

# Research on Risk Assessment and Intervention Methods of Freight Vehicle Traffic Safety via Data Analysis

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**Keywords:** Traffic Safety; Freight Vehicles; Vehicle Factors.

**Abstract:** In order to deeply explore the traffic safety risks of freight vehicles, the data of freight vehicles in Ningxia Autonomous Region is taken as an example. Through the analysis of the driver's traffic behavior and the condition of the freight vehicle, the XGBOOST model is established to help the relevant departments reasonably understand the driver's traffic safety risks. The analysis results show that the classification accuracy of the XGBOOST model is 86%, and the fitting effect is good. In an analysis of driver traffic behavior, drivers were more likely to cause more serious fatal accidents when they misused their turn signals and lights. Using the wrong turn signal is 1% more likely to result in a fatal accident than using the right turn signal. In the analysis of vehicle conditions, the legal and safety conditions of trucks in Ningxia Autonomous Region are not good, and the vehicles have potential safety hazards. Relevant departments should strengthen safety issues such as scrapped vehicles, irregular inspections, poor lighting, poor braking, and faulty signaling devices.

## 1 INTRODUCTION

Heavy trucks have the characteristics of large transportation volume, extensive management, lack of monitoring channels, unfixed transportation routes, and high mobility of vehicles (Park 2019). In the process of driving heavy freight vehicles, due to their own factors such as large body size, frequent overloading, speeding, and weak safety awareness of some drivers, they are very easy to cause heavy and very serious traffic accidents, which directly affect the property interests and safety of the people (McDonald 2019). According to statistics from the Traffic Management Bureau of the Ministry of Public Security, the current domestic truck ownership accounts for about 8% of the motor vehicle population, and the death toll from truck accidents accounts for about 30% of the total accident deaths. The truck accident rate per 10,000 vehicles is higher than the national traffic accident rate per 10,000 vehicles. More than twice as high, the frequency and severity of truck accidents are significantly higher than other motor vehicles, and road transportation safety is very severe. Frequent traffic accidents of freight vehicles have brought huge challenges to the supervision of freight traffic safety (Muratori 2017,

Ruesch 2016, Wang 2021, Wang 2021). People are increasingly realizing that it is urgent to prevent and reduce freight vehicle traffic accidents and implement road traffic safety management scientifically and effectively (Taylor 2019, Wang 2021, Wang 2021).

Therefore, in order to dig deeper into the traffic safety risks of freight vehicles, take the data of freight vehicles in Ningxia Autonomous Region as examples, analyze the traffic behaviors of drivers and the status of freight vehicles to help relevant departments rationally understand the traffic safety risks of drivers.

## 2 ANALYSIS OF ILLEGAL DATA ON FREIGHT VEHICLES

### 2.1 Data Source and Preprocessing Page Setup

The two data sets studied in this paper come from the databases of the public security traffic management departments of Ningxia Autonomous Region. First, the acquired data is preprocessed. In this article,

duplicate samples and samples with more vacancies are deleted.

## 2.2 Data Analysis

### 2.2.1 Irregular Use of Turn Signals

Vehicles, especially trucks with a large volume and carrying capacity, are more likely to cause traffic accidents when turning, changing lanes, U-turning, overtaking, sudden braking, sudden start and other special behaviors than when driving in a straight line. As one of the traffic signals, the normal use of the vehicle turn signal can remind other road users that the vehicle is about to turn, change lanes, and turn around, so that other road users can take measures such as slowing down and avoiding in advance to

reduce traffic accidents. Taking the Ningxia Autonomous Region as an example, the result of analyzing the use of the turn signal of the accident vehicle is shown in fig.1. There were a total of 305 truck traffic accidents, of which 200 were accidents with the correct use of vehicle steering lights, accounting for 66% of the total number of accidents. There were 105 accidents with incorrect use of turn signals, accounting for 34% of the total number of accidents. In accidents with incorrect use of turn signals, there are situations such as turning on the left turn signal when the vehicle is going straight, and double flashing when turning left and right. The wrong signal is transmitted to other traffic participants, which is a hidden danger to the occurrence of traffic accidents.

