2019-10

Investigating the Causes and Counter Measures of Heavy Truck Accidents: The Case Study of Sinotruk Related Accidents In Amhara Region, Ethiopia

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INVESTIGATING THE CAUSES AND ENGINEERING COUNTER MEASURES OF HEAVY TRUCK ACCIDENTS: THE CASE STUDY OF SINOTRUK RELATED ACCIDENTS IN AMHARA REGION, ETHIOPIA

BY

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BY

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A thesis submitted to the school of Research and Graduate Studies of Bahir Dar

Institute of Technology, BDU in partial fulfillment of the requirements for the degree of

Masters of Science Degree in the Road and Transport Engineering in the Faculty of Civil and Water Resources Engineering.

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Bahir Dar, Ethiopia

October 4, 2019

Declaration

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Acknowledgements

Before all, I would like to express my thanks from the bottom of my heart for God who gives me the power to do this research and his supports in each and every activity.

I would like to forward my sincere gratitude to my advisor Enyew Asires (PhD Cand.) for all his valuable support through consultation, and encouragement, and every support for this work to be completed successfully.

My special thanks go to my wife Abebech Fitawok for her understanding and heartfelt motivation that kept me persistent and strong during my study and my friends for their tireless support during the entire period of the research work especially during the data collection process.

Furthermore, I would like to thank Bikila Teklu (PhD) for his friendly involvements and support during proposal development, particularly from the initiation of the thesis work.

Next I try to say thank you for Traffic officials in Amhara regional state, driver training center officials, road and transport office and members in the region for giving good and appropriate information about traffic crash in this city orally through interview and the recorded traffic crash data.

Finally, my gratitude is given for Bahir Dar institute of technology civil and water resources faculty for writing a letter to the concerned body and all individuals who participate in the observation may survey specially traffic speed data collection.

Abstract

SINOTRUK accident has increased in Ethiopia day by day due to both drivers and vehicle factors. Primary and secondary data has been collected from different stakeholders explicitly to identify the major cause for SINOTRUK accident with in the study area. Based on the finding the study identified the major cause of SINOTRUK related accidents and established recommendation to tackle the severity of SINOTRUK accident in Amhara regional state on the selected link roads. In this research the researcher focused on drivers and vehicle related factors because of environmental and road related factors have a little effect on SINOTRUK accident. Majorly the researcher has given attention to collect the data from traffic police accident record sheets (CR) and from drivers through interview and questionnaires. The collected data were analyzed using descriptive statistical analysis and binary logistic regression analysis. Based on the result from the analysis the basic contributing factors for SINOTRUK road traffic accident has categorized as , lack of experience to lower vehicle, over loading, absence of speed controller GPS, a time gap during training, driver's attention problem, traffic police commitment problem, drivers speed selection problem, youth age of drivers, vocational based training methods, difference between training & working places, difference between training and the vehicle to drive and SINOTRUK problems. Hence the recommendations were giving continuous training for drivers and traffic polices, installing speed controlling GPS for SINOTRUKs, giving more practical based trainings for driving trainees, giving the trainees practical exercise at a proper location with proper vehicles, improve licensing laws and vehicular problems of SINOTRUK specially vehicle brakes.

Key words: Crash, Accident, regression, human factors, vehicle factors.

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List of Abbreviations

BAC	Blood Alchool Concentration.
CAS	Crash Analysis System
CDL	Commercial Driving License
CI	Confidence Interval.
CR	Creatical Reason.
CVC	Commercial Vehicle Collision.
CVES	Commercial Vehicle Enforcement Section.
GDLS	Graduated Driver Licensing System
GDP	Growth National Product
ESS	Epworth Sleepness Scale.
FARS	Fatal Accident Reporting System.
FHWA	Federal Highway Adminstration.
FMCSA	Federal Motor Carrier Safety Adminstration.
HFF	Human Functional Failure
HOV	High Occupancy Vehicle.
MCS	Motor Carrier Safety.
MoT	Minstry of Transportation.
MV	Multiple Vehicle.
NHTSA	National Highway Traffic Safety Adminstration.
NTTIS	National Truck Trip Information Survey.

OPS	Office of Transport System
PDO	Property Damage only
RR	Relative Risk.
RTC	Road Traffic Crash.
SPSS	Statistical Packages for Social Sciences.
SV	Single Vehicle.
TIFA	Trucks Involved in Ftal Accident.
TRACE	Traffic Accident Causation in Europe
UFoV	Usfull Field of View
UK	United Kingdom
US	United States.
USA	United States of America.

List of Symbols

n_o	Estimated sample size
z	Z-score found in statistical table
p	Estimated proportion of attributes present in the population
e	Desired level of precision
n	Adjusted sample size
N	Population size

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CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Heavy vehicle is defined in the Australia heavy vehicle national law (HVNL) as a vehicle that has a gross vehicle mass (GVM) or aggregate trailer mass (ATM) of more than 4.5 tonnes. The GVM of a vehicle is the maximum it can weigh when fully loaded, as specified by the manufacturer. For example, heavy vehicles include Semi-trailers, B-double freight trucks, road trains, passenger buses, vehicle carriers, livestock and other agricultural vehicles, mobile cranes and other special purpose vehicles [(1)] . SINOTRUK is one of the vehicles included under heavy vehicle industry manufactured in china for the first time by China National Heavy-Duty Truck Group Corp. Ltd. (SINOTRUK) which is China's first heavy duty truck manufacturer. The importance of the trucks is not questionable, since Ethiopia is in construction with buildings, homes and roads. It is believed that SINOTRUK cars earn up to 400 per round for the transport of stone, metal and soil in the construction area, and they are expected to generate between 35,000 and 40,000 revenues in five days. In Ethiopia, the number of fatalities accounted for 2% of all car accidents, ranked 10th. Of the 17.904 car accidents registered in Addis Ababa in 2005/06, 20% were registered.

The Amhara regional state police commission annual report shows that today in Ethiopia due to the development of motor vehicles technology and construction of road and other infrastructures , road traffic crash (RTC) increases rapidly. Specially most of the construction industry used heavy vehicles like Sinotruck to transport construction materials from one location to the other location. Due to inadequate road networks, slow road construction and maintenance, over loading of trucks, low performance of drivers, excessive speeding, rapid traffic growth, shortage of parking space in the narrow streets, as well as ineffective traffic management and enforcement, there is rapid growth of road traffic accidents specially in heavy vehicles (World health organization, 2015).

Road traffic accidents occur as a result of factors associated with different system. Africa has one of the highest road traffic death rates in the world, with little difference in rates between those countries categorized as low-income (32.3 deaths per 100,000 populations per year). Whereas the range of fatalities per 100,000 populations in countries of African region is not very wide, 70% of all the deaths in the Region occurred in the ten countries that account for 70% of the regional population: Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Madagascar, Mozambique, Nigeria, South Africa, and Tanzania (World Health Organization & World Bank, 1999).

To ensure the normal life of SINOTRUK and obtain the good economic benefit, all the instructions of the maintenance requirements mentioned need strictly to be followed. Pure fuel in accordance with the quality requirement is required to be used during the vehicle’s running. All chosen oil, lubricating oil, hydraulic oil etc. for vehicles shall be consistent with the provided grades of this manual. The SINOTRUK company reserve the rights of technical alteration and upgrades for better improvement without prior notice.

Table 1: Maintenance requirement of SINOTRUK as specified by the company

<table>
<tr><th colspan="2">Assembly</th><th>Oil type</th><th>First Maintenance</th><th>Scheduled Maintenance</th></tr>
<tr><td rowspan="4">Engine</td><td rowspan="2">Diesel Engine</td><td rowspan="2">Diesel Engine Oil</td><td rowspan="2">2000-5000 kms</td><td>Road vehicles: every 10,000 kms</td></tr>
<tr><td>Off-road vehicles: every 5,000 kms</td></tr>
<tr><td rowspan="2">Gas Engine</td><td rowspan="2">Gas Special Oil</td><td rowspan="2">2000-5000 kms</td><td>Road vehicles: every 10,000 kms</td></tr>
<tr><td>Off-road vehicles: every 5,000 kms</td></tr>
<tr><td rowspan="2">Transmission</td><td rowspan="2">HW Series</td><td rowspan="2">Gear Oil</td><td rowspan="2">2000-5000 kms</td><td>Road vehicles: every 100,000 kms</td></tr>
<tr><td>Off-road vehicles: every 80,000 kms</td></tr>
<tr><td rowspan="4">Driving axle</td><td rowspan="2">HC Axle</td><td rowspan="2">Gear Oil</td><td rowspan="2">2000-5000 kms</td><td>Road vehicles: every 100,000 kms</td></tr>
<tr><td>Off-road vehicles: every 80,000 kms</td></tr>
<tr><td rowspan="2">AC Axle</td><td rowspan="2">Gear Oil</td><td rowspan="2">2000-5000 kms</td><td>Road vehicles: every 100,000 kms</td></tr>
<tr><td>Off-road vehicles: every 80,000 kms</td></tr>
<tr><td rowspan="4">Steering Gear box</td><td rowspan="2">SS Axle</td><td rowspan="2">Steering Fluid</td><td colspan="2">Road vehicles: every 100,000 kms</td></tr>
<tr><td colspan="2">Off-road vehicles: every 80,000 kms</td></tr>
<tr><td rowspan="2">DS Axle</td><td rowspan="2">Steering Fluid</td><td colspan="2">Road vehicles: every 100,000 kms</td></tr>
<tr><td colspan="2">Off-road vehicles: every 80,000 kms</td></tr>
<tr><td colspan="2">Clutch</td><td>Brake Fluid</td><td colspan="2">160,000 kms</td></tr>
<tr><td colspan="2">Cooling System</td><td>Cooling Liquid</td><td colspan="2">Every Year</td></tr>
</table>

Note: SSA is Single Steering Axle, DSA represents Double Steering Axle.

Review of the magnitude of the problem revealed that 1.2 million people die due to road traffic crashes annually. On the average, in advanced and many developing countries, one out of every ten hospital beds are occupied by road traffic crash accident victims (National Road Safety Council, 2010).

Crashes involving heavy trucks often result in more serious road trauma outcomes, in part because when a heavy truck is involved in a crash their vehicle mass elevates the crash forces involved and hence increases the severity of the crash. The majority of heavy truck crashes involve multiple vehicles, largely either rear end or other angle first impact crash types. Single vehicle heavy truck crashes occur mostly on weekdays, with crashes peaking on Tuesday and Friday (versus peaks on Wednesdays for all heavy truck crashes (Government of Australia, 2015).

Despite the increasing number of heavy vehicles on highways and freeways, the influence of heavy vehicles on their surrounding traffic has received little attention. Because of the large size of heavy vehicles and their limited operational capabilities (e.g. speed and acceleration/deceleration), they have the potential to bring psychological disadvantages for their surrounding passenger car drivers (Sara Mordipor, Ehsan Mazlour and Mohamed Mesbah, 2014).

According to Sara Mordipor, Ehsan Mazlour and Mohamoud Mesbah, the effects of heavy vehicles on their surrounding traffic are greater than passenger cars. There is potential for heavy vehicles to have a substantial impact on macroscopic and microscopic traffic flow characteristics because of the interference effect they have on surrounding vehicles. Previous studies show that heavy vehicle and passenger car drivers have fundamentally different driving behavior. The heavy vehicle drivers' car following and lane changing behavior has been investigated, and models have been developed to estimate their driving behavior.

On-road driving experience is the way higher-order cognitive skills related to driving (e.g. hazard perception) are developed and maintained. Conventional driver training is unlikely to undo firmly established past learning laid down over weeks, months and years of practice and experience, nor alter motivation or personal values. It is of concern that the provision of conventional driver training beyond that required to gain an initial driver licence often leads to increased crash risk among novice drivers. Research suggests that this is because the training can encourage earlier licensing, increase exposure-to-risk and/or unduly increase the confidence of novices about their driving abilities (Monash University Accident Research Centre, 2001).

The 2011 traffic accident report of the Ministry of Transport National Road Safety Council indicated that next to pedestrians (51%), passengers' accident ranks second, accounting 46% of fatality. Of the total traffic accidents, 93% of the cases were associated with human factors, 5%

accounted for vehicle factors, and 2% were associated with road related problems. Similarly, the Ethiopian Federal Police report of (2011) stated that road accident level of the country is one of the worst in the world, as expressed by per 10,000 vehicles. Moreover, the report stated that majority of road accidents were concentrated in Addis Ababa, which is the capital city of Ethiopia, and Oromia region, accounting 58 percent of all fatalities and two-third of all injuries.

1.2. Statement of the Problem

The rate of SINOTRUK road traffic crash increased day by day in Ethiopia due to poor road infrastructure, poor enforcement of traffic laws, poor awareness of drivers and pedestrians and other related factors. On the major roads of Amhara region, the road traffic crash due to SINOTRUK is very serious that causes serious injuries and a lot of people lost their life, a large number of people injured and millions of property damage were recorded. In Amhara regional state from 2008 to 2010, over 50 % of series injury and fatal crashes were happened due to heavy vehicles according to Amhara regional state police commission annual report. From the total number of accidents 20 % of accidents were happened due to SINOTRUK.

Despite there were a lot of research conducted on road traffic accidents, no researches have been conducted only on the causes of accident on heavy vehicles independently in the selected study area. The previous studies show that the cause for heavy vehicle accident and other small vehicle accidents were similar but there may be causes which were very sever for heavy trucks and and less sever for other small vehicles. In the previous study there were gap to categorize the cause of SINOTRUK accident independently with other vehicles and to tackled them by evidence-based counter measures. But this study focused on road traffic accidents due to driver's and vehicle factors on the major roadway of selected Amhara region towns at which SINOTRUK traffic accident is relatively very high and finally suggestive counter measures has directed. The researcher selects this specific area because of there is no mare studies conducted on this area related to SINOTRUK traffic crash independently. Hence, this study is conducted on selected link roads in Amhara region, the data sources were Amhara regional state traffic police officers, SINOTRUK drivers and related previous studies.

1.3. Objectives

1.3.1. General Objective

The primary objective of this study is to investigate the major causes of road traffic accident due to SINOTRUK on the selected link roads in Amhara regional state, Ethiopia.

1.3.2. Specific Objectives

In addition to the primary objective, this research has the following specific objectives.

- ✓ To describe the major factors that contribute to Sino truck accidents in Amhara regional state.
- ✓ To identify and characterize SINOTRUK related accidents in the study area.
- ✓ To propose/ recommend an appropriate counter measures based on the identified causes.

1.4. Research Questions

In light of the above statement of the problem, this study tried to answer the following basic research questions:

- ✓ What are the causes and contributing factors of road traffic accident due to SINOTRUK?
- ✓ What is the current level of SINOTRUK accident in the study area?
- ✓ What are the possible counter measures used to minimize Sino truck accident in this region?

1.5. Significance of the Study

Road traffic accidents due to SINOTRUK have been increasing from time to time however; the previous researchers were not focused on identifying the basic cause of the problem and its counter measures independently. Therefore, the result of this study will help to:

- ✓ Aware SINOTRUK drivers and traffic polices about the problem in order to contribute on their own part in reducing road traffic accidents.
- ✓ The study is believed to enrich the existing literature in SINOTRUK accidents caused by driver's and vehicle factors.
- ✓ To inform the current situation so that readers to save their life by showing the severity of the accidents.

- ✓ To create or design effective prevention and protection policy, strategy to policymakers, transport authorities, road engineers, and other concerned bodies, to take counter measures and monitor road safety problems.
- ✓ Give a clue to those who interested in conducting research on traffic accidents due to heavy trucks.

1.6. Scope of the Study

The study is confined on the major link roads of Amhara regional state. The study would have tried to show and identify the major cause of SINOTRUK accidents and their possible counter measures on the selected major link roads in the region. The researcher limited on this area because of time and budget constraint. Therefore, in order to complete this study with this limited time and budget, the researcher focuses only on drivers and vehicle factors that cause SINOTRUK accident on the major link roadway of the regional state.

1.7. Limitations of the Study

In this research the researcher was faced the following limitations starting from the beginning to the end of the thesis work.

- ✓ The Damaged property price estimation was not included the price of victim SINOTRUK and the estimation was not supported by professionals.
- ✓ SINOTRUK accidents faced on link roads was not recorded independently with others in crash recording sheets.
- ✓ Some SINOTRUK accidents were not recorded in legal way after accident that means some accidents were solved by victim driver's discussion.
- ✓ In this research, due to man power problem the data collection techniques were not supported to electronic video recording devices.

1.8. Challenges of the Study

The major challenges faced in this research includes the following;

- ✓ Transporting questionnaires from one place to other place and collecting questionnaires from respondents.
- ✓ Transportation: to collect the data at rural area, it is difficult to access transportation after data collection.

