record of reported crashes, compiled typically by state law enforcement agencies [6]. If more than one commercial vehicle was involved in a crash, each was counted towards the number of commercial vehicles involved.

3. DATA ANALYSIS AND DISCUSSION

3.1 Commercial Vehicle Crashes in Louisiana

The annual crash frequencies on Louisiana's interstate highway system remained relatively constant between 2016 and 2019 but declined in 2020, possibly due to theCOVID-19 pandemic. Even though the annual total number of crashes remained relatively constant, the ratio of the annual number of crashes saw an increasing trend between 2016 and 2020.

Despite the declined total number of crashes in 2020, the proportion of commercial vehicles involved in crashes for that year was highest at 15.54%. The crash frequencies, the annual number of vehicles involved, and the ratio of the number of vehicles involved to the annual crash frequencies on the interstate highway system between 2016 and 2020 are shown in **Figure 2**.

In terms of crash rate, expressed in 100 MVMT, interstate I-110 had the worst performance in 3 of the five years studied. Other worst performers were interstate I-610, which had two out of five worst crash rates of the five years studied, and interstate I-310, with moderately high crash rates. Other interstate highways with moderate- to moderately high crash rates over the study period were I-220, I-210, I-10, and I-12, as shown in **Figure 3**.

Further, Interstate I-49 was relatively safer, with the lowest crash rates in 3 out of the five years studied. Besides, interstate highways I-55 and I-59, with 66.0 and 11.0 miles, respectively, had moderately lower crash rates over the studied period. Also, Interstate highway I-510 had spiky commercial vehicle crash rates over the period, indicating anomalies in the estimated performance, as shown in **Figure 3**.

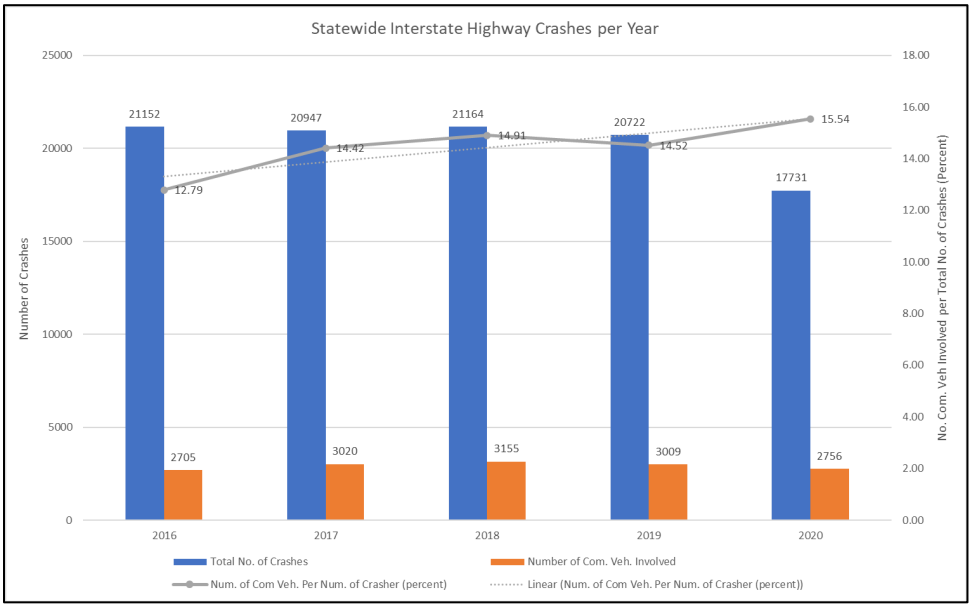
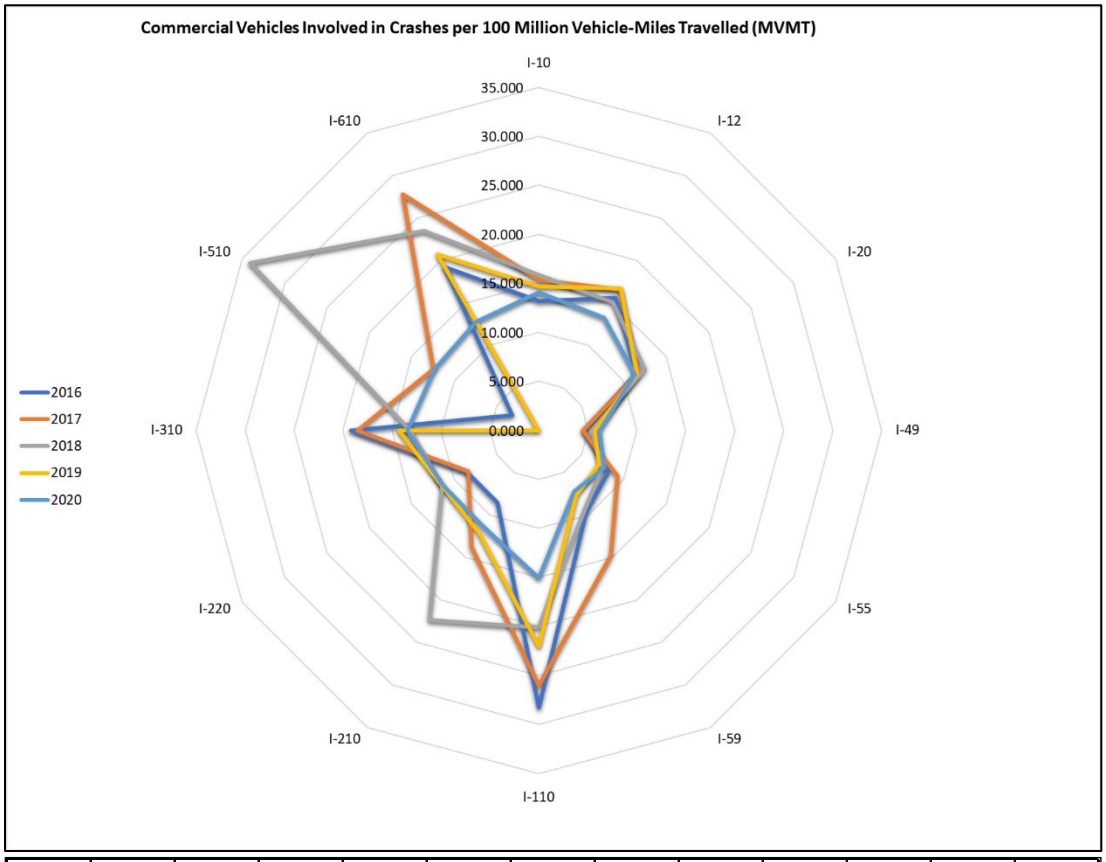