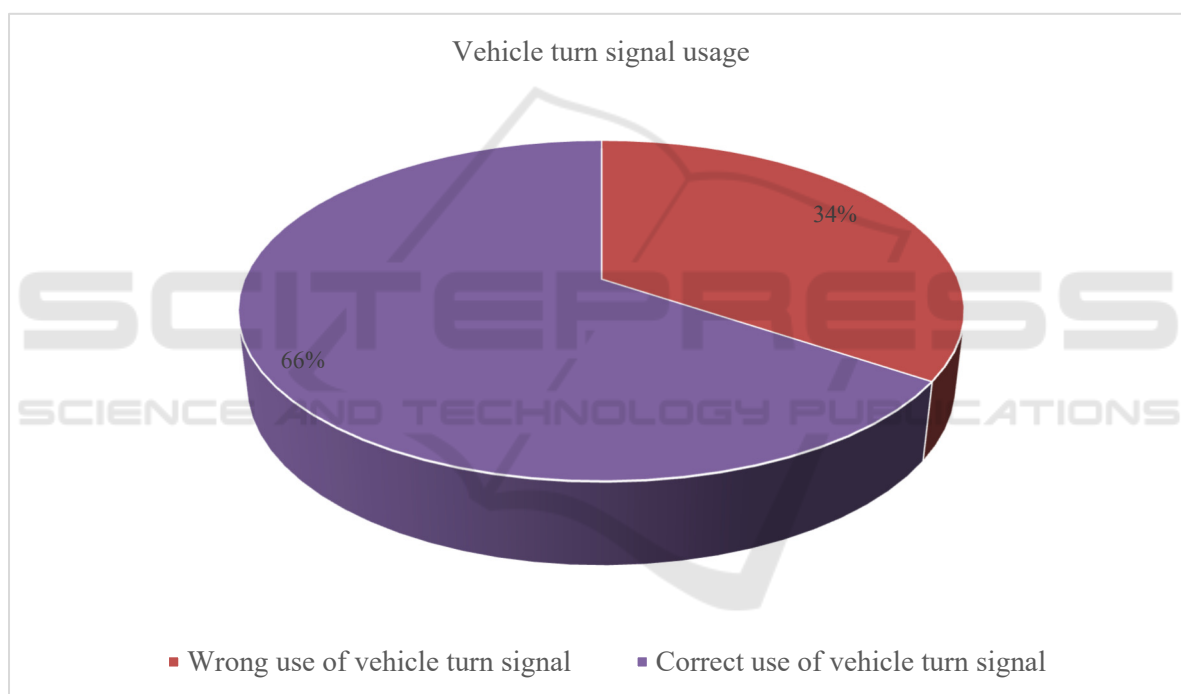


Figure 1: The use of vehicle turn signal.

Further analysis of the use of the turn signal of the accident vehicle, the distribution of accidents corresponding to the correct and wrong use of the turn signal is shown in fig.2 and fig.3 respectively. In the data of accident vehicles, there were 97 fatal accidents out of 200 accidents when the turn signal was used correctly, accounting for 49% of the total number of accidents when the turn signal was used correctly. When the turn signal is used incorrectly, there are 53 fatal accidents in 105 accidents, accounting for 50% of the total number of accidents when the turn signal is used incorrectly. The use of

the wrong turn signal is 1% higher than the probability of a fatal accident when the turn signal is used correctly.