- ✓ It is difficult to access man power having knowledge and skill related to traffic data collection.
- ✓ Availability of responsible bodies: the responsible bodies in some of the traffic offices and transport offices were not avail timely.

1.9. Organization of the Paper

The research paper would be organized into five major chapters. The first chapter would be deals with the introduction of the paper that is background of the study, statement of the problem, research questions, objective of the study, significance of the study, the scope of the study, challenges and limitations of the study. The second chapter would be concerned with review literature. The third chapter would be deals research methodology and organization of the study. The fourth chapter would be deals data present, analysis and interpretation of the result, and finally the fifth chapter would be deals with conclusion and recommendations.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. General

According to Monash University Accident Research Centre, 2001 road traffic accident (RTA) is defined as accident which takes place on the road between two or more objects, one of which must be any kind of a moving motor vehicle. “Accident” is the commonly accepted word for an occurrence involving one or more transportation vehicles in a collision that results in property damages, injury, or death. But the word accident also expresses naturally occurring phenomena which causes death and property damage. The term “accident” implies a random event that occurs for no apparent reason other than “it just happened”.

The word traffic crash implies that the collisions that could have been prevented or its effect minimized by modifying driver behavior, vehicle design (called “crashworthiness”), roadway geometry, or the traveling environment (Nicholas J. Garber and Lester A. Hoel, Nicholas).

Athens university of medical school (2013) distinguished behavioral factors can be as (i) those that reduce capability on a long-term basis (inexperience, aging, disease and disability, alcoholism, drug abuse), (ii) those that reduce capability on a short-term basis (drowsiness, fatigue, acute alcohol intoxication, short term drug effects, binge eating, acute psychological stress, temporary distraction), (iii) those that promote risk taking behavior with long-term impact (overestimation of capabilities, macho attitude, habitual speeding, habitual disregard of traffic regulations, indecent driving behavior, non-use of seat belt or helmet, inappropriate sitting while driving, accident proneness) and (iv) those that promote risk taking behavior with short-term impact (moderate ethanol intake, psychotropic drugs, motor vehicle crime, suicidal behavior, compulsive acts).

Nicholas J. Garber and Lester A. Hoel, Nicholas showed that the major contributing cause of many crash situations is the performance of the driver of one or both (in multiple vehicle crashes) of the vehicles involved. Driver error can occur in many ways, such as inattention to the roadway and surrounding traffic, failure to yield the right of way, and/or traffic laws. These “failures” can occur because of unfamiliarity with roadway conditions, traveling at high speeds, drowsiness, drinking, driver’s age, educational levels and using a cell phone or other distractions within the vehicle

Like young drivers, older drivers tend to be over involved in vehicle crashes. Avinoam Borowsky, David Shinar and Tal OronGilad (2010) showed that the increase in older drivers' accident involvement is smaller than the increase in older drivers' presence in traffic. This finding may be partially because older drivers who are aware of their age-related limitations (e.g., physical, visual, etc.) adopt a self-regulation policy or related strategies such as driving slower, avoiding difficult conditions, reducing night driving, and driving only in familiar areas.

Heavy vehicles make a disproportionate contribution to road fatalities. Information from overseas jurisdictions shows that trucks are between 1.3 and 3 times more likely to be involved in a fatal accident than light passenger vehicles, per kilometer driven. Approximately 80% of the fatalities in truck-involved accidents are other road users. The main reason for this is the greater mass and structural differences of trucks relative to other road users. Overall, trucks are not more likely to be involved in an accident than light passenger vehicles, but this is countered by the greater harm when they are involved. The rate of fatal crashes involving trucks per million kilometers driven is around three times the rate for light vehicles. Road users other than truck drivers account for 80 percent of fatalities (Zealand Ministry of Transport, July 2015).

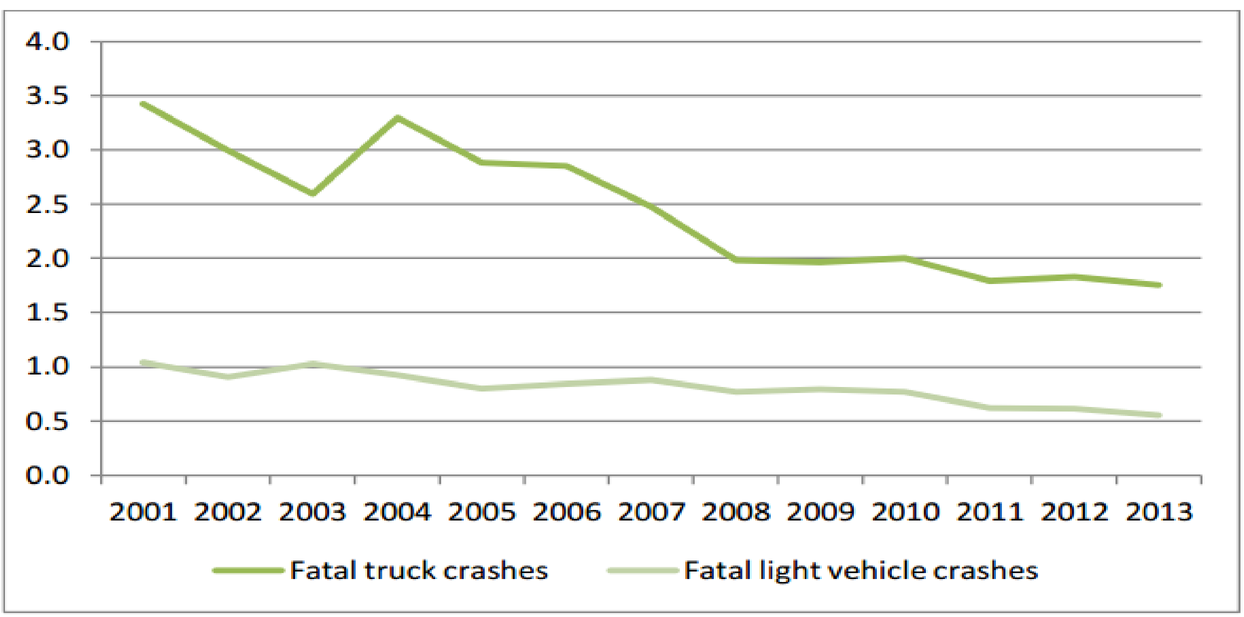


Figure 1: Fatal crashes in trucks and light vehicles in New Zealand, per million vehicle kilometers travelled 2001-13

Truck drivers are less likely than other drivers to be judged responsible in a multiple-vehicle accident in which they are involved. Data from New Zealand and overseas shows that truck drivers are judged to have some responsibility in 20-30% of fatal accidents in which they are involved. Critical risk factors for light vehicle drivers such as alcohol and night driving are less important for truck drivers because they are less likely to consume alcohol and drive. Despite a significant amount of research on the subject, the role of fatigue in truck driver accident risk remains unclear. Night driving and fatigue are prevalent factors in single-vehicle truck accidents, while impairment of other vehicle drivers is a factor in multiple-vehicle, truck-involved accidents. In multiple-vehicle accidents where truck drivers are found responsible, the most prevalent factors are inattention, poor observation, inappropriate speed and violation of road rules (New Zealand Ministry of Transport, July 2015).

The serious deficiencies in the training and qualification of drivers lead to increased number of accidents due to speeding and inability to respond quickly and adequately in distressed situations. The low road culture of the majority of road users violating traffic rules, poor state control and unsatisfactory road infrastructure conditions lead to the occurrence of accidents, which are enormous material and personal loss for society. It is necessary to identify priority areas in which traffic safety organizations to work. An interaction between state institutions is necessary to improve road safety at national, regional and municipal level (Nikolay Georgiev, Violina Velyova, Mileta Dimitrova, 2014).

2.2. Association Between Age and Fatality and/or Crash Rates in Commercial Heavy Vehicle Drivers

In 1991 in USA the minimum age for drivers of commercial vehicles engaged in interstate commerce was 21 years, and consideration was being given to lowering this age to 19. The focus of this study was to examine age in relation to accident rate, as well as to other factors associated with increased accident risk (such as time of day, type of heavy vehicle). The results demonstrated that risk estimates of percent accident involvement per percent of travel for drivers of large heavy vehicles continue to be over-involved until the age of 27 years, when the risk generally decreased until the age of 63, after which increases was observed.

Increased risk associated with accidents/fatalities for younger drivers of heavy vehicles was also supported by McCall and Horwitz (2005), Häkkänen and Summala (2001), Braver et al. (1992), Stein and Jones (1988) and Hamelin (1987). Analyzing worker's compensation data in Oregon, USA for truck accidents between 1990 and 1997, McCall and Horwitz (2005) found an over-representation of claims related to accidents for heavy vehicle drivers' ≤ 25 years of age: 19.5% of claims for ≤ 25 years while for the same period heavy vehicle drivers 25 years or younger represented only 8.5% of heavy vehicle drivers in Oregon. The majority of claimants were for heavy vehicle drivers' ≤ 35 years of age (51.4%) and had less than one year of job tenure (51%). The findings of this study support an elevated risk of fatal involvement for younger drivers of large heavy vehicles.

2.3. Heavy Vehicle Drivers, Fatigue and Accidents

Driver fatigue has been identified as a leading contributor to roadway crashes among workers as well as the general population. Fatigue affects driving performance by impairing information processing, attention, and at times reaction times; it may also cause a driver to fall asleep. Time of day, duration of wakefulness, inadequate sleep, sleep disorders, and prolonged work hours have all been identified as major causes of fatigue (Akerstedt, 2000). Driver drowsiness or fatigue has been implicated in fatal crashes: in USA in 2000, 3.1% of crashes were attributable to fatigue or driver sleepiness. However, fatigue was reported for 7.4% of drivers of large heavy vehicles involved in single-vehicle crashes and implicated in only 1.0% of large-heavy vehicle drivers involved in fatal, multiple-vehicle crashes (Pratt, 2003)

Kanazawa et al. (2006), Howard et al. (2004), Maycock (1997) and Summala and Mikkola (1994) have found that being a younger driver of a heavy commercial vehicle is associated with a higher risk of excessive sleepiness at work with an expected higher risk of accident involvement. Kanazawa et al. (2006)conducted a cross-sectional study of commercial long-haul heavy vehicle drivers in Japan (N= 1005) assessed burden of driver characteristics (e.g. age) and work factors (e.g. night shifts) on excessive sleepiness at work and sleep quality disturbance and found that compared to 18–29 year old, with increasing age there was a decrease risk of excessive sleepiness at work and lower associated risk of accidents; with the reference age group 18–29 years, OR (95% CI) were 0.9 (0.5–1.6), 0.6 (0.3–0.9) and 0.3 (0.2–0.5) for age groups 30–39, 40–40,≥50 years, respectively. This trend is further supported by results of an interview study of 996 heavy goods vehicle drivers in the UK, which included administration of the Epworth Sleepiness Scale (ESS) and self-report of accident history (Maycock, 1997) that found the accident frequency was highest for the youngest group of 17–29 years and the accident frequency decreased to less than one third of this for drivers over 55 years of age; this result was considered to be the combined effects of age and driving experience. Likewise, in an Australian survey of commercial drivers (N= 1687) aged between 16 and 71 years, of sleepiness and self-reported accidents, Howard et al. (2004) found age to be a strong predictor of accident risk (in the last three years) with increase in age associated with a decrease in risk (OR: 0.86, p= 0.03). Results of Summala and Mikkola (1994) research in Finland using in-depth studies of accidents where at least one occupant had died (N= 586 single vehicles; 1357 multiple vehicle) among car and truck drivers found trailer-truck drivers for whom fatigue contributed to the accident were younger than those involved in other types of fatalities.

2.4. Importance of Heavy Vehicle Safety

Accidents involving heavy vehicles are acknowledged to account for a disproportionate percentage of fatalities among road users. The Ministry of Transport reports that in 2012, trucks were involved in 17 percent of road fatalities and 6 percent of reported injuries on New Zealand roads although they accounted for just 6 percent of the total distance travelled (MoT, 2013). Fatalities involving trucks have dropped to about a third of what they were in the early 1990 but their proportion of the total road toll has remained relatively stable. The rate of fatal crashes involving trucks per million kilometers driven is around three times the rate for light vehicles (see Figure 1). Road users other than truck drivers account for 80 percent of fatalities. (9)

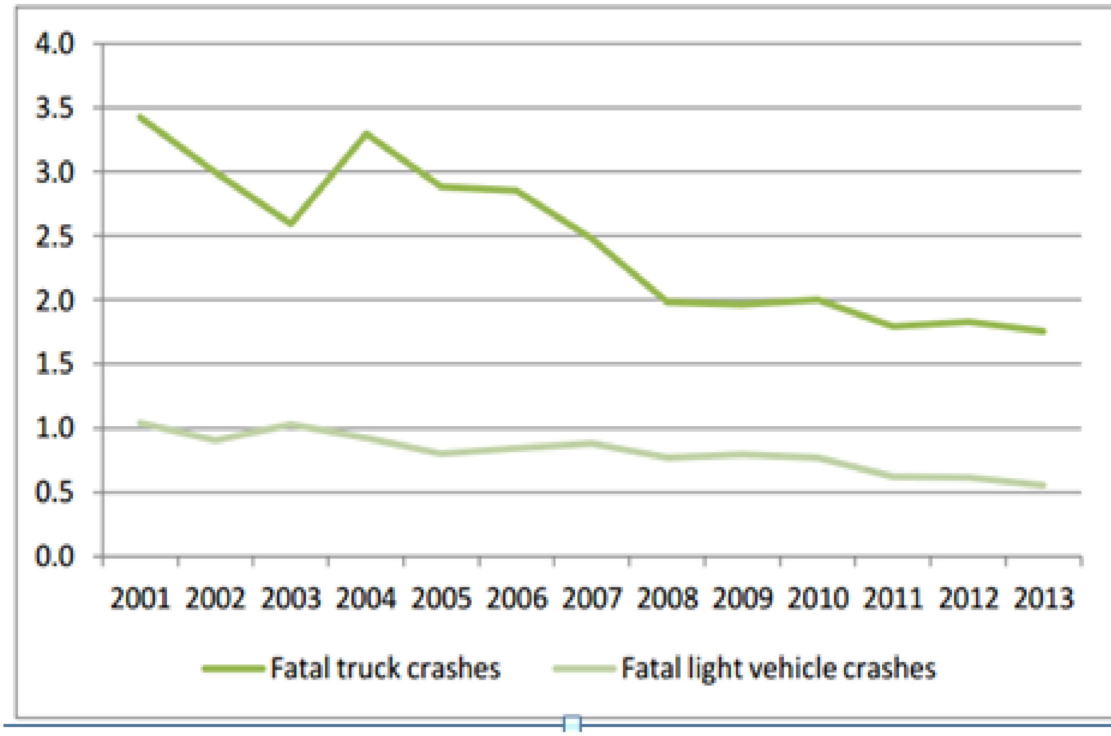


Figure 2: Compression fatal crashes between trucks and light vehicles

In Australia, Fabre and Christie (1999) estimated that there were approximately three times as many fatalities per million kilometers driven by trucks compared to passenger vehicles or buses. The main reason for the overrepresentation of heavy vehicles in fatal accidents is most likely their greater mass and structural differences relative to other road users (such as cars and pedestrians), which makes death more likely in any given accident.

2.5. Heavy Vehicle Accident Factors

Overall, multiple vehicle (MV) crashes with truck driver crash were more similar to multiple vehicle crashes with other vehicle critical reason (CR) than to single vehicle (SV) crashes.

Avinoam Borowsky, David Shinar and Tal OronGilad. Beer Sheva, Israe (2010) mentioned that heavy vehicle crashes were significantly less likely to involve excessive speed or alcohol in either rural or urban areas, or fatigue, road factors, poor handling, or poor judgment in rural areas.

Night driving: Driving during the hours of darkness is recognized as a factor in accident risk for light vehicles. For heavy vehicles, Campbell (1991) found that night time accident risk was approximately double that of daytime driving, while Blower and Campbell (1998) reported that overall, night time fatal/casualty accident risk for truck-trailer combinations was also about double that of daytime. Night time accidents tended to be more severe, with about three times more fatalities per thousand crashes.

Fatigue: Fatigue is one of the most widely-discussed and researched topics in relation to heavy vehicle safety, although conclusions about its role in accidents vary. Blower and Campbell (1998) suggest that fatigue is underestimated as a factor in accidents – studies report from a few percent to 40% - though they have mainly concentrated on the truck driver, when fatigue is also a factor in non-truck drivers. They report Fatal Accident Reporting System (FARS) data from 1993-95 in Israel (Ben-Gurion university) showing that fatigue was identified as a factor in 9.7% of single vehicle truck crashes (reaching around 20% in accidents between midnight-6:00 am), but in multiple vehicle crashes it was 0.9% for truck drivers and 2.4% for non-truck drivers.