Figure 2. Annual crashes on Louisiana's interstate highway system (2016-2020)



Year	I-10	I-12	I-20	I-49	I-55	I-59	I-110	I-210	I-220	I-310	I-510	I-610
2016	13.161	15.620	11.482	4.527	8.262	9.649	28.286	8.506	8.530	19.205	3.128	19.192
2017	15.390	16.561	11.705	4.480	9.301	14.704	26.050	13.727	8.384	18.559	12.467	27.771
2018	15.820	15.083	12.499	5.368	7.567	9.328	20.137	22.340	11.430	13.164	34.053	23.508
2019	14.666	16.682	11.537	5.735	7.048	7.659	22.059	12.133	11.417	14.290	0.000	20.705
2020	14.069	13.279	11.343	6.199	7.658	7.207	15.105	11.334	11.299	13.450	12.383	12.800
Mileage	274.0	85.0	189.0	247.0	66.0	11.0	9.0	12.5	18.0	11.5	3.0	4.9

Figure 3. Commercial vehicle crash rates in 100 MVMT (2016-2020)

4. CONCLUSIONS

This paper presents an analytical framework for evaluating safety goals for statewide commercial vehicle operations (CVO); and uses crash data from the State of Louisiana to evaluate State's goal to reduce commercial vehicle crash rates on freight-significant highways between 2016-2020. The framework is transferable to states with similar goals as Lousiana.

The statewide annual crash frequencies on the interstate highway system remained relatively constant between 2016 and 2019 but declined in 2020, possibly in response to COVID-19. Even though the annual frequency of crashes statewide remained relatively constant, the ratio of commercial vehicles saw an increasing trend between 2016 and 2020, with the highest proportion of commercial vehicles involved in crashes in 2020 at 15.54%.

In terms of commercial vehicle crash rate, expressed in 100 MVMT, interstate I-110 had the worst performance in 3 of the five years studied, with the other worst performers being interstate I-610 and Interstate I-310. Interstate I-49 was relatively safer, with the lowest crash rates in 3 out of the five years. Besides, interstates I-55 and I-59 had moderately lower crash rates.

Recommendation for Future Studies

Future studies can investigate the reasons for the high commercial vehicle crash rates on interstate highways I-110, I-310, I-610, I-10, and I-12 and propose countermeasures. Additionally, the apparent anomalies in high crash rates in 2018 on I-210 and I-510 need to be investigated to unearth contributing factors and determine appropriate countermeasures to prevent future occurrences.

Significance of Study

This paper presents an analytical framework for evaluating safety goals for statewide commercial vehicle operations (CVO). It is an example of how data can be used to set safety priorities; it also demonstrates how data can be used to identify areas with the greatest need for improvement in a transportation system.

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AUTHOR CONTRIBUTIONS

The authors confirm the paper's contribution: paper conception and design; data collection: K. A. Abedi; analysis and interpretation of results: K. A. Abedi, R, Thapa, J. Codjoe & V.K.A. Gopu; draft manuscript preparation: K. A. Abedi, R. Thapa, J. Codjoe & V.K.A. Gopu. All authors reviewed the results and approved the final version of the manuscript.

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