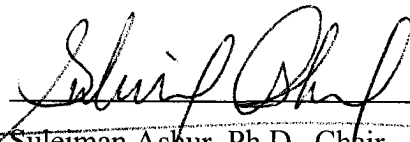



**MEASURES TO IMPROVE TRUCK TRAFFIC SAFETY**  
**ON TEXAS ROADWAYS**

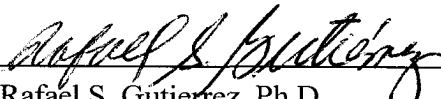
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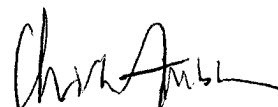
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PREVIEW

**MEASURES TO IMPROVE TRUCK TRAFFIC SAFETY  
IN TEXAS ROADWAYS**

by

**NABIL GHARIANI**, Ingénieur de l'Etat.

**THESIS**

Presented to the Faculty of the Graduate School of  
The University of Texas at El Paso  
in Partial Fulfillment  
of the Requirements  
for the Degree of

**MASTER OF SCIENCE**

Department of Civil Engineering

**THE UNIVERSITY OF TEXAS AT EL PASO**

December 2001

UMI Number: EP05559

PREVIEW

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## ACKNOWLEDGEMENTS

This thesis is dedicated to many people, whom without their constant contribution will not be in the actual format.

First, the author expresses his great appreciation to Dr. Suleiman Ashur for his guidance, advice, great patience, and support to accomplish at best this thesis project. Thanks also to the continuous and indefinite help that the author found from Dr. José Weissmann, associate professor at the University of Texas at San Antonio, whose support and help were always there when ever I was in need. Thank you for your help and guidance. In addition, the author thanks Dr. Charles D. Turner and Dr. Rafael S. Gutierrez for serving as thesis supervising committee. At last, the author would express special thanks to Dr. Roberto Osegueda who gave an opportunity to pursue a Master degree in Civil Engineering at the University of Texas at El Paso.

My special and great thanks to my family that I missed a lot during all these years, where all my thanks go to them. Thank you for being patient, I hope that this achievement is only the beginning and more success will come.

This thesis was submitted to the thesis committee on August 25, 2001

## ABSTRACT

The increase of large truck (trucks weighing more than 10,000 lbs.) operation on different types of roadways has been found to have an impact upon safety and quality of traffic flow on major roadways. Understanding the factors that cause crashes can enable engineers, as well as planners, to identify and implement adequate and effective countermeasures to reduce the frequency of truck crashes and their accompanying severities. Fortunately, numerous research projects have been conducted to determine crash frequencies with multiple variables such as time, geometric characteristics of roadways, and drivers' conditions at the time of the crashes. Nevertheless, these studies did not provide alternative solutions or countermeasures to reduce truck crashes.

This study identifies the frequencies of major factors that have contributed to large truck crash, and provides alternative countermeasures to reduce the number of crashes, as well as their severities.

The study was limited to different classes of roadways in the state of Texas. The data were obtained from the Texas Department of Public Safety, where an extensive statistical study was performed using Statistical Analysis Software (SAS) software to discern the possible elements that truck crashes from the years 1991 to 1999.

The final conclusion provides summary of findings and possible countermeasures that might be implemented to reduce the number of crashes based on results obtained from this study.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 PROBLEM BACKGROUND

Large trucks (trucks weighing more than 10,000 lbs.) have and still make an important contribution to the growth of the nation's economy in the United States, providing an unprecedented degree of mobility. Despite all their advantages that they provide, accidents involving trucks are becoming one of the major traffic issues in the United States. Crash data from United States Department of Transportation (U.S. DOT)/National Highway Traffic Safety Administration's General Estimate System (GES), show that the number of crashes involving large trucks increased from 362,000 to 379,000 from the year 1995 to 1996 nationwide, with an increase of injuries and fatalities from 88,472 to 98,755 during the same period (Source: GES).

Because of their size, weight, and the amount of travel mileage, large trucks are most likely to be the cause of fatal crashes if involved in crashes on Texas roadways. Information from the Texas Department of Public Safety (DPS), Accident Record Bureau shows that tractor-trailers caused 9,423 accidents from which resulted in 337 fatalities and 8,834 injuries for the calendar year 1997. This was an increase of 6.7% in the number of accidents from calendar year 1996.