Distraction: Inattention and/or poor observation are among the most common factors in the studies of truck crashes from different jurisdictions cited above. They also seem to be the most frequent contributing factors in multiple-vehicle crashes where the truck driver is judged to have some responsibility for the accident. Perrin et al (2007) suggest that distraction may be an underreported factor in crash databases and that further research is needed.

Alcohol: Rogers and Knipling (2007) reported that in the US 2002, only 2% of truck drivers involved in fatal crashes had a BAC above 0.08%, as opposed to 25% of non-truck drivers. Data reported by the US Federal Motor Carrier Safety Administration (FMCSA, 2014) shows that during 1992-2012, drivers of other vehicles in truck involved fatal accidents were about ten times more likely to have a Blood Alcohol Content (BAC) over 0.08% than truck drivers.

Excessive Speed: The speed of motor vehicles is at the core of the road traffic injury problem. Speed influences both crash risk and crash consequence. The physical layout of the road and its surroundings can both encourage and discourage speed. Crash risk increases as speed increases, especially at road junctions and while overtaking as road users underestimate the speed and overestimate the distance of an approaching vehicle (New Zealand Ministry of Transport, July 2015.)

According to New Zealand Ministry of Transport (July 2015) drivers' speed choice is influenced by a number of factors that can be considered as:

- ✓ Driver-related factors (age, sex, alcohol level, number of people in the vehicle),
- ✓ Factors relating to the road and the vehicle (road layout, surface quality, vehicle power, maximum speed)
- ✓ Traffic related and environment-related factors (traffic density and composition, prevailing speed, weather conditions).

Driver's age and experience: according to New Zealand Ministry of Transport, (July 2015) young drivers involved in accidents were 50% more likely to be charged with a violation than middle-aged drivers. In car vs. truck accidents, young truck drivers were more likely than the car driver to be charged with a hazardous action or violation – the opposite of the case for truck drivers in general. The author's review of a sample of accident cases involving young drivers revealed that overly aggressive driving, unsafe speed, poor vehicle control and attention deficits all played a role, as did failure to anticipate the unexpected actions of other road users.

The effects of truck driver age and experience in accident risk is considered by Sullman et al (2002), whose primary purpose was to evaluate the effect of aberrant driving behaviors (errors, lapses and violations) on truck driver crash risk. The study used self-reported accident involvement and driving behaviors in 378 New Zealand truck drivers, the majority of whom worked hauling logs, milk or petrol (hence likely to have been driving larger truck-trailer combination vehicles). They found that younger driver age was significantly correlated with accident involvement, driving violations and aggressive violations as well as with higher preferred driving speed. Driver age was very highly correlated with track driving experience, so the study does not separate age from experience factors (although experience was not significantly correlated with aggressive violations).

Table 2: Crash rate according to different age categories (New Zealand Ministry of Transport, 2015)

Age group	Male		Female		Accident rate male-female ratio
	No. of accidents	Accident rate (accident per 1000 drivers)	No. of accidents	Accident rate (accident per 1000 drivers)	
18-25	1,217	16.12	106	4.19	3.85
26-35	3,259	16.32	95	4.96	3.29
36-50	1,767	16.46	87	5.04	3.27
51-65	357	14.51	20	4.91	2.96
>65	204	11.73	10	3.77	3.11
Total	6,804		318		

Variations among age groups are statistically evaluated at the 5% significance level. Evaluations indicate that male and female accident rate differences are significant only among age groups less than 50 years. In older age groups, differences are not significant.

Overall, there have been fewer, less rigorous studies of the relationship between age, experience and accident risk for truck drivers than for car drivers. However, available findings report higher accident risk for younger drivers, particularly for drivers under 21 years of age. When involved in an accident, younger drivers were also more likely to be judged to have contributed to the accident. The Avinoam Borowsky, David Shinar and Tal OronGilad and Beer Sheva (2010) findings suggest that maturity and judgments, rather than just driving experience, are factors in age -related accident risk. These findings suggest a precautionary approach to lowering the effective minimum age for driving the heaviest vehicles or for seeking a more important role for younger, less experienced drivers in the truck-driving workforce.

2.6. The Impacts of Age and Experience on Heavy Vehicle Safety

There is considerable evidence on the independent and combined effects of age and experience on driver safety for car drivers (e.g., McCarty, 2009; Mayhew et al, 2003; OECD-ETC., 2006), but less evidence specifically for heavy vehicles. Duke et al (2009) review the available literature and find some support for the hypothesis that younger heavy vehicle drivers (under 27 years) have more likelihood of being involved in a serious crash. However, none of the studies cited by the authors separate age effects from experience effects.

Blower (1996) undertook an analysis of accident rates based on the population of commercial driver license (CDL) holders in Michigan. He found that the youngest drivers had six times the rate of casualty accidents and four times the rate of property damage-only (PDO) accidents compared to all CDL holders, and 20-21-years old had 2 and 2.5 times the casualty and PDO accident rates respectively. The study also found that truck drivers aged 18 to 21 in Michigan and North Carolina had twice the rate of traffic violations as drivers 30 to 49.

Data available from New Zealand's Crash Analysis System (CAS) for 2008-14 indicates that truck drivers under the age of 20 who are involved in an accident resulting in injury are much more likely to be assigned responsibility for the accident. As shown in Figure 2, this holds for all injury accidents and for serious and fatal accidents combined, but not for fatal accidents alone, although numbers are small for the latter case.

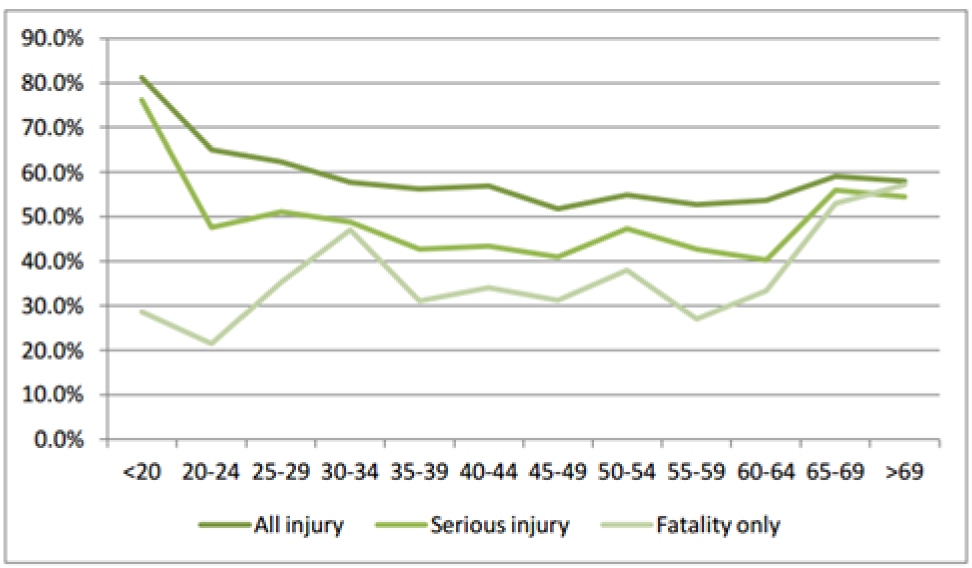


Figure 3: injury versus age groups of heavy vehicle drivers in New Zealand

The effects of truck driver age and experience in accident risk is considered by Sullman et al (2002), whose primary purpose was to evaluate the effect of aberrant driving behaviors (errors, lapses and violations) on truck driver crash risk. The study used self-reported accident involvement and driving behaviors in 378 New Zealand truck drivers, the majority of whom worked hauling logs, milk or petrol (hence likely to have been driving larger truck-trailer combination vehicles). They found that younger driver age was significantly correlated with accident involvement, driving violations and aggressive violations as well as with higher preferred driving speed. Driver age was very highly correlated with truck driving experience, so the study does not separate age from experience factors (although experience was not significantly correlated with aggressive violations).

2.7. Driving Experience and Visual Attention

Many researchers agree that driving experience is one of the key predictors of crash rates (Chapman and Underwood, 1998; Gregersen and Bjurulf, 1996), with young novice drivers being particularly at risk (Clarke et al., 2006; Neyens and Boyle, 2008). Although accident risk in young drivers has been decreasing both in the USA (Foss, 2007) and Europe (Twisk and Stacey, 2007) traffic crashes still constitute the most common cause of death for young people in the developed world (Clarke et al., 2005), with a global annual loss of around 400,000 people aged under 25 (WHO, 2007). In relation to night driving it has been found that young novice drivers are at proportionally higher risk (Clarke et al., 2006), with young drivers having up to three times more crashes at night than daytime (Williams, 2003).

An important factor that links the potential increased crash risk of low visibility conditions with driving experience is the deployment of visual attention. This includes both foveal and peripheral attention, which have both been shown to change with increased task experience. For example, it has been suggested (Ball et al., 1993) that the Useful Field of View (UFoV) is a better predictor of accidents in older drivers than the typical acuity tests. Also, the extent of peripheral attention has been shown to be dependent on cognitive factors, such as processing load, which can be moderated by driving experience (Crundall et al., 1999, 2002). If night and rain driving increases cognitive demand, then this may reduce the useful field of view in these conditions.

2.8. Driving Experience and Hazard Perception

The ability to "read" the environment and to anticipate a possible hazard which may (or may not) materialize is experience related. Young drivers who lack the appropriate experience-based knowledge (e.g., Endsley, 1995; Logan, 1985) have difficulties in anticipating potentially hazardous situations because they have not yet accumulated enough feedback (experience) from similar situations in which the potential hazard materialized. Hazards must be salient and pose an imminent and obvious threat before young-inexperienced drivers decide to take action. Older and experienced drivers, who have much more driving experience as well as more established experience-based knowledge, were able to indicate (anticipate) potentially hazardous situations even when the probability that they will materialize was low. In support of this notion we found that both experienced and older-experienced drivers fixated on potentially hazardous situations such as a merging road at a T intersection even when no salient hazard was visible. These results are consistent with those of Pollatsek et al. (2006) who found that novice drivers are not searching for hazards in areas along the road where potential hazards are obscured.

According to Mehrdad Givechi (2013) the more experienced the driver, the greater the expectancy, which can be good and bad in terms of roadway safety. More driving experience leads to quicker and more accurate reactions as long as driver's expectancy is met. However, a sudden change in road conditions violates this expectancy and increases the likelihood of driver error and increased reaction time because the driver takes longer to understand the situation and respond to it.

2.9. Age and Hazard Perception in Heavy Vehicle Drivers

Older drivers in the present research had more than 37 years of driving experience on average. Consistent with Bolstad and Hess (2000), and Underwood et al. (2005) our older and experienced drivers detected more potential hazards than young drivers. Older drivers' ability to perceive hazardous situations was not significantly affected by age-related problems. This finding is consistent with the results of some other studies (e.g. Bolstad and Hess, 2000). Event M1E3 demonstrated that older drivers responded on average 2.15 s later than experienced and young drivers to events, and they also described the hazard instigator as being caused by another driver (e.g., "lack of signaling" of the lead vehicle) and not by assuming own responsibility (as "I had to brake") like the majority in the other two groups. However, this finding needs to be further examined on a wider array of events.

According to Roeder Cartage (2016), track drivers should have the following seven characteristics that make a successful truck driver.

Able to work independently: Life as a trucker means going through long stretches of time being alone. In order to be successful, track drivers have to be ok with being alone with them and their thoughts. Additionally, track drivers have to have the ability to be a self-starter/motivator; taking responsibility for all tasks that need to get done.

Adaptable: Sometimes this job can be unpredictable. Being able to smoothly transition from roadblocks, both on and off the road, would make the job more enjoyable.

Reliable: There is someone relying on truck drivers to make that delivery. When drivers take on a job, they are giving their word that they would get the delivery made at a certain time. Being reliable on the job means people trust they get the job done right.

Responsible: Some people carry around a greater sense of responsibility than others. Truckers are responsible for hauling thousands of pounds of goods to (sometimes) great distances. Being responsible in this field means taking safety seriously.

Stress management skills: Man, can things get stressful while trying to make a delivery? So many things can potentially go wrong, highway backup because of an accident or driver's vehicle tire blew and drivers have to be able to handle that stress. Setbacks are going to happen; great truckers know how to handle those setbacks with ease.

Timeliness: In trucking, drivers have to make their delivery dates and times. they need to have time management and be able to forward think to plan out their day and/or sleep schedule so they can make that delivery safely and on time.

Work ethic: Successful truck drivers have a strong work ethic for all the characteristics listed above and more. Having a strong work ethic means continually striving to go above and beyond what is required of you. This is what truly sets truck drivers apart from the rest.

2.10. Driving and Accidents as Interaction Processes

As stated by Mehrdad Givechi (2013), the term 'human error' can be misleading, giving the impression that an accident is only the result of the last action performed in its sequential course, which is an oversimplified conception of how events occur. Differentiating from the common sense acceptation of 'human error', HFF viewed from an ergonomic meaning will not be considered as the origin of the accident, but as the result of factors which involve the different components of the system: drivers, vehicles, layout, etc.

An accident is the result of an incorrectly adjusted interaction between the system components. So, the cause of accident should not be searched into one or another of these components taken separately, but in the defective inter-component interactions (Mehrdad Givechi (2013)).

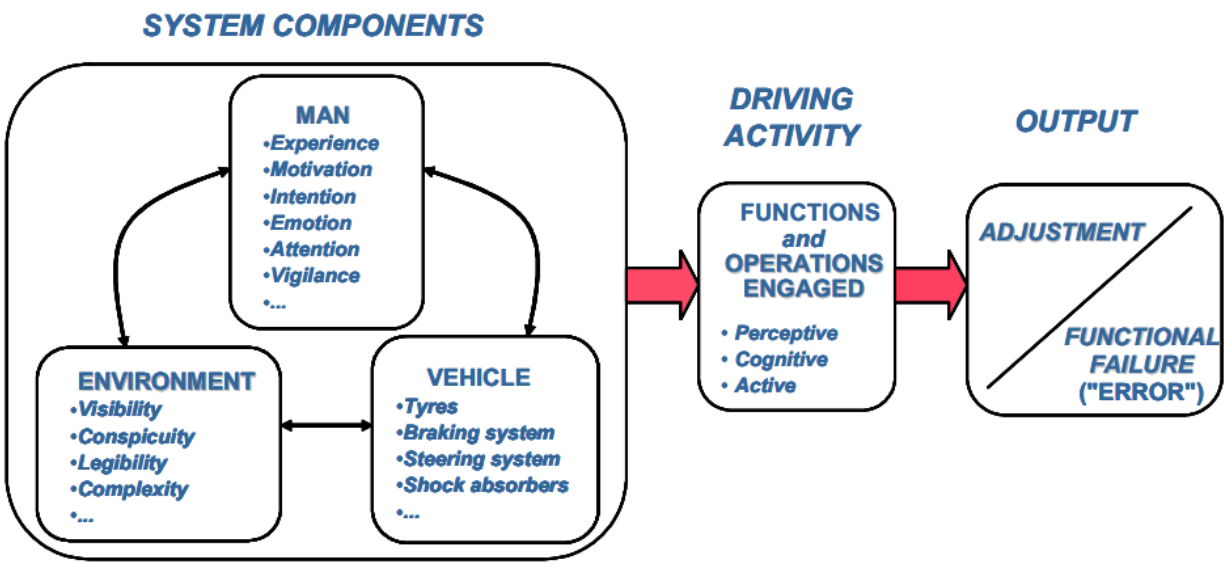


Figure 4: Interactions within the elementary Human-Vehicle-Environment system. (source: Kansas Local Technical Assistance Program, 2013)

It is important to recognize the specific role of the human element in the traffic system: it is both a component and the principal actor of its functioning.

As a component, the driver is characterized by a certain number of internal variables (e.g. Experience, Motivation, Vigilance, Attention, etc.) which are in a certain state, more or less favorable to driving task performance. In the same way, the other components of the system are also described by variables in a more or less degraded state. The interaction between these components forms the driving system and the factors of accidents are to be found inside these human, vehicular and environmental states of this system.

But the driver is also the element that drives the system. It is his or her task to regulate his activity and adjust it to the problems arising from the interactions between the different components, including him. To negotiate those difficulties, he performs a number of functions, especially cognitive ones. And we shouldn't forget that most of the time the use of these functions allows road users to succeed in compensating from driving system drawbacks. These human functions are at the basis of the (efficient) driving system functioning. But the same functions that usually enable the driver to regulate his activity may fail if he encounters major malfunctions within the system that prevent those functions from attaining their regulating objective. It results as an output in a functional failure (related to detection, cognition and action), which is commonly called 'human error'.