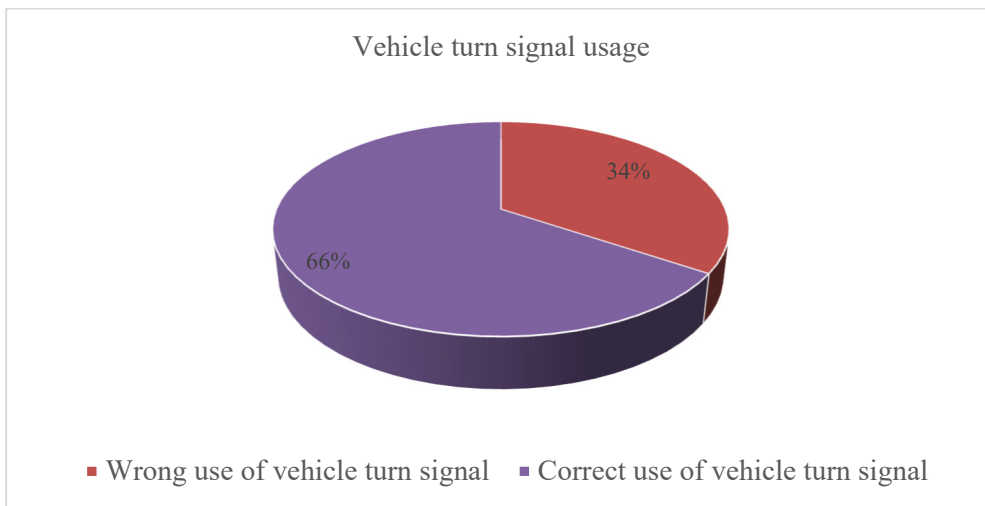


Figure 2: Distribution of accident types when vehicle turn signals are used correctly.

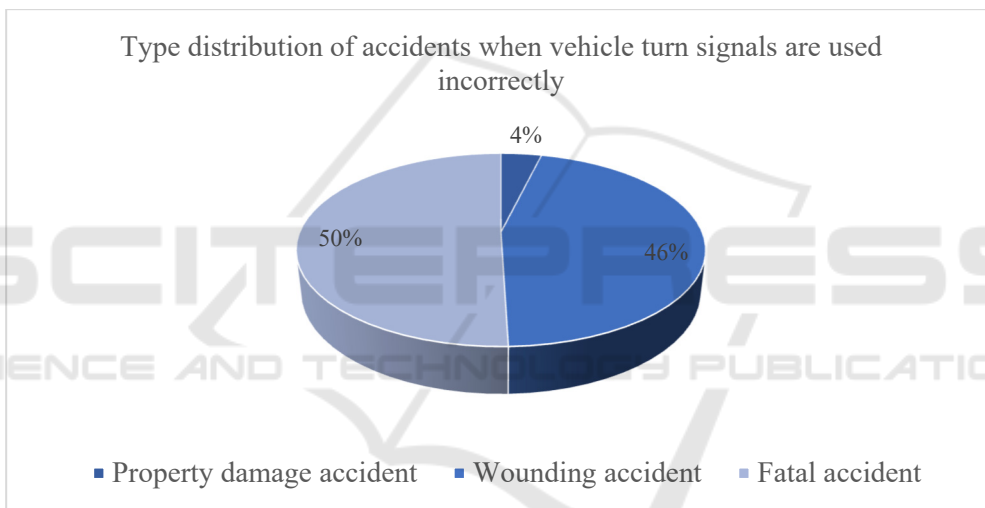


Figure 3: Distribution of accident types when vehicle turn signals are used incorrectly.

### 2.2.2 Irregular Use of Lighting

The use of low-beam, high-beam, and position lights of vehicles can provide lighting and reminders for vehicles under poor road lighting conditions, meeting vehicles, etc., but the vehicle's low-beam, high-beam, and position lights are wrong. The use will not only produce poor lighting effects for the driver, but also its adverse effects on other road traffic users is also one of the factors leading to traffic accidents. Take Ningxia Autonomous Region as an example to analyze the lighting usage of the truck in the accident, and the result is shown in fig.4. There were a total of

305 truck accidents, of which 215 were accidents with correct vehicle lighting, accounting for 70% of the total number of accidents. There were 90 accidents involving incorrect use of lighting, accounting for 30% of the total number of accidents. In the accidents of incorrect use of lighting, there are situations in which vehicles use high beams illegally when there are street lights at night, and do not use lights when there are no street lights at night. Wrong use of high beam headlights can cause instant blindness to the opposing driver. Do not use lights under poor lighting conditions, which are all hidden dangers that lead to traffic accidents.