Issues involving truck operations and safety have been receiving more attention from the transportation professionals and organization, along with federal, state and local agencies in order to determine the magnitude and causes of large truck crashes with better accuracy. Important parameters will be determined and quantified through extensive

statistical study. At last, recommendations and solutions will be presented that can lead to improve safety and reduce large truck crashes on Texas roadways.

Fatality Analysis Reporting System (FARS), GES from the National Highway Traffic Safety Administration (NHTSA) and Truck Involved in Fatal Accidents (TIFA) from the University of Michigan Transportation Research institute (UMTRI), are the sources of data on highway crashes caused by trucks. These computerized database sources are available and used to summarize the type, date, location, surface road characteristics, and any other factor (as example drug, alcohol, drivers inexperience, etc...). More in depth information about the databases will be presented in chapter 3.

This study will provide a systematic process to evaluate road safety management and recommends alternative countermeasures to reduce the number and severity of crashes, which involve large trucks in Texas State.

## **1.2 RESEARCH OBJECTIVES**

This study is part of a large safety program launched in January 2001 by the U.S. Department of Transportation to fulfill safety actions planned to reduce number of deaths on U.S. roadways that are associated with truck crashes. This issue is set as high priority to improve safety in U.S. roadways.

Based on the need to reduce fatalities and injuries that are associated with truck crashes on Texas roadways, the objectives of this study are:

1. To determine the human factors and other components related to driver's performance (e.g., maximum number of hours of driving to avoid fatigue, alcohol involvement, or any type of drug that can reduce driving performance).

2. To determine vehicle/truck operation, which is related to maintenance, mechanical performance and route choice on the network system.
3. To study roadway design, factors related to geometric highway design and roadway surface condition.
4. To determine the factors that lead to fatal and injury crashes involving large trucks.
5. To develop recommendations that will be part of proactive actions to minimize crashes and their severities, instead of reactive plans that are commonly used.

These factors will help the government agencies in Texas State, as well as the concerned parties, to better act in efficient manners to help prevent these types of crashes to occur in the first place.

### **1.3 METHODOLOGY AND RESEARCH APPROACH**

This research study will determine the number of crashes at different years and their percentage of increase or decrease, as well as multiple cross tabulations analysis to determine the reasons for the crash; and factors that contributed to the crash. Finally, to provide recommendations on the best type of countermeasures that have to be applied.

In order to achieve the goals of this research study, the following steps/tasks will be followed or under taken:

1. Gathering and comparing crash data from available sources.
2. Statistical analyses of truck crashes using SAS software.
3. Identification of associated crashes causal factors through the statistical analyses
4. Providing possible countermeasures to reduce crash tolls and/or minimize their fatalities.

## 1.4 THESIS LAYOUT

This thesis is divided in six chapters. The first chapter is the introduction and the objective of the study, then chapter two will address the literature review and past researches done on the same subject to look at different approaches, findings, and results and conclusions. Chapter three will discuss different types of crash data sources that are available and present an evaluation and assessment of data for the use in this research. Chapter four will provide the statistical and probabilistic analyses that will be performed on the data set. The proposed different alternative countermeasure to reduce truck crashes and the most possible ones that may be applied in Texas state roadways is listed in chapter five.

Chapter six will summarize study findings; conclusions and proposed recommendations of the study and future research are presented.

PREVIEW

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 REVIEW OF PAST RESEARCH**

The growth of any country is generally due to efficiently utilizing all transportation modes to move goods and people in different areas in a better and efficient way, whether it is intra or inter-regional movements. Among the modes of transportation, large trucks (commercial vehicles weighing 10,000 lbs and above) in the U.S. play a major role to distribute a large portion of the nation's product to different areas around the country. Nonetheless, their contribution to this progress did not come without a price, where traffic crashes due to these large trucks resulted to injuries and deaths of vehicle occupants and pedestrians, as well as property damage.

The purpose of the literature review is to search for related researches and published works in order to determine what approaches have been used to study large-truck accidents on roadways and what results have been drawn on the issue. The research was done on emphasis to the characteristics of large-trucks crashes particularly in relation to associated causal factors and the types and severity of crashes.