2.11. Delineation of Human Functional Failure

To make things easier, failures found in accident cases are delineated below in a 'Classification model for human functional failures in road accidents' following a sequential information processing chain of human functions involved in information gathering, processing, decision and action. It doesn't imply at all that drivers effectively function in a linear way. In the common functioning of the individual, there are numerous feedbacks between the various modules, and the data processing is strongly looped. But involving accidents as in the analysis which follows, we stop this functional buckle in the stage of rupture in the progress of the driver, as he is confronted with an unexpected difficulty which is going to lead him to lose the control of the situation which was more or less suitably regulated so far (Van ELSlande, Claire Naing and Ralf Engel, 2008).

2.12. Factors Leading to Human Functional Failure

Based on Mehrdad Givechi (2013) description human failures occur at the end of a dysfunctional process. They are explained by factors characterizing the state of the system, i.e. the defects of its components (human and other) and of their interactions. These factors form the explicative elements of the road users' incapacity to adapt to the situation in hand or to adopt a suited behavior. They are essential to be clearly characterized in order to find operational means to prevent the occurrence of human failures.

Depending on the specific accident scenario, the same factors can appear at different stages of the accident and may have different roles, being contributing, triggering, or aggravating factors to the process. A specific factor could appear within any of these four phases and influence the likelihood of a functional failure, which occurs between the rupture phase and emergency phase.

As part of classifying factors which lead to human functional failure, three integrated levels of categorization were developed, corresponding to the types of real-world accident data commonly available to analysts

Table 3: General Classification of Factors Leading to Functional Failure.

User (U)	A. User State	1. Physical/ Physiological
		2. Psycho-Physiological Condition
		3. Internal Conditioning of Performed Task
	B. Experience	1. Little/None
		2. Over- Experienced
	C. Behaviour	1. Conflicting (Distraction)
		2. Risk Taking
Vehicle (To)	A. Road Condition	
	B. Road Geometry	
	C. Traffic Condition	
	D. Visibility Impaired	
	E. Traffic Guidance	
	F. Other Environmental Factors	
Environment (E)	A. Electro-Mechanical	
	B. Maintenance	
	C. Design	
	D. Load	

User (Human): This category of factors is described as any factors related to the individual and personal demographic. This includes any physical (e.g. Level of vigilance) and psychological (e.g. level of attention) states that may be of relevance, any psychomotor disorders that the user may have incurred through alcohol or misuse of drugs, or any emotional/motivational states unfitted with safe and efficient driving. The user is defined as any human in charge of a vehicle within the accident (e.g. driver, motorcyclist, cyclist) or any pedestrian injured in the accident, and is described as a ‘road user’.

From reviewing the literature and current data collection systems, three main subcategories of user factors were decided on, as follows:

- ✓ User State
- ✓ Experience
- ✓ Behaviour

Environment: The environment encompasses all aspects related to the users' surroundings (i.e. External to the vehicle and road user). Six categories of environment-related factors have been defined and are outlined below:

- ✓ Road Condition
- ✓ Road Geometry
- ✓ Traffic Condition
- ✓ Visibility Impaired
- ✓ Traffic Guidance
- ✓ Other Environmental Factors

Vehicle (Tool): This category involves the equipment or devices the user is interacting with in the task. The subcategories developed to deal with the vast array of tools were:

i. Mechanical – Vehicle failures which directly affects vehicle control;
ii. Maintenance - Anticipated vehicle fault, indirectly affects control of vehicle;
iii. Design - Design of vehicle affects safe/efficient operation;
iv. Load - Did a vehicle load affect ability to control vehicle?

Further thought is needed to ensure that the 'tool' can be related to any type of 'vehicle' used on the road, including car, van, truck, bus, motorcycle, bicycle. Also, if this tool is also to be relevant for pedestrians, consideration must be given to what the 'pedestrian's' equivalent 'tool' (vehicle) is? For example, in OTS, 'shoe' is coded as the pedestrian's vehicle.

2.13. General Overview of Traffic Accident in Ethiopia

The 2011 traffic accident report of the Ministry of Transport National Road Safety Council indicated that next to pedestrians (51%), passengers' accident ranks second, accounting 46% of fatality. Of the total traffic accidents, 93% of the cases were associated with human factors, 5% accounted for vehicle factors, and 2% were associated with road related problems. Similarly, the Ethiopian Federal Police report of (2011) stated that road accident level of the country is one of the worst in the world, as expressed by per 10,000 vehicles. Moreover, the report stated that majority of road accidents were concentrated in Addis Ababa, which is the capital city of Ethiopia, and Oromia region, accounting 58 percent of all fatalities and two-third of all injuries. A five-year (2003 to 2007) average traffic accident record of the Federal Police Commission show that, of the total fatal accidents, 76% were caused due to drivers' error, 6% due to vehicle technical problems, 5% due to pedestrian error, 2% due to road defects and 12% due to other factors. This indicates that drivers' error has been contributing to majority of the road accidents in Ethiopia (Minister of Transport, February, 2011).

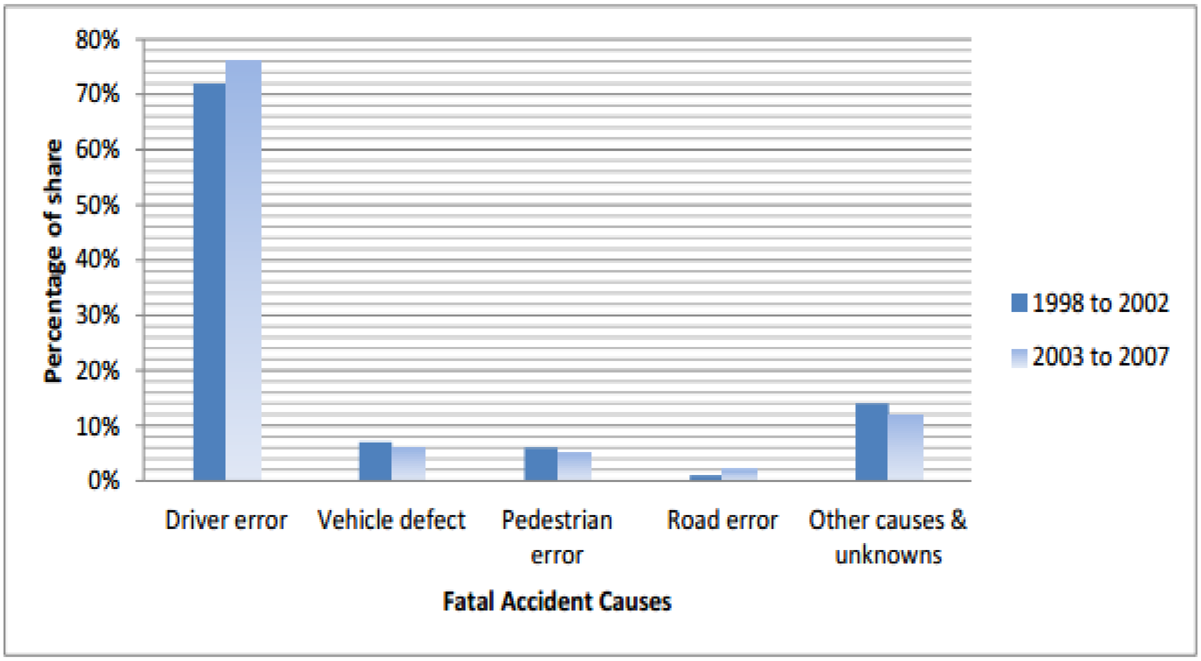


Figure 6: Causes of fatal accidents for the periods 1998 to 2002 and 2003 to 2007

The report further indicated that problem of road defects as a direct cause of accident was very low. The summary report of the Federal Police Commission also shows that 82% of the accidents occur on straight and level roads with good surface, while 83% of all the accidents were occurred on good asphalt roads. During the last five years, the ratio of people who injured as a result of traffic accidents (fatal, serious and light) includes 48% pedestrians, 45% passengers and 7% drivers. This all facts show that majority of traffic accidents have been caused by poor driving skill or negligence towards traffic rules and regulations. (Ministry of Transport, February, 2011).

As per the same report, which was prepared using road crash data collected from the Federal Police Commission, the underlying reasons for road traffic accidents were:

1. Improper behavior or low skill of drivers, which is associated with:
2. Poor technical conditions of vehicles (shows improvement over the last 5 years)
3. Poor traffic law enforcement
4. Safety consideration not sufficiently addressed during roads developments and etc.

Overview of the above assessment of road traffic accidents in Ethiopia indicated that majority of traffic accidents have been registered in major towns and cities where there is large number of vehicles. As a result, road traffic accident, especially in the main and city road, is now a major concern for the government and institutions working on road safety as well as the public in general. These shows that the challenges of traffic accident in major towns and cities require focused and coordinated effort to curb the problem at hand.

Figure 7: Very Series sinotruck Accident images in Amhara Images in the Region (@ degan near to Kombolcha, durbetie to kosober line, near to woldiya and near to Shewarobit town)

2.14. Classification of Crash by the Traffic Police

According to Nicholas J. Garber and Lester A. Hoel (4^{th} edition) road traffic crash can be summarized based on type, pattern, crash severity, by contributing circumstances, by environmental conditions and by time period. The traffic polices classify the crashes based on crash pattern (type) and severity level at the site of crash. The victims and the number of vehicles and/or people involved have been identified by the traffic police at the time and place of occurrence. They have been used four classes or levels to describe severity. Those are fatal, heavy injury (serious injury), light injury and property damage.

Fatality: Fatal injuries are clear to classify and it includes immediate death and death after the medical treatment (untreatable injury) due to the accident. The medical report is vital for the fatalities after treatment. They told us that they have been using this technique to identify fatalities of crash.

Heavy/ Serious Vs. Light Injury: Identification have been made between heavy and light injury that if injured persons have got breakdown of one of his organs (teeth, bone, leg, hand… for example), then it will be reported as heavy injury. But this inclusion is made with the support of medical report about the injury level of the victim which will have been submitted for juridical conclusion. Light injury classification is made if the victim has no damaged body parts in addition to the medical report.

Property damage: Statements of traffic policemen reveal that for the economic appraisal due to property damage, policemen, drivers and professionals and experienced personnel are involved. Rating is also done by the legal jurisdiction.

CHAPTER THREE

2. MATERIALS AND METHODS

This chapter covers the materials methods used to undertake the research. To attain the objectives of the study, the different materials and methods applied for study is summarized and incorporated in this section. Accordingly, this chapter deals with materials used in the research, data source, types of data and data collection techniques, data analysis techniques, and data processing. Details of these techniques are presented as shown below.

3.1. Materials

To complete this research, the researcher used different materials in addition to computer, pen and paper. Some of the materials are;

- ✓ Lasso
- ✓ Stopwatch
- ✓ Meter

Lasso: this material was used as a reference for starting and ending points in order to start and stop to record the time used to calculate the speed. First the lasso was extending along the road transversally at the starting point and the the recorder starts to recorded the time and plate number immediately when the the front wheel of the vehicle touched the lasso at the entry reference point. At the end reference the second recorder starts to record the time and plate number when the vehicle touched the lasso at the exit reference point.

Figure 8: Lasso used as a reference for starting and end points

Stop watch: this material was used to record the time. The stop watch was beginning when the front wheel of the vehicle stars to tech the lasso at the beginning and ending points.

Meter: is a device used to measure the distance between starting and ending points in order calculate the speed of the vehicle or to identify the speed selection of drivers.

Figure 9: Distance measuring tape

3.2. Description of the Study Area

"The Amhara Region is located in the northwestern part of Ethiopia. Its land area is estimates at about 170000 square kilometers. Amhara borders Tigray Region in the North, Afar in the East, Oromiya in the South, Benishangul-Gumiz in the Southwest and the country of Sudan in the west. (17)

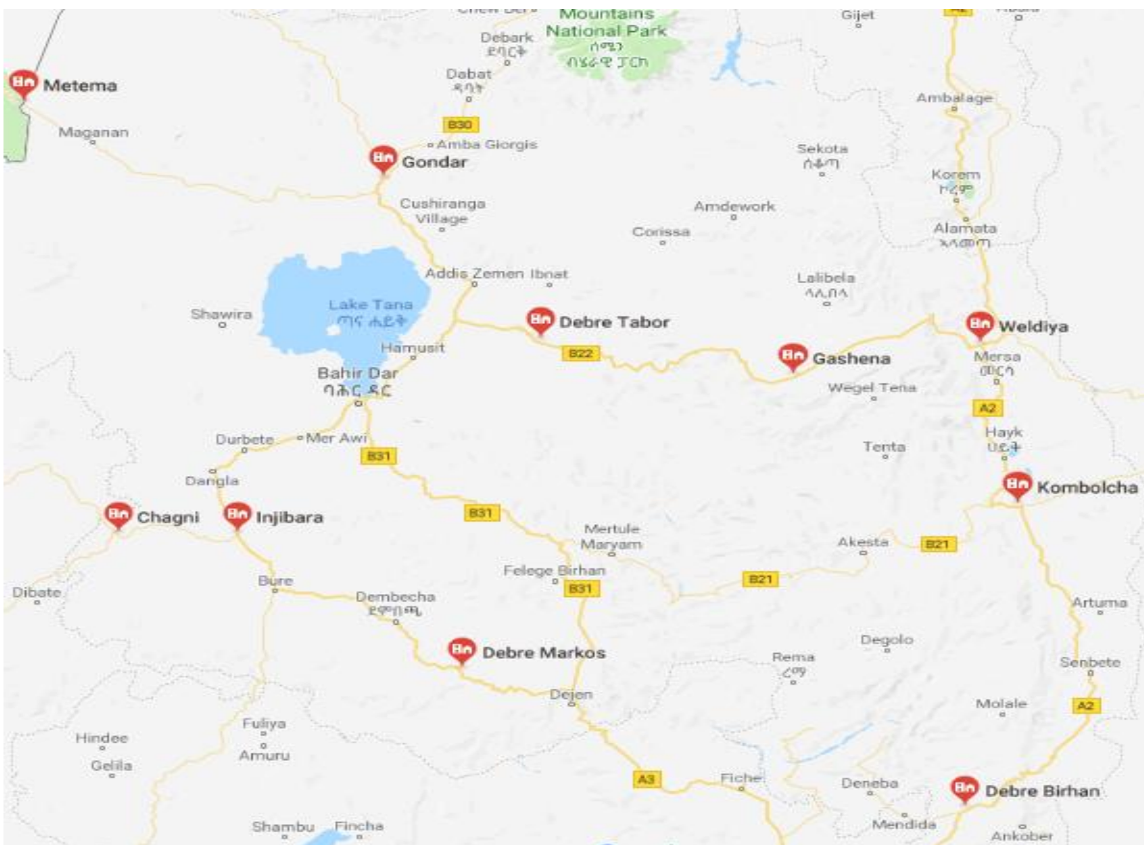


Figure 10: link roads in the study area (Amhara regional state)

Amhara Region (Amharic: □□□) is one of the nine ethnic divisions of Ethiopia, containing the homeland of the Amhara people. Previously known as "Region 3", its capital is Bahir Dar. Ethiopia's largest inland body of water, Lake Tana, which is the source of the Blue Nile river, is located within Amhara. The region also contains the Semien Mountains National Park, which includes Ras Dashan, the highest point in Ethiopia. Amhara is bordered by the state of Sudan to the west and northwest, and in other directions by other regions of Ethiopia: Tigray to the north, Afar to the east, Benishangul-Gumuz to the west and southwest, and Oromia to the south. (18)

3.3. Research Approach

In this study, the researcher was used both qualitative and quantitative research approach (which is known as a mixed approach). A mixed research design involves having both a quantitative design and qualitative design. This approach was selected because this study requires both quantitative and qualitative designs to address the problem statement. Mixed design studies take significantly more time, more resources, and require the researcher to develop expertise in qualitative analysis techniques and quantitative analysis techniques. Qualitative studies can use numbers, counts and even descriptive statistics. Using numbers does not mean the study has to be quantitative or mixed methods.

Nowadays, a number of researchers are applying mixed approach to reduce the weakness of qualitative and quantitative approaches. According to C.R. Kothari (second revised edition, 2004) the weakness of qualitative design includes; the knowledge produced may not be generalized to other people or other settings (i.e., findings may be unique to the relatively few people up on whom the research focused), the results are more easily influenced by the researcher's personal biases and idiosyncrasies, etc. The weakness of Quantitative design also includes knowledge produced may be too abstract or general for direct application to specific local situations, contexts, and individuals. The evolution of mixed approach is associated with the field of social psychology. It intends to converge, i.e. to triangulate the different qualitative and quantitative data sources. Among the mixed approach strategies, transformative strategy was employed in this inquiry (C.R. Kothari, 2004). transformative strategy may or may not be sequential during data collection.