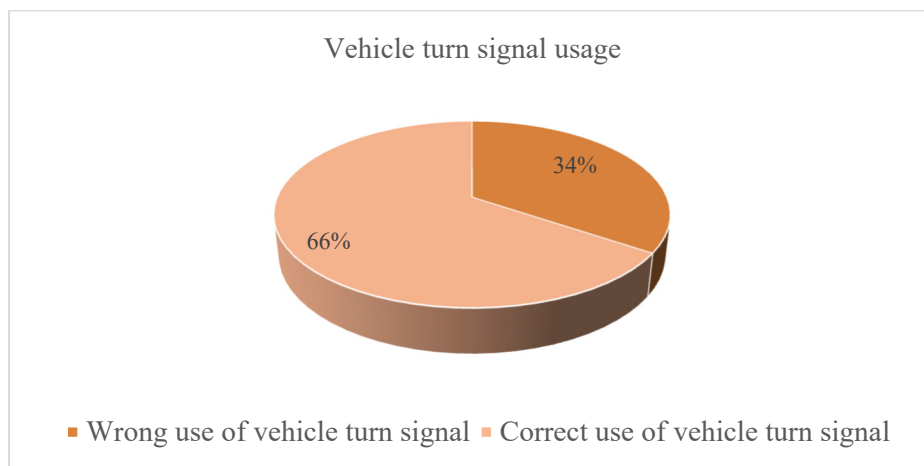


Figure 4: Use of vehicle lighting.

### 2.3 Vehicle Status

Taking Ningxia Autonomous Region as an example, the result of the analysis of the legal status of the accident vehicle is shown in fig.5. There were 305

truck accidents, of which 293 were accidents with vehicles in a legal status, accounting for 96% of the total number of accidents. There were 12 accidents in which vehicles were illegal, accounting for 4% of the total number of accidents.

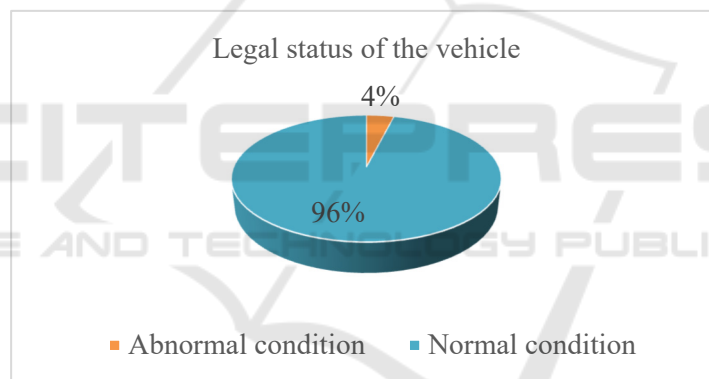


Figure 5: Analysis of the legal status of vehicles.

Further analysis of the illegal status of the vehicle, the illegal status of the vehicle is shown in fig.6. Among the 12 accidents where vehicles were illegal,

1 vehicle was scrapped, 3 vehicles were not inspected on time, and 8 vehicles were other reasons.

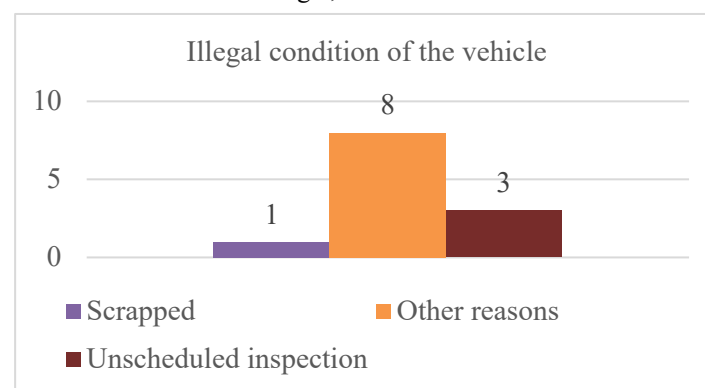


Figure 6: Analysis of illegal conditions in vehicles.