Findings were satisfactory in terms of the quality of studies, the variety of studies of truck crashes issues, and their approaches of tackling them.

After reviewing the previous articles and studies, the issues related to large truck crashes can be presented in these areas:

1. Human-related Factors to Large Truck Crashes
2. Vehicle-related factors

3. Highway, traffic, and environment related factors

4. Statistical Analyses of Large Truck Crashes

A summary of the findings in the literature review is presented in the following subcategories:

### **1. Human-related Factors to Large Truck Crashes**

The human related factor concerns drivers' errors, which they have been recognized as one of the major factor in the causal chain in accidents that involve large trucks.

It was identified the following sub-factors that were found on multiple studies carried out to investigate the influence of driver-related factors on truck crashes.

#### **A. Age, Experience, and Training**

Numerous studies have based their data and statistical analyses on the distribution of large-truck crashes by age and experience of drivers. As results obtained from all the analyses in the area of truck crashes, it was found that young drivers have a high crash rates comparing to other group ages. Referring to a study done by Seiff (1), shows that truck drivers under 21 years of age have a bout five times the average crash rate, whereas it was also found that the rate falls down to twice the average at age 21. Drivers are safer than the average of all truck drivers. These statistical results did not take in account drivers' years of experience. There is little information concerning drivers' experience due to lack of reporting such information. In addition, it was noticed that there was a considerable influx of inexperienced drivers into trucking industry due to deregulation.

The available data, however, revealed that many drivers involved in crashes did not have formal driving education or training.

### **B. Fatigue**

It was found that drowsiness is probably one of the primary causes of truck crashes. American Automobile Association (AAA) (2) has conducted a study where it concluded that 41 percent of large truck crashes also were caused by fatigued and drowsy truck drivers. In addition, Smist and Ranny (3) concluded in their study that drivers of articulated trucks were often reported to be drowsy or fatigued.

### **C. Alcohol use**

Reasons that lead drivers to drinking and driving are not well understood. Results from studies have expectedly found under-reporting of alcohol involvement in truck crashes among truck drivers. Thus, crashes where drivers were fatally injured, alcohol involvement ranged from 36% (4) to 24% (5). In addition, drivers of straight trucks have a high likelihood to have been cited as drunk drivers prior to a crash compared to other truck drivers.

### **D. Drug use**

It has been found that there is a lack of studies concerning drug use in the involvement in truck crashes. Terhune and Fell (6) indicated in their study that about 1% of truck drivers are drug users. In another study, Wyckoff (7) mentioned that marijuana appears to be at similar level to those in general population.

### **E. Medical condition**

Through the literature that has been studied, very few crashes were related to driver's medical conditions. Accident researches as well as concerned organizations have found that some medical conditions can impede or reduce driver's ability to respond to a complex driving situation, which can contribute to crashes. An estimation from Waller (8) shows

that 15 percent of all crashes could be attributed to medical conditions. However, it can be noticed that there is lack of data relating drivers medical conditions to truck crashes.

## **2. Vehicle-related factors**

A vehicle, whether it was a large truck or personal car, from its design to its maintenance was recognized as direct or indirect causes of crashes. The extent to which these factors interrelate with driver factors and roadway or environmental factors to cause a crash is often difficult to establish.

The vehicle-related factors identified so far in studies regarding large truck crashes are summarized as follow:

### **A. Vehicle design and weight**

Vehicle design is referred to vehicle length, width, number of towed units, body type, and gross vehicle weight. Numerous researches have been done to determine the influence on off tracking (vehicle design), splash and spray, vehicle's aerodynamics, speed on grades, braking, and stability on roadways. A particular study done by Eno Foundation (9) claimed that large truck fatality rate is 75 percent higher than the rate for all vehicles, in which it concluded that the high fatality rate is a function of vehicle mass. It has also been concluded that crashes involving a large truck and a smaller vehicle, the sheer size and weight of the truck puts the other vehicle's occupants at greater risk. In study from the University of Virginia (10) (11), it was found that braking and stability can deteriorate as truck length, weight, and the number of towed trailers increases. In addition, a study by Winfrey, et al. (12) found that heaviest weight trucks have the highest fatality rate, but the lowest crash rate.