Priority can be given to either of the designs (qualitative or quantitative). The strategy has a theoretical perspective to guide the study. Statistical methods were also employed here to now the association of different contributing factors and compare the causes of SINOTRUK accident which played significant role in SINOTRUK accident. Therefore, the use of statistical software's was possibly being important for both quantitative and qualitative data.

The first stage of the study period was being possibly gathering all necessary data from observations, interview, recorded data from traffic authorities and other institutions. Then, the causes or contributing factors of SINOTRUK accident was evaluated using crash report data with the help of questionnaire and interview results taken from SINOTRUK drivers. Then the possible engineering counter measures for those problems was recommended.

3.1. Data Source

Now researchers use both primary and secondary sources in order to conduct research. In this thesis, the researcher uses those two types of sources. The primary data were collected from garages, drivers and responsible bodies through interview and questionnaires. The secondary data was taken from each selected zone traffic police office records and Amhara regional state traffic police offices. So, this research is based on primary sources obtain through, questioners and interview and secondary sources obtained from traffic police office records.

3.1. Types of Data

The data collected to achieve the objectives of this research can be classified in to two as primary data and secondary data.

Primary Data: this is the data which were not collected published before this research. The primary data used in this research were SINOTRUK speed data on the selected roads and data collected through questionnaire and interview.

Secondary Data: Secondary data is a type of data that has already been published in books, newspapers, magazines, journals, online portals etc. in this research the secondary data includes traffic accident data, the selected road design speed data and other literatures taken from different journals and books.

3.2. Research Design

According to C R Kothari, A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data.

The general conceptual structure (flow) of the research design can be summarized below as a flow chart form.

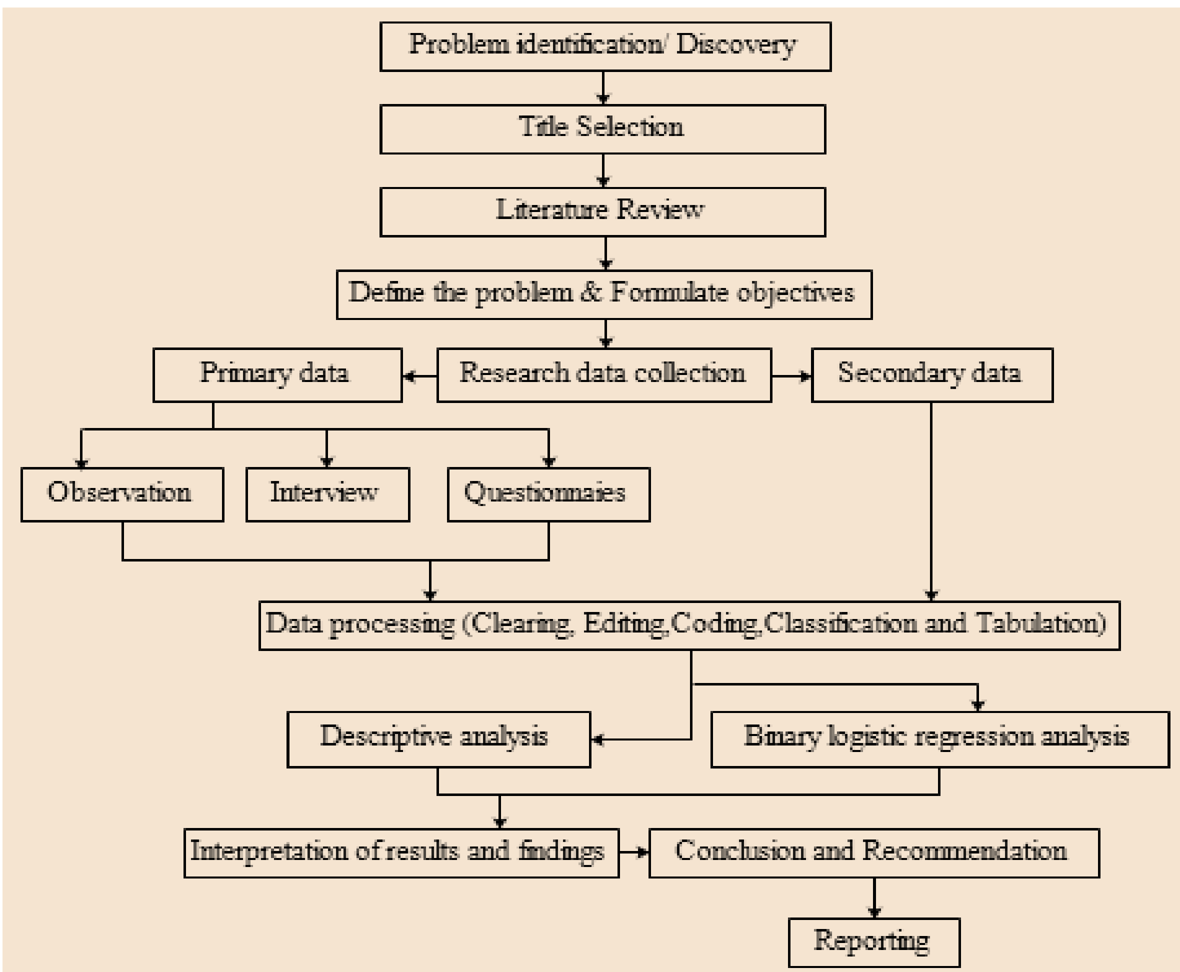


Figure 11: research design flow chart prepared using EDRAW MAX

3.3. Sample Size Determination

Given the lesser heterogeneity of the population, the researcher believes that it is possible to capture the representative data from a reasonable sample size. The actual sample size will determine based on statistical method. In order to strength the responses, the researcher offered interview and questionaries' for the responsible bodies.

Sample size determination is the foremost task prior to conducting a research work. Since the population in this research is finite, the researcher will use the following sample size determination formula:

$$n_o = \frac{Z^2 p(1-p)}{e^2}$$

Where: 'n_o' is sample size, 'Z' is Z-score found in statistical tables, 'p' is is the estimated proportion of an attribute that is present in the population and 'e' is the desired level of precision. Since the sample is from the finite population, the sample size will need an adjustment and the adjusted sample size will be calculating as:

$$n = \frac{n_o}{1 + \frac{(n_o - 1)}{N}}$$

Where: 'n' is adjusted sample size and 'N' is the population size.

Based on the formula the sample size is calculated to be 126, these 126 sample drivers and sample SINOTRUKs were selected based on simple random sampling method and well-structured questionnaires was distributed to the sampled drivers.

3.4. Sampling Methods

In this research, both probability sampling (simple random sampling, stratified sampling) and non-probability sampling (purposive or judgmental sampling) techniques was applied. First Amhara region was stratified in to towns. For speed observations the areas were selected randomly in between towns. The road traffic data in the traffic offices can be sampled using systematic sampling that means by identifying the data that have full information's that the researcher want for my research.

3.5. Traffic Accident Data

In this thesis, road traffic accident data were collected from twenty-three traffic police stations for the study period of 2008 to May 2011. The source of road accident data were accident booklets compiled by Traffic Police Officers. To acquire reliable data, a road traffic accident form was designed. The form included day and time of accident, vehicle ownership, Driver sex, age and educational background, Accident type, accident degree of severity, number of victims and location of accident. In this case, some accident reports recorded on crash recorded sheets were not full in information. So, the researcher selected only the the crash recorded sheets having full information.

3.6. Data Collection Techniques

It is must to choose the methods of data collection based on the research perspectives and strategies. In this thesis literature studies and survey through observation questioner and interviews was carried out to collect necessary data that the researcher used for the research.

3.6.1. Literature studies

Different literatures were used as a source of information or secondary data sources. Among them Articles, journals and traffic police reports prepared the regional state transportation system and traffic police offices at different times collected from either government offices or individuals were the major ones. Documents prepared on the basis of the causes and counter measures of road traffic accident in different time were collected from internet, library and different offices. Accident records, consultancy reports and other relevant documents were collected from transport office and traffic departments of the regional state. In addition to the documents collected from the above-mentioned governmental offices, different documents relevant to the regional state heavy vehicle transport and land use behavior were collected from heavy vehicle transporters, garages, individuals and from websites.

3.6.2. Survey

In this research, the researcher was used three major approaches of survey to collect the data used in the research. These are direct observation, face-to-face interviews and questioner distribution.

Direct Observation: The observation method is the most commonly used method of data collection in research. This types data collection techniques used to check and validate realities in a structured way. The data collected through this method were recorded in properly recorded observation sheet. In this research the speed data on the selected road sections were observed and compared with the design speed of the road.

Interview: Interviews can be defined as a qualitative research technique which involves "conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation**.** Interviews in this thesis was carried out with selected persons that have direct or indirect involvement with the concept or themes of the research. The result of this interview was used to support the result from questionnaires and secondary sources. If the response of the interviewer were significantly different with the response from questionnaire respondents, the researcher goas to more detail investigation and additional analysis. Otherwise if the respondents answer from questionnaires and interview were the almost the same, no need of additional detailed investigations and analysis. This includes government and private officials, heavy vehicle drivers traffic police officers and driver training center professionals that having different level of knowledge regarding to the research questions. The researcher was made interview with Amhara regional state transport authority representatives and different zone traffic officials regarding to traffic law and law enforcements, with heavy vehicle drivers, operators and garages regarding to vehicle related factors that contributes Sino truck crashes and their counter measures related to SINOTRUK vehicular characteristics, with driver training centers regarding to driver's performance in training. All the above stakeholders will directly have interviewed based on streams of question on a guided conversation approach.

Questionnaire: In this thesis questionnaires were prepared first in Amharic and distributed to the respondents. Then after collecting from those respondents, it converts in to English for the analysis purpose. Questionnaires can be classified as both, quantitative and qualitative method. Specifically, answers obtained through closed-ended questions with multiple choice answer options were analyzed using quantitative methods and they may involve charts and percentages. Answers obtained to open-ended questionnaire questions were analyzed using qualitative methods and they involve discussions and critical analyses without use of numbers and calculations.

In addition to direct interview a list of questions was prepared in questioner format and distributed to the selected stakeholders in the heavy vehicle transport industry. The major stakeholders in this research includes, heavy vehicle drivers.

3.7. Data Processing and Analysis

3.7.1. Data Processing

The data, after collection, has to be processed and analyzed in accordance with the outline laid down for the purpose at the time of developing the research plan. This is essential for a scientific study and for ensuring that we have all relevant data for making contemplated comparisons and analysis. In this research, the data was passed the following processing operations before data analysis.

Clearing: the collected data from different sources may show inconsistencies in parameters, terminology and definitions of variables. So, various types of data clearing were performed. Because the age and experience of drivers in crash reports were registered as a single number, the age of drivers was grouped as different categories (less than 20 years, 20-26 years, 26-32 years, 32-38 years, 38-45 years and above 45 years) and the experience of drivers also categorized as different categories (no experience, less than two years, 2-4 years, 4-6 years, 6-8 years and above 8 years). All the data were grouped or categorized like this.

Editing: the data collected through questionnaires, interviews and from secondary sources was examined in order to detect errors and omissions and correct those errors. This editing involves a careful scrutiny of the completed questionnaires and interviews. In this paper editing was done to assure that the data are accurate, consistent with other facts gathered, uniformly entered, as completed and have been well arranged to facilitate coding and tabulation.

Coding: for efficient analysis, the same data was assigned in numerals or other symbols. Such classes should be appropriate to the research problem considered in this research. For example, normal load is symbol as 1 and over load is symbol as 2, age groups less than 20 symbol as 1, 20-26 symbol as 2, 26-32 symbol as 3, 32-38 assigned as 3, 38-45 assigned as 4, above 45 years assigned as 5. The experience of drivers also assigns like this (1 for 0-2 years, 2 for 2-4 years, 3 for 4-6 years, 4 for 4-8 years and 5 for above 8 years). All the data that needs such types of codes and numerical representations was assigned using the appropriate values in order to analyze efficiently.

Classification: in order to get meaningful relationships, the data was grouped in the same common characteristics. The data having common characteristics were placed in one class and in this way the entire data get divided in to a number of classes or groups. In this research the data was grouped as driver related, vehicle related, road and environmental related.

Tabulation: the data collected through different sources and techniques was orderly arranged in columns and rows and arrange the same in some kind of concise and logical order. For further statistical analysis, the data was summarized and displaying the same in the form of statistical tables. In this research tabulation was being done using Microsoft excel or Microsoft spread sheet.

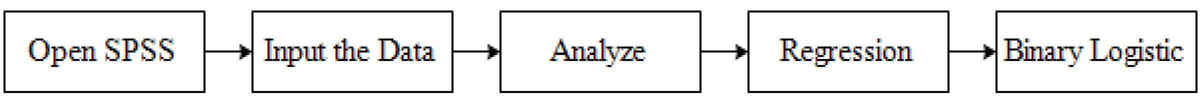
3.7.2. Data Analysis

The term analysis refers to the computation of certain measures along with searching for patterns of relationship that exist among data-group. The data collected from different sources that passes the above listed processing operations were analyzed to meet the general and specific objectives of this research. Different analysis techniques were adapted based on the type of data and relevance of techniques to be used. In this research the researcher was used two basic methods of analysis (descriptive analysis and binary logistic regression analysis) in order to identify factors affecting the occurrence of road traffic accidents and their counter measures in Amhara regional state.

Descriptive Analysis: this descriptive analysis was conducted through descriptive statistics. Descriptive statistics deals with the presentation of numerical facts, or data, in either tables or graph form, and with the methodology of analyzing the data. Descriptive statistics provide simple summaries about the sample and about the observations that have been made. Such summaries may be either quantitative, i.e. summary statistics, or visual, i.e. Simple-to-understand graphs. These summaries may either form the basis of the initial description of the data as part of a more extensive statistical analysis, or they may be sufficient in and of themselves for a particular investigation

The traffic accident data collected from the enterprise is analyzed and characterize using descriptive analysis to examine the relationships among variables and to identify possible source of cause and contributing factors. This helps to know which accident variables frequency are significantly higher compared to crashes of other relative variables. This method of analysis provides simple summaries about the samples and about the observation that was being made. In addition to this the researcher was characterized the data based on the properties using this analysis method. This analysis was conducted with the help of spreadsheet or Microsoft excel and binary logistic regression analysis using SPSS software. The data collected from traffic police offices (SINOTRUK accident data) and speed data collected from the field was analyzed by using Microsoft excels and the data collected from drivers through questionnaire was analyzed using descriptive statistics and binary logistic regression analysis.

Binary Logistic Regression Analysis: the second methods of analysis in this research is binary logistic regression analysis which was used to studies the association between a categorical dependent variable and a set of independent (explanatory) variables. The name logistic regression is used when the dependent variable has only two values, such as 1 and 2 or Yes and No. the type of data used for the dependent variable is different from that of multiple regressions. These methods of analysis were differing from linear regression analysis because in this method the researcher can compare and associate more than one independent variables with the dependent variable. In this thesis, the researcher associates the dependent variable (accident) with different contributing factors (cause of accident) using this binary logistic regression analysis. For the purpose of analyzing using this method the researcher used SPSS software. This method follows the procedure shown below:



Logistic regression analysis extends the techniques of multiple regression analysis to research situations in which the outcome variable is categorical. Assumptions were should consider for the efficient use of logistic regression as given below. The following are the basic assumptions:

- ✓ Logistic regression assumes meaningful coding of the variables. Logistic coefficients were difficult to interpret if not coded meaningfully. The convention for binomial logistic regression is to code the dependent class of interest and the other class as binomial.
- ✓ Logistic regression does not assume a linear relationship between the dependent and independent variables.
- ✓ The dependent variable must be categorical.
- ✓ The independent variables need not be interval, no normally distributed, no linearly related and no equal variance within each group.

- ✓ The groups must be mutually exclusive and exhaustive; a case can only be in one group and every case must be a member of one of the groups.
- ✓ The error terms need to be binomially distributed.
- ✓ Logistic regression requires the dependent variable to be categorical (Mostly binary).

3.8. Variable Definitions

A variable is a feature characteristic of any member of a population differing in quality or quantity from one member to another.

Depending on the objective of the study and the type of data collected from different sources, this study identified the following independent and dependent variables to be used for research under consideration.

Independent Variables: The variable that is stable and unaffected by the other variables you are trying to measure. It refers to the condition of an experiment that is systematically manipulated by the investigator. In this research the independent variables were the accident contribution factors like loading condition, vehicle related problem and drivers related problem.

Dependent Variable: The variable that depends on other factors that are measured. These variables are expected to change as a result of an experimental manipulation of the independent variable or variables. It is the presumed effect. In this thesis the dependent variable was accident.