The results of the analysis of the safety status of accident vehicles in Ningxia Autonomous Region are shown in fig.7. There were 305 truck traffic accidents, of which 278 accidents were in a legal state,

accounting for 91% of the total number of accidents. There were 27 accidents in which vehicles were illegal, accounting for 9% of the total number of accidents.

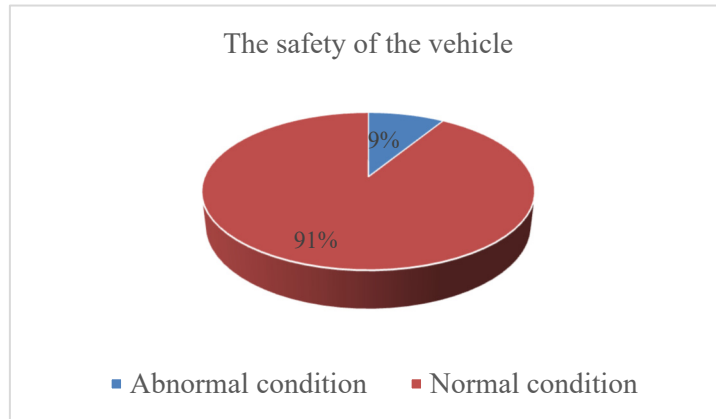


Figure 7: Analysis of the legal status of vehicles.

Further analysis of the unsafe condition of the vehicle, the unsafe condition of the vehicle is shown in fig.8. Among the 27 accidents in which vehicles were in unsafe conditions, one was due to leakage of

oil/liquid/gas from the vehicle, one was due to failure of vehicle lighting and signaling devices, and 11 were due to poor vehicle braking or failure.

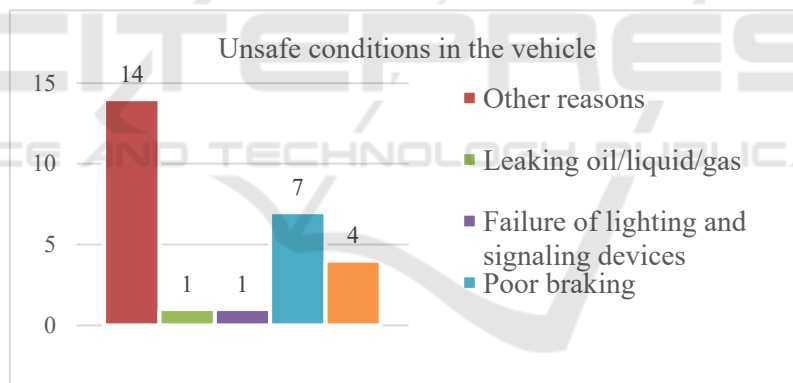


Figure 8: Analysis of illegal conditions in vehicles.

## 2.4 Model Establishment

Using Python, using Jupyter lab as a tool, call the XGBClassifier function of the xgboost package to build the XGBOOST model. All parameters use default values.

The accident type is used as the label, and the value types are: property damage accident and casualty accident. The legal status of the vehicle, the safety status of the vehicle, the usage of turn signals, lighting conditions and other factors are input into the model as features.

It is concluded that the classification accuracy of the model on the test set reaches 86%. The model has excellent fitting effect and can be used to identify the severity of traffic accidents

## 3 CONCLUSION

This article is to dig deeper into the traffic safety risks of freight vehicles. Taking the freight vehicle data of Ningxia Autonomous Region as an example, the following conclusions can be drawn by analyzing the

traffic behavior of drivers and the status of freight vehicles:

(1) In the driver's analysis of traffic behavior, it is more likely to cause more serious fatal accidents when the driver misuses the turn signal and lighting.

(2) In the analysis of the vehicle status, the legal status and safety status of trucks in Ningxia Autonomous Region are not good, and there are hidden safety hazards in the vehicles. The relevant departments need to strengthen the disposal of vehicles, unscheduled inspections, poor lighting, poor braking, and signaling devices.

(3) The classification accuracy of the XGBOOST model on the test set reaches 86%. The model has excellent fitting effect and can be used to identify the severity of traffic accidents

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