The relationship between dependent variables and independent variable looks like the following:

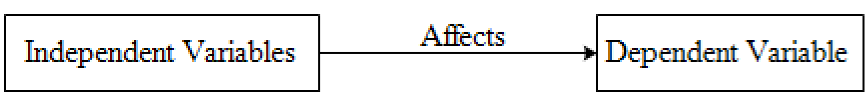


Figure 12: The relationship between dependent variable and independent variables

A variable in this research also classified in to two as qualitative (expressed in qualities or non-numerical) variables and quantitative (expressed in numbers) variable.

3.9. Counter Measures Identification

After identifying the major causes of the SINOTRUK accident, possible countermeasures have been suggested to improve the road accident situation along the road. The engineering counter measures should be less in related to cost and simple to apply. Those counter measures were selected depending on the identified causes of SINOTRUK accident. That means, no need of counter measure identification analysis independently. First the data used were collected from different sources. Then the collected data were processed and analyzed to identify the major causes of SINOTRUK accident. Finally, the appropriate engineering counter measures were chosen based on the identified causes.

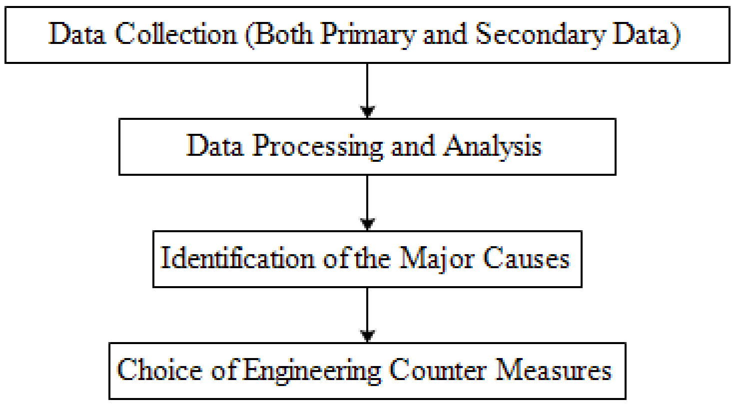


Figure 13: Flow chart showing the major activities carried out counter measure identification

CHAPTER FOUR

4. ANALYSIS AND DISCUSSION

Analysis and results include the result from field studies or observation and questionnaire and interview analysis collected from traffic police offices and SINOTRUK drivers. First the data collected from different traffic offices were analyzed using descriptive statistical analysis method and second the data collected from drivers through questionnaire and interview were analyzed using descriptive statistical analysis method. Then the data collected from SINOTRUK drivers through questionnaire and interview were analyze using both descriptive and binary logistic regression analysis methods.

4.1. Secondary Traffic Data Result

In this research traffic data stored in traffic offices were collected to identify the causes of SINOTRUK accidents by using the information on the recorded sheet as a starting point. Those data were analyzed by using descriptive statistics. Basically, the information's used as an indication for the causes of SINOTRUK related accidents on the recording sheet (CR) includes derivers experience, drivers age, Vehicle service year, drivers educational background, loading conditions and level accident.

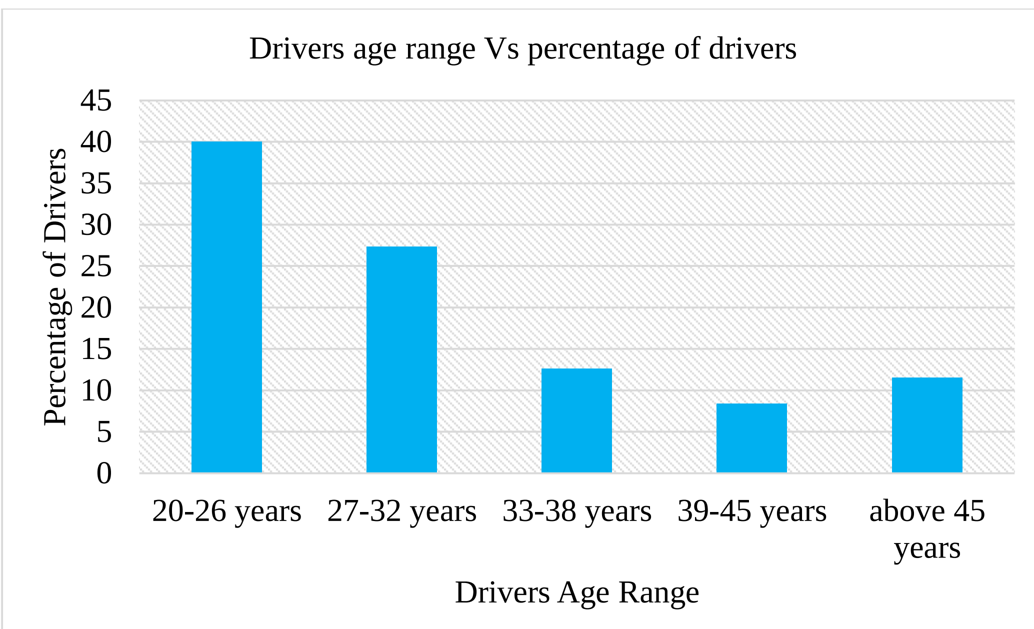


Figure 14: Drivers age range Vs percentage of driver's graph

Table 4: Drivers age frequency table

Drivers Age	Frequency	Percentage
20-26 years	38	40
27-32 years	26	27.37
33-38 years	12	12.63
39-45 years	8	8.42
above 45 years	11	11.58

Based on the data collected from traffic police offices shown on the above tables and figure (chart) 38 (40%) off drivers taken from the total sample of 95 calculated using statistical formulas from the total properly recorded traffic accident data crash report sheet (CR) were under the age of 20-26 year's age. In addition to from those total samples 26 (27.37 %), 12 (12.63%), 8 (8.42 %) and 11 (11.58 %) of drivers were under the age of 27-32, 33-38, 39-45 and above 45 year's age respectively.

Figure 15: Drivers experience Vs percentage of victim driver's graph

Table 5: Drivers experience frequency table

Drivers experience	Frequency	Percentage (%)
0-2 years	31	32.63
2-4 years	28	29.47
4-6 years	16	16.84
6-8 years	8	8.42
above 8 years	12	12.63

The result from the above tables and graphs shows that 31 (32.63 %) drivers from the total sample had driving experiences from 0-2 years. 28 (29.47 %) drivers had 2-4 year's experience and 16 (16.84 %), 8 (8.42%) & 12 (12.63 %) of drivers from the total sample had driving experience 4-6 years, 6-8 years and above 8 years respectively.

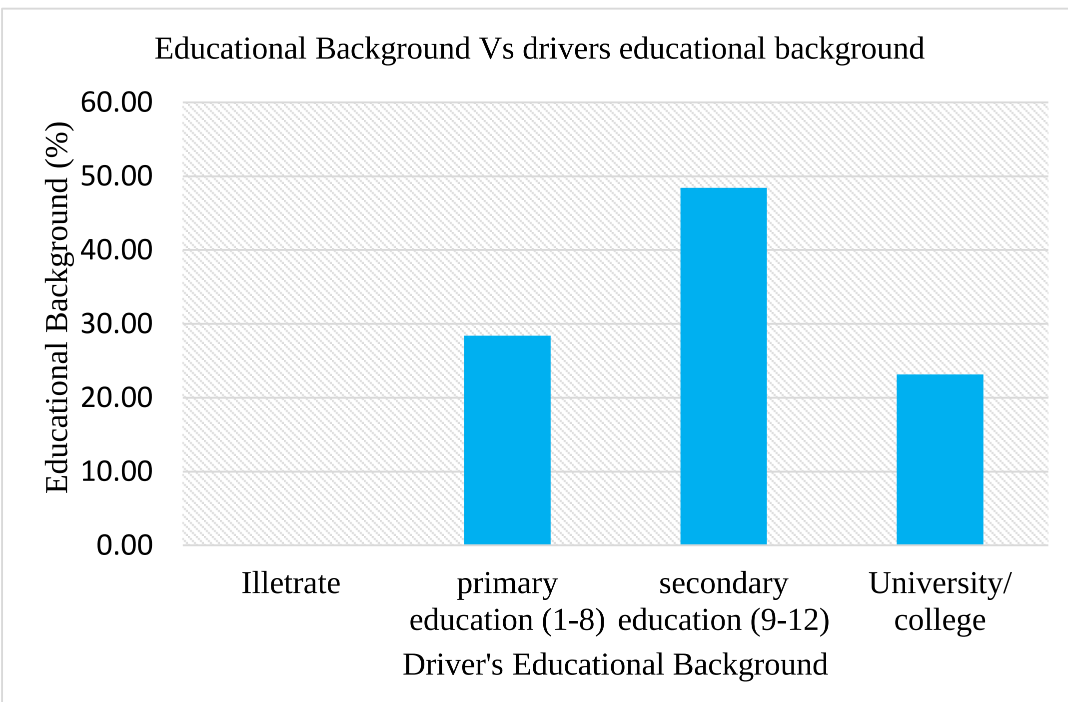


Figure 16: percentage from the total of educational background

Table 6: Drivers educational background frequency table

Educational background	frequency	Percentage (%)
Illiterate	0	0.00
primary education (1-8)	27	28.42
secondary education (9-12)	46	48.42
University/ college	22	23.16

The educational background of SINOTRUK accident victim drivers was shown above. From the total sampled victim drivers 27 (28.42 %) had primary level educational background, 46 (48.42 %) of drivers had secondary level educational background and 22 (23.16 %) of victim drivers had university or college level educational background.

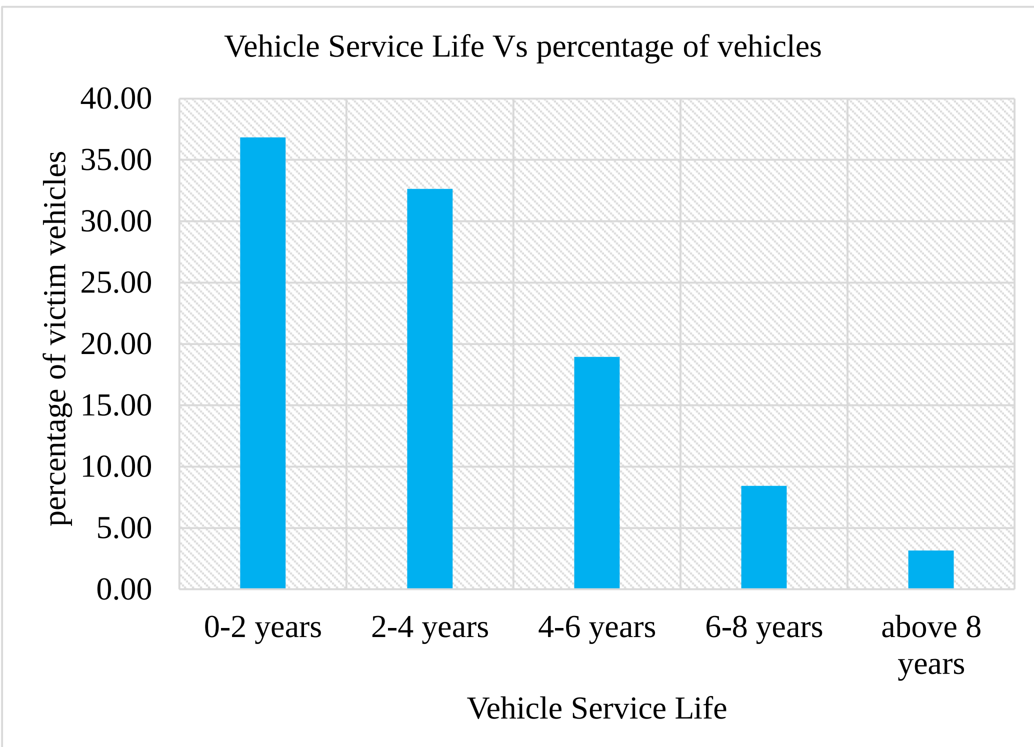


Figure 17: Vehicle Service Life Vs percentage of vehicles

Table 7: vehicle service year frequency table

Vehicle service year	Frequency	Percentage
0-2 years	35	36.84
2-4 years	31	32.63
4-6 years	18	18.95
6-8 years	8	8.42
above 8 years	3	3.16

As stated in the above table and chart or figure 35 (38.84 %) of victim SINOTRUK had 0-2 year's service year, 31 (32.63 %) of victim SINOTRUK had 2-4 year's service life, 18 (18.95 %) victim Sino track had 4-6 year's service life, 8 (8.42 %) of victim SINOTRUK had 6-8 year's service life and 3 (3.16 %) of victim SINOTRUKs had above 8 year's service life.

Table 8: Traffic level of accident frequency table

level of accident	Frequency	Percentage (%)
having death	52	54.74
having heavy injury	59	62.11
Light injury	76	80.00
Property damage only	83	87.37

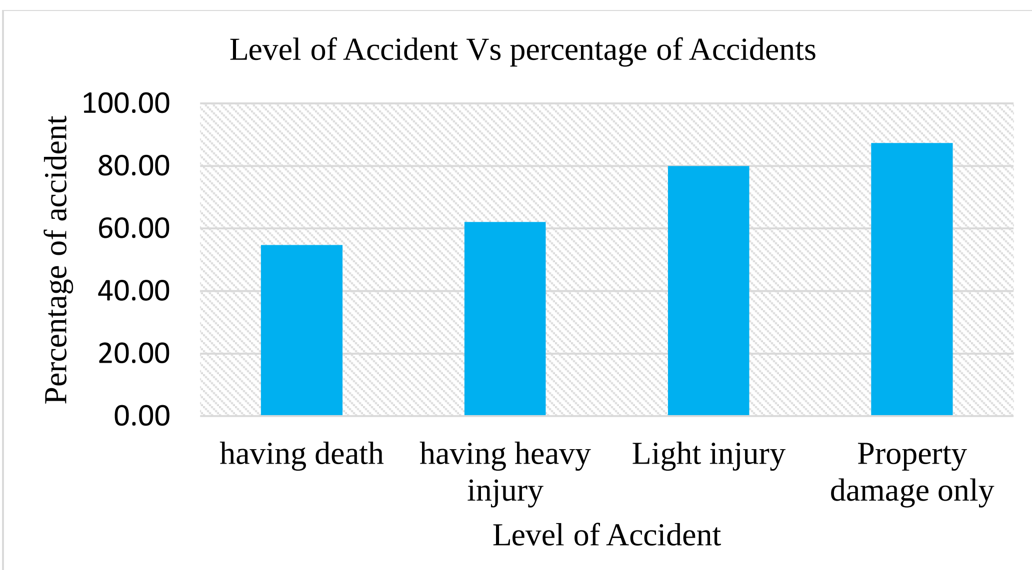


Figure 18: Level of Accident Vs percentage of Accidents

Based on the above table and chart 52 (54.74 %) of SINOTRUK accidents from the total sample were faced with death, 59 (62.11 %) of Sino track accidents were faced with with heavy injury, 76 (80 %) of SINOTRUK accidents were faced with light injury and 83 (87.37 %) of SINOTRUK accidents were faced with property damage.

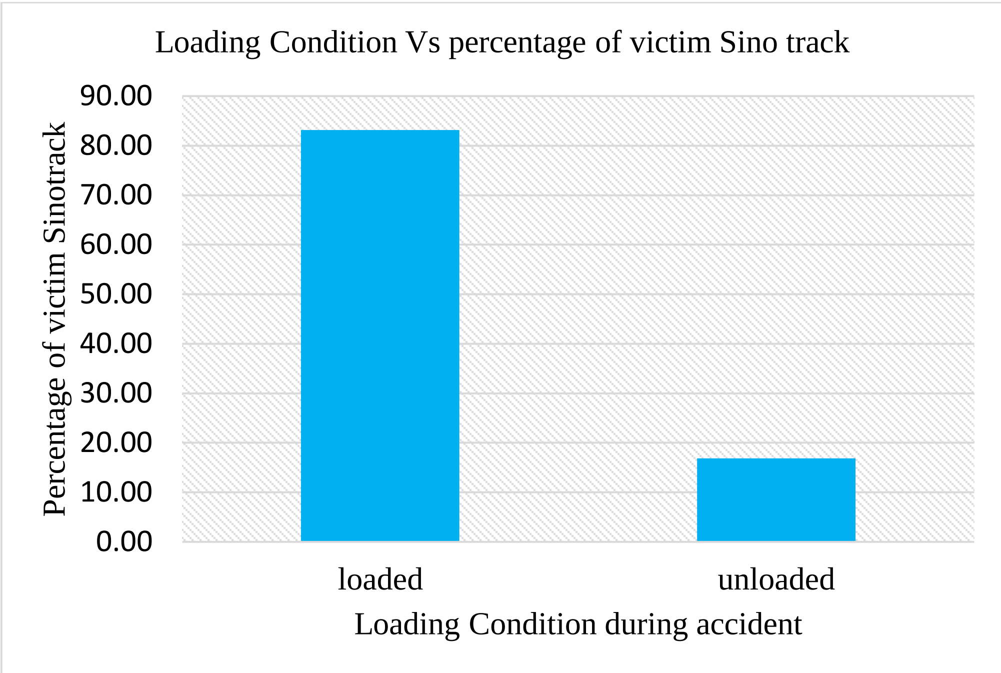


Figure 19: Loading Condition Vs percentage of victim Sino track

Table 9: Frequency table of Sino track loading condition during accident

Loading Condition	Frequency	Percentage (%)
Loaded	79	83.16
Unloaded	16	16.84

The table and chart shown above indicates that 79 (83.16 %) of victim SINOTRUK were with loaded condition and 16 (16.84 %) of victim SINOTRUKs from the total sampled accidents were with unloaded condition during accident.

4.2. Speed Data Analysis (Speed Data Result)

Speed is the major contributing factors for SINOTRUK road traffic accidents. So, in this research the speed selections of sampled SINOTRUK drivers were collected at different locations of selected link roads in Amhara regional states and compared with the design speed of the road.

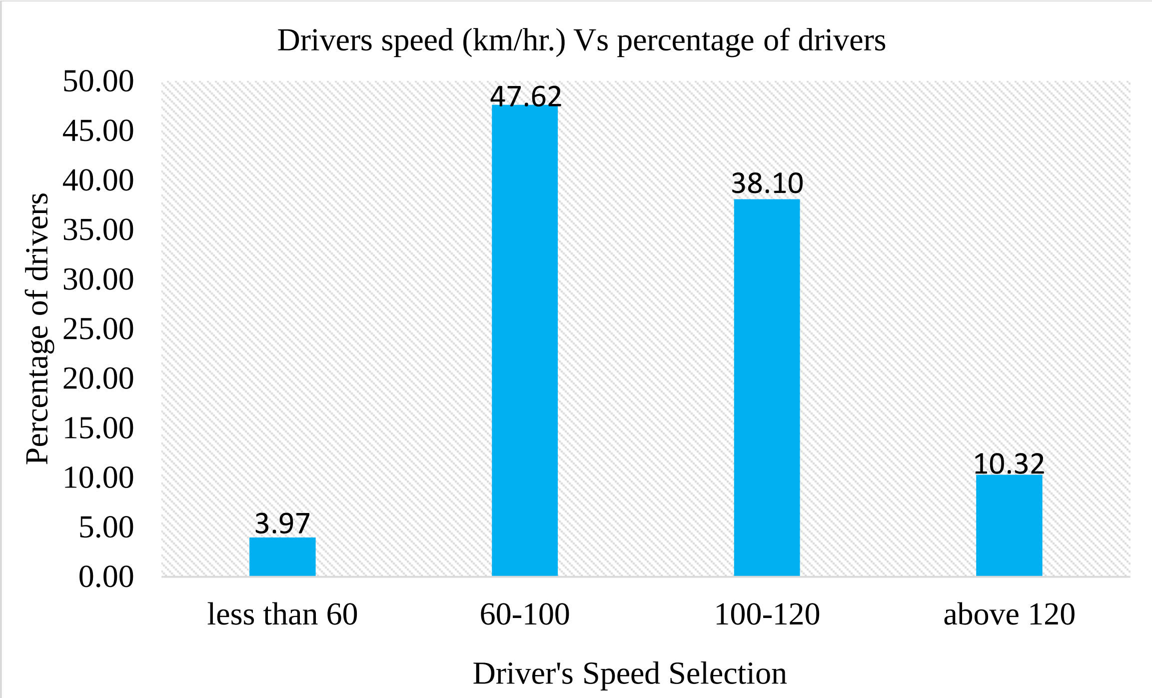


Figure 20: Drivers speed (km/hr.) Vs percentage of drivers

Table 10: frequency of driver's speed selection at selected area

Drivers speed (km/hr.)	frequency	Percentage (%)
less than 60	5	3.97
60-100	60	47.62
100-120	48	38.10
above 120	13	10.32

The result of driver's speed selection data stated on the above table and chart shows that 5 (3.97 %) of drivers from the total sample drives with an approximate speed of less than 60 km/hr. on the selected link roads. 60 (47.62 %), 48 (38.10 %), and 13 (10.32 %) of drivers were drive with a speed of 60-100, 100-120 and above 120 km/hr. respectively. The maximum design speed at the selected areas were 80 km/ hr. so, based on the result given above more than 48.42 % of drivers drive over the design speed of the road.

4.3. Questionnaire Results

4.3.1. Demographic Data Analysis

In this research a total of 126 SINOTRUK drivers were selected (based on the statistical formula shown on the methodology) as respondents of questionnaire and interview. Based on the result 126 (100 %) of respondents (SINOTRUK drivers) were male. Similarly, respondents under the age of 20-26 years, 27-32 years, 33-38 years, 39-45 years and > 45 years were 42 (33.3 %), 41 (32.5 %), 30 (23.8 %), 7 (5.6 %), 6 (4.8 %) respectively. The level of education also varies from driver to driver. From the total sample SINOTRUK drivers 72 (57.1 %) were under primary education. 44 (34.9 %) of SINOTRUK drivers were under secondary education level and the remaining 10 (7.9 %) of sample SINOTRUK drivers were under university or college level.

Table 11: Demographic results of questionnaires

Demography		Drivers response	
		Number	Percentage
Respondents gender	Male	126	100
	Female	0	0
	Total	126	100
Respondents age	20-26 years	42	33.3
	27-32 years	41	32.5
	33-38 years	30	23.8
	39-45 years	7	5.6
	> 45 years	6	4.8
	Total	126	100
Respondents level of Education	Illiterate	0	0
	Primary education (1-8)	72	57.1
	Secondary education (9-12)	44	34.9
	University/ College	10	7.9
	Total	126	100

The table shown below (Table 12) is distribution of collisions by drivers' age with accident severity. Over sixty eight percent of the drivers involved in collisions were between the ages of 20 and 32. In this age group, about forty-four per cent were between 20 and 26 years old. Nationally, drivers of this age group are fewer in number but their contribution to accidents seem to be very high. Education of younger drivers may be an appropriate area of focus. Drivers aged between 20 and 32 have a share of 68 per cent. This age group is most active in the economy and most of them are hired drivers.

Table 12: Distribution of accidents by drivers' ages

Drivers Age	Fatal	Heavy Injury	Light Injury	Property Damage	Total	%
20-26 years	22	24	31	36	113	43.97
27-32 years	13	16	19	20	62	24.12
33-38 years	7	9	9	10	35	13.62
39-45 years	5	3	5	7	20	7.78
> 45 years	4	6	9	8	27	10.51
Total	46	58	73	81	257	100
%	17.9	22.57	28.40	31.57	100	

Note: the number 257 is greater than the total sample size. Because in this cause drivers that causes fatal accident may be causes for heavy injury, light injury and property damage. That means one accident may be numbered more than one times.

4.3.2. Frequency Tables of SINOTRUK Driver's Response

The frequency tables of SINOTRUK drivers (respondents) response with percent, valid percent and cumulative percent were summarized below as taken from SPSS software output.

Table 13: Have you faced accident in your driving life of SINOTRUK?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	111	88.1	88.1	88.1
	No	15	11.9	11.9	100.0
	Total	126	100.0	100.0	

Table 14: How long have you been driving (experience) SINOTRUK in Amhara region?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-2 years	42	33.3	33.3	33.3
	2-4 years	41	32.5	32.5	65.9
	4-6 years	30	23.8	23.8	89.7
	6-8 years	7	5.6	5.6	95.2
	> 8 years	6	4.8	4.8	100.0
	Total	126	100.0	100.0	

Table 15: Is there a speed controller GPS on your SINOTRUK?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	126	100.0	100.0	100.0

Table 16: In which condition accident was faced?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Loading condition	90	71.4	80.4	80.4
	Non loading condition	22	17.5	19.6	100.0
	Total	112	88.9	100.0	
Missing	System	14	11.1		
Total		126	100.0		

Table 17: Do you think that SINOTRUK have its mechanical problem by its nature that causes an accident?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	99	78.6	78.6	78.6
	No	27	21.4	21.4	100.0
	Total	126	100.0	100.0	

Table 18: Do you drive other vehicles which are less than SINOTRUK in capacity and size before you drive Sino-Track?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	36	28.6	28.6	28.6
	No	90	71.4	71.4	100.0
	Total	126	100.0	100.0	

Table 19: Do you drive at night time?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	87	69.0	69.0	69.0
	No	39	31.0	31.0	100.0
	Total	126	100.0	100.0	

Table 20: Have you challenged by drowsiness during driving during night driving?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, always	1	.8	1.1	1.1
	Yes, sometimes	67	53.2	77.0	78.2
	no	19	15.1	21.8	100.0
	Total	87	69.0	100.0	
Missing	System	39	31.0		
Total		126	100.0		

Table 21: Which teaching method is more implemented in the institute during your training period?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Practical exercise	19	15.1	15.1	15.1
	Dictation (vocabulary learning)	107	84.9	84.9	100.0
	Total	126	100.0	100.0	

Table 22: Is the time given for you for training of driving is good enough?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	23.8	23.8	23.8
	No	96	76.2	76.2	100.0
	Total	126	100.0	100.0	

Table 23: How do you rate traffic police commitment to their duties and responsibilities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very good	8	6.3	6.3	6.3
	Good	20	15.9	15.9	22.2
	Poor	83	65.9	65.9	88.1
	Very poor	15	11.9	11.9	100.0
	Total	126	100.0	100.0	

Table 24: Is there a difference between training truck and driving track (Sino-Track?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	111	88.1	88.1	88.1
	No	15	11.9	11.9	100.0
	Total	126	100.0	100.0	

Table 25: Is there a difference between the natures of training location and actual driving locations?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	87	69.0	69.0	69.0
	No	39	31.0	31.0	100.0
	Total	126	100.0	100.0	

Table 26: Which one is the foremost cause of your SINOTRUK accident if you are facing accident?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Drivers related problem	78	61.9	61.9	61.9
	Vehicle related problem	31	24.6	24.6	86.5
	Road related problem	11	8.7	8.7	95.2
	Environmental problem	6	4.8	4.8	100.0
	Total	126	100.0	100.0	

Table 27: How often do you make overloading?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	sometimes	93	73.8	73.8	73.8
	Never	33	26.2	26.2	100.0
	Total	126	100.0	100.0	

Table 28: In your driving time which parts of the SINOTRUK is difficult for you and vulnerable to accident?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Vehicle brake	93	73.8	73.8	73.8
	Guider	18	14.3	14.3	88.1
	motor	15	11.9	11.9	100.0
	Total	126	100.0	100.0	

Table 29: How often do you give driving attention during driving SINOTRUK?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	39	31.0	31.0	31.0
	Sometimes	87	69.0	69.0	100.0
	Total	126	100.0	100.0	

Table 30: How often do you give a continuous and periodic service for your SINOTRUK as recommended by the company?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	18	14.3	14.3	14.3
	Some times	107	84.9	84.9	99.2
	Never	1	.8	.8	100.0
	Total	126	100.0	100.0	

Table 31: Do you think that SINOTRUKs have a controlling system problem?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	102	81.0	81.0	81.0
	No	24	19.0	19.0	100.0
	Total	126	100.0	100.0	

4.3.3. Statistics Results for Respondent Drivers

Generally, Standard error of mean of this distribution individual sample mean is in relation to the true mean with 95% confident interval and that 5% maximum error of the estimate and standard error of mean is less than maximum error of the estimate. As a result, response from drivers are reliable and more accurate support to conclude. Some of the statistics results for drivers are shown below as a sample,

Table 32: Statistics results for respondent drivers

		Drivers gender	Have you faced accident…?	Is there a speed controller GPS….?	…. condition of accident…	--SINOTRUK have its own problem?
N	Valid	126	126	126	112	126
	Missing	0	0	0	14	0
Mean		1.000	1.119	2.000	1.196	1.214
Std. Error of Mean		.0000	.0290	.0000	.0377	.0367
Std. Deviation		.0000	.3251	.0000	.3991	.4120

		Do you drive other vehicles….?	do you drive at night time?	…challenged by drowsiness?	Which teaching method….?	Is the time given for training…?
N	Valid	126	126	87	126	126
	Missing	0	0	39	0	0
Mean		1.714	1.31	2.207	1.849	1.762
Std. Error of Mean		.0404	.041	.0466	.0320	.0381
Std. Deviation		.4536	.464	.4350	.3593	.4276

4.3.4. Questionnaires Descriptive Analysis

The table below shows that there were no any SINOTRUK accidents caused by drivers less than 20 years. About 43.65 % of drivers aged below 26 years and the majority (45 %) of accidents was caused by those age group drivers. 36.9 % of accident was caused by drivers under the age group of 26-32 years while 8.1 %, 4.5 % and 5.4 % of accidents were caused by drivers under the age of 32-38 years, 38-45 years and above 45 year's age group.

About 57.14 % and 34.92 % of drivers have primary and secondary educational level. The remaining 7.94 % of drivers have a university or college level educational background. the majority (59.5 %) of accident was caused by drivers under primary primary educational background.

Among the sampled drivers 33.33 %, 32.54 %, 23.81 %, 5.56 % and 4.76 % had experiences from 0-2 years, 2-4 years, 4-6 years, 6-8 years and above 8 years respectively. Most of the accidents were caused by drivers having an experience less than 4 years.

80.36 % drivers were under loaded condition during the accident and the remaining 19.64 % of SINOTRUK driers were under unloaded condition during accident. The majority (81.1 %) of SINOTRUK accidents in this case were caused by drivers facing accident in loaded conditions.

From the total sampled drivers, 71.43 % was no trained or experienced with lower vehicles before driving SINOTRUK and the most accidents were due to those drivers. While the remaining 28.57 % of drivers were experienced with lower vehicles.

The majority (46.83) of drivers were drive with a speed of 40-60 km/hr. on link roads around the town and most of the accidents in this cause were caused by those drivers. In this case 4.76 %, 34.92 %, 9.52 % and 3.97 % of drivers from the total sample were drive with a speed range of less than 30 km/hr, 30-40 km/hr, 60-80 km/hr and greater than 80 km/hr respectively on the link roads around the town. In addition to that, the most accidents (47.7 %) on a link road around rural area was caused by 48.41 % of drivers whose speed selection were in the range of 100-120 km/hr. 7.94 %, 38.88 % and 4.76 % of drivers were select an approximate speed range of less than 60 km/hr, 60-100 km/hr and above 120 km/hr respectively.

Base on the result in the table shown below majority (69.05) of drivers were drive at night time and the most (67.6 %) of SINOTRUK accidents in this case were happened by those drivers. While 30.95 % of SINOTRUK drivers were not drive at night time. In addition, from those drivers driving at night the majority (53.17 %) of drivers were challenged by drowsiness sometimes and caused by the most (74.7 %) of SINOTRUK accidents. Around 0.79 % and 15.08 % of night driving drivers were challenged by drowsiness during driving at night.

The proportions of traffic police who have very poor, poor, good and very good commitments on their works were 11.90 %, 65.87 %, 15.87 % and 6.37 % respectively. The table shown below reviled that 64 % of accidents were happened due to traffic polices who have low commitment on their works.

The table below shows that 62.2 % of accidents were happened due to drivers related problem and this covers the majority (54.76 %) of Sino track accident in Amhara region. Additionally, 24.3 %, 8.1 % and 5.4 % of accidents were caused by vehicle related problems, road related problems and environmental related problems.

Most importantly the majority (81.1 %) of SINOTRUK accidents were happened due to drivers (73.81 %) that loads over sometimes. In this case 26.16 % SINOTRUK drivers loads normal.

Most of (76.6 %) the Sino track accidents were happened by drivers who gives attention sometimes and this covers 69.05 % of the total sampled SINOTRUK drivers. In addition to this, the remaining 23.4 % of SINOTRUK accidents were happened by drivers who gives attention always during driving.

From the total sampled SINOTRUK drivers, the majorities (85.71 %) gives continues and periodic services (maintenance) for their SINOTRUKs and most of the accidents were caused by those drivers. 13.5 % and 0.79 % of drivers in this cause gives continuous and periodic services (maintenance) for their SINOTRUKs always and never respectively.

Table 33: Association of traffic accidents with different contributing factors

		Have you faced accident in your driving life of SINOTRUK?			
		Yes (N, %)	No (N, %)	Total (%)	p-value
Respondent Drivers age	< 20 years	0 (0)	0 (0)	0	0.073
	20-26 years	50 (45)	5 (33.3)	43.65	
	26-32 years	41 (36.9)	4 (26.7)	35.71	
	32-38 years	9 (8.1)	3 (20.0)	9.52	
	38-45 years	5 (4.5)	3 (20.0)	6.67	
	> 40 years	6 (5.4)	0 (0)	4.76	
Respondent Drivers educational background	Illiterate	0 (0)	0 (0)	0	0.033
	Primary education (1-8)	66 (59.5)	6 (40)	57.14	
	Secondary education (9-12)	37(33.3)	7 (46.7)	34.92	
	University/ College	8 (7.2)	2 (13.3)	7.94	
Respondent Drivers SINOTRUK driving experience	0-2 years	37 (33.3)	5 (33.3)	33.33	0.099
	2-4 years	36 (32.4)	5 (33.3)	32.54	
	4-6 years	27 (24.3)	3 (20)	23.81	
	6-8 years	6 (5.4)	1 (6.7)	5.56	
	> 8 years	5 (4.5)	1 (6.7)	4.76	
In which condition accident was faced?	Loading condition	90 (81.1)	0 (0)	80.36	0.196
	Non loading condition	21 (18.9)	1 (100)	19.64	
Do you drive other vehicles which are less than SINOTRUK in capacity and size before you drive SINOTRUK?	Yes	30 (27.0)	6 (40)	28.57	0.225
	No	81 (73.0)	9 (60)	71.43	
approximate average driving speed on roads in the town	< 30 km/hr.	5 (4.5)	1 (6.7)	4.76	0.216
	30-40 km/hr.	42 (37.8)	11 (73.3)	34.92	

	40-60 km/hr.	48 (48.2)	2 (13.3)	46.83	
	60-80 km/hr.	11 (9.9)	1 (6.7)	9.52	
	> 80 km/hr.	5 (4.5)	0 (0)	3.97	
approximate average driving speed on link roads in rural	< 60 km/ hr.	9 (8.1)	1 (6.7)	7.94	0.234
	60-100 km/hr.	45 (40.5)	4 (26.7)	38.88	
	100-120 km/hr.	53 (47.7)	8 (53.3)	48.41	
	> 120 km/hr.	4 (3.6)	2 (13.3)	4.76	
do you drive at night time?	Yes	75 (67.6)	12 (80)	69.05	0.39
	No	36 (32.4)	3 (20)	30.95	
Have you challenged by drowsiness during driving during night driving?	Yes, always	1 (1.3)	0 (0)	0.79	0.425
	Yes, sometimes	56 (74.7)	11(91.7)	53.17	
	no	18 (24)	1 (8.3)	15.08	
How do you rate traffic police commitment to their duties and responsibilities?	Very good	8 (7.2)	0 (0)	6.35	0.56
	Good	18 (16.2)	2 (13.3)	15.87	
	Poor	71 (64)	12 (80)	65.87	
	Very poor	14 (12.6)	1 (6.7)	11.90	
Respondent drivers foremost cause of SINOTRUK accident	Drivers related problem	69 (62.2)	0 (0)	54.76	0.117
	Vehicle related problem	27 (24.3)	2 (100)	23.02	
	Road related problem	9 (8.1)	0 (0)	7.14	
	Environmental problem	6 (5.4)	0 (0)	4.76	
	others	0 (0)	0 (0)	0	
How often do you make overloading?	always	0 (0)	0 (0)	0	0.000
	sometimes	90 (81.1)	3 (20)	73.81	
	Never	21 (18.9)	12 (80)	26.19	
How often do you give attention during driving SINOTRUK?	Always	26 (23.4)	13 (86.7)	30.95	0.000
	Sometimes	85 (76.6)	2 (13.3)	69.05	
	Never	0 (0)	0 (0)	0	
How often Do you give a continuous and periodic service for your SINOTRUK as recommended by the company?	Always	15 (14.4)	2 (13.3)	13.5	1.00
	sometimes	95 (85.6)	13 (86.7)	85.71	
	Never	1 (0)	0 (0)	0.79	

4.3.5. Binary Logistic Regression Analysis

Binary logistic regression analysis was used to identify the significant risk factors for SINOTRUK traffic accident in Amhara regional state of Ethiopia. In the analysis process a univariable analysis was first done with a 0.25 level of significance for selecting the candidate of variables for multivariable analysis. The variables significant at univariable analysis were then included in the multivariable analysis. The multivariable analysis helps to adjust for the confounding effect (19). The major decisions involved in constructing the Binary logistic regression models were deciding what explanatory variables to include in the model equation that would be the best fit to the data set (20). Therefore, binary logistic regression models that satisfying assumptions and having model fitting statistics were chosen. The Hosmer and Lameshow test result from table below third step indicated that the fitted binary logistic regression model was statistically significant and possible interpret the model further.

Table 34: Hosmer and Lameshow Test

Step	Chi-square	df	Sig.
1	2.445	7	.931
2	6.352	7	0.499

4.3.6. Results of Binary Logistic Regression Analysis

The results of binary logistic regression analysis were given in the table below. The table shows that

- ✓ The coefficients,
- ✓ Standard errors,
- ✓ Wald tests,
- ✓ Associated p-values (sig.)
- ✓ The odds and
- ✓ The 95 % confidence interval of coefficients.

In order to interpret the predictor variable coefficients, the researcher compares the associated p-values with 0.05 level of significance. If the p-value is less than 0.5, at least one categories of the predictor is significantly associated with the response. Based on the result shown on the table below, the p values of teaching methods during training, loading over the capacity of the vehicle, giving attention during driving and driving vehicles less than SINOTRUK were less than 0.05. while drivers driving experience, educational background, training time were greater than 0.05 and not included in the binary logistic model. This indicates that there is no statistical evidence to to say about the relationship.

Table 35: variables in logistic regression analysis

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	teaching (1)	-3.155	1.016	9.637	1	.002	5.043	.006	.313
	overloading (1)	-2.036	1.126	3.269	1	.031	2.131	.014	1.187
	attention (1)	3.258	1.105	8.700	1	.003	25.998	2.983	226.550
	Constant	-1.067	2.520	.179	1	.672	.344		
Step 2[b]	town			6.597	4	.159			
	town (1)	-1.454	1.350	1.160	1	.282	.234	.017	3.294
	town (2)	-3.504	1.595	4.830	1	.050	2.030	.001	.684
	town (3)	-2.229	1.669	1.784	1	.182	.108	.004	2.835
	town (4)	-20.009	17611.900	.000	1	.999	.000	.000	.
	vehicles (1)	.633	.716	.781	1	.027	4.883	.463	7.663

a. Variable(s) entered on step 1: teaching, overloading, attention.

b. Variable(s) entered on step 2: town, vehicles

The estimated Exp (B) of drivers giving trainings focusing on vocational learning is 5.045. it shows that the odds of giving teaching vocational based training is 5.045 to the occurrence of SINOTRUK accident than the reference category (practical exercise). The estimated odds of loading over the capacity of the vehicle is 2.131. this indicates that overloading was 2.131 times more likely to the occurrence of SINOTRUK accidents. The odds of giving attention during driving is 25.998. this refers that giving attention reduces the occurrences of accident by 25.998 times. The odds of driving Sinotruck at speed of 40-60 km/hr indicates that driving with a speed of 40-60 was 2.03 times to the occurrences of accident.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Now a day SINOTRUK accident is becoming increasingly due to the development of infrastructure in Ethiopia. This study aimed to investigate the major cause of SINOTRUK related accidents and to recommend the possible counter measures in Amhara regional state on the selected link roads. The methods of data analysis used in this research were descriptive analysis and binary logistic regression analysis. In this research the basic contributing factors of SINOTRUK road traffic accident includes, lack of experience to lower vehicle, over loading, absence of speed controller GPS, a time gap during training, driver's attention problem, traffic police commitment problem, drivers speed selection problem, youth age of drivers, vocational based training methods, difference between training & working places, difference between training and and the vehicle to drive and SINOTRUK problems.

The majority (45 %) of accidents was caused by drivers in the age groups of less than 26 years age group drivers. The researcher concludes that the occurrence of SINOTRUK accident was very high at youth drivers than aged drivers. About 59 % accident was happened due to drivers under primary educational level. This indicates that the more drivers educated the less the occurrence of SINOTRUK accident. Most (around 66 %) of the accidents were caused by drivers having an experience less than 4 years. This indicates that the occurrence of accident in lesser experienced drivers was higher. The majority (81.1 %) of SINOTRUK accidents were caused by drivers facing accident in loaded conditions. So, overloading was the basic contributing factors for SINOTRUK traffic accident. From the total sampled drivers, 71.43 % was not trained or experienced with lower vehicles before driving SINOTRUK and the most accidents were due to those drivers. In order to minimize Sino related accidents, it is better to trained the trainees using SINOTRUK. The majority (46.83) of drivers were drive with a speed of 40-60 km/hr. on link roads around the town and most of the accidents in this cause were caused by those drivers. This indicates that excessive speeding with overloading is the major causes of accident. Most of (76.6 %) the SINOTRUK accidents were happened by drivers who gives attention sometimes and this covers 69.05 % of the total sampled SINOTRUK drivers. This reveals that Sino track accidents increases with decreasing attention during driving.

5.2. Recommendations

Depending on the result of this research, the following points can be recommended by the researcher.

- ✓ The government should develop a rule that enforces drivers to install speed controller GPS on their vehicle.
- ✓ The government should set a rule that the driving trainees should have a good educational background (i.e. must established graduated driver licensing system).
- ✓ The government also take a series measure on victim drivers until driver licence cancelation.
- ✓ The driver should drive and train with lower vehicles in capacity and size before driving SINOTRUK.
- ✓ The driver training institute should have focused on trainings more based on practical exercises in addition to vocational learnings and should provide all vehicle types for trainees.
- ✓ Since the data in this research were collected manually, the future researcher should collect the data using video based digital electronic devices.
- ✓ Finally, this research was conducted in Amhara region, so the future researcher shall be better to conduct this research in other regions.

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Appendix 1: Secondary SINOTRUK Accident Data from Traffic Police Offices

s.n	Plate No.	Drivers Age	Drivers experience	Educational background	Vehicle service year	level of accident				Loading condition	
						death	heavy injury	Light injury	PDO	loaded	unloaded
1	3-01636	24 years	3 years	Grade 8	2 years	2	1	2	56,000	loaded	
2	3-38119	24 years	3 years	Grade 10	1 year	1	2	8	10,000	loaded	
3	3-00912	32 years	11 years	Grade 8	3 years		1	6	300,000	loaded	
4	3-46896	30 years	6 years	Grade 12	2 years	6	1	2		loaded	
5	3-34106	26 years	3 years	Grade 12	1 year			2	15,000		unloaded
6	3-60256	22 years	4 years	Grade 10	4 years		5	3	35,312.66	loaded	
7	3-41078	31 years	6 years	Grade 10	4 years	2		1	18,000		unloaded
8	3-33882	28 years	5 years	Grade 6	5 years	12	2	1	30,180	loaded	
9	4-02343	58 years	19 years	Grade 4	6 years		1	1	50,000	loaded	
10	3-39467	23 years	4 years	Grade 10	3 years			5	183,201.98	loaded	
11	4-07993	52 years	14 years	Grade 9	5 years	1	1	2	3400	loaded	
12	3-05826	43 years	8 years	Grade 10	7 years		1		5000		unloaded
13	3-05417	28 years	2 years	10+3	2 years	8	4	2	10,000	loaded	
14	3-22639	24 years	9 years	University	4 years	1	2	1	5,000	loaded	
15	3-01101	30 years	6 years	Grade 8	3 years		1	1	66,130	loaded	
16	3-00505	37 years	4 years	Grade 12	2 years	2	3	5	27,678.98		unloaded
17	3-05737	46 years	21 years	Grade 5	8 years			1	10,000	loaded	
18	3-27574	35 years	8 years	Grade 6	5 years		1		30,000	loaded	
19	3-07280	40 years	5 years	Grade 7	3 years	16	1		11,154	loaded	
20	3-50372	22 years	6 years	Grade 9	4 years	2		1	12,245.55	loaded	
21	3-05099	51 years	20 years	Grade 8	6 years	10		2	50,000	loaded	
22	3-41756	25 years	4 years	Grade 12	2 years	15	2		2,000	loaded	
23	3-59675	38 years	10 years	Grade 10	5 years	1	1		20,000	loaded	
24	3-19497	22 years	1 year	Grade 12	2 years	1	1		5,000		unloaded
25	3-01636	24 years	2 years	Grade 8	2 years	2		2	56,000	loaded	
26	3-20358	23 years	2 years	Grade 10	1 year	1		1	10,000	loaded	
27	3-06912	32 years	11 years	Grade 12	7 years			1	30,000	loaded	
28	3-19602	27 years	4 years	Grade 8	2 years			1	59,000	loaded	
29	3-51783	32 years	6 years	10+3	1 year				28,000	loaded	
30	3-74186	26 years	1 year	Grade 10	2 years	12		4	20,000		unloaded
31	3-57343	20 years	4 years	Grade 10	4 years	9	2		10,000	loaded	
32	3-81566	34 years	4 years	Grade 9	4 years	6	1	3	20,000	loaded	
33	3-81908	24 years	2 years	Grade 10	3 years			1	70,500	loaded	
34	3-75860	22 years	1 year	College	2 years	1	2	3	70,000	loaded	
35	3-28534	22 years	4 years	Grade 12	3 years		3	1	23,456.44	loaded	
36	3-14150	26 years	5 years	Grade 8	5 years			2	87,789.04	loaded	
37	3-80015	25 years	6 years	Grade 9	4 years	1		1	2,000		unloaded
38	3-83913	27 years	3 years	College	3 years			2	12,345.32	loaded	
39	3-28717	25 years	4 years	University	4 years		2	5	70,000	loaded	
40	3-52252	27 years	7 years	10+3	3 years	2	2	3	80,000	loaded	
41	3-63695	27 years	2 years	Grade 8	1 year	12	2		25,000	loaded	
42	3-33518	42 years	3 years	Grade 12	6 years			1	50,000	loaded	

43	3-63510	25 years	4 years	Grade 8	1 year	6		2	100,000	loaded	
44	3-49654	26 years	8 years	Grade 10	4 years	10	1	1	200,000	loaded	
45	3-55686	24 years	2 years	Grade 8	3 years	6	2	4			unloaded
46	3-74267	45 years	11 years	Grade 10	2 years	5		1	500,000	loaded	
47	3-80807	30 years	5 years	Grade 10	7 years	3	5	4		loaded	
48	3-81426	33 years	5 years	Grade 10	2 years	1	2	2		loaded	
49	3-57093	21 years	1 year	Grade 8	2 years	3	1			loaded	
50	3-29269	33 years	11 years	Grade 10	6 years	2	2		60,000	loaded	
51	3-30697	33 years	6 years	Grade 12	7 years				10,000		unloaded
52	3-18593	29 years	3 years	Grade 12	3 years	1			20,000	loaded	
53	3-57903	28 years	3 years	Grade 8	10 years		1		100,000	loaded	
54	4-03932	21 years	3 years	Grade 10	3 years			2	200,000	loaded	
55	3-44289	24 years	2 years	Grade 9	6 years			3	30,000	loaded	
56	3-57828	25 years	2 years	Grade 12	2 years	2		1		loaded	
57	3-80014	23 years	3 years	Grade 12	4 years				10,000		unloaded
58	3-54817	24 years	2 years	Grade 10	2 years	4	2		20,000	loaded	
59	3-46883	28 years	8 years	Grade 9	1 year	7	4	6	500,000	loaded	
60	3-02727	29 years	3 years	Grade 8	3 years			1	78,000	loaded	
61	3-85558	27 years	5 years	College	6 years	8	2	2	6,000	loaded	
62	3-57674	40 years	4 years	Grade 11	3 years	3		5	13,500	loaded	
63	3-27201	25 years	1 year	Grade 10	2 years		1	1	93,623.11	loaded	
64	3-58714	26 years	3 years	Grade 12	3 years		2	4	10,000	loaded	
65	3-58981	29 years	4 years	Grade 10	5 years			1	11,500	loaded	
66	3-84062	27 years	2 years	Grade 10	3 years		1	3		loaded	
67	3-77992	40 years	4 years	Grade 9	6 years	3			20,000	loaded	
68	3-84803	35 years	10 years	Grade 5	10 years	23	1	1	94,000	loaded	
69	3-12718	68 years	10 years	Grade 12	15 years	2	2	2	4000		unloaded
70	3-89152	30 years	4 years	Grade 10	6 years		1	4	5,000	loaded	
71	3-69831	24 years	1 year	Grade 10	5 years	3	4	6	33,000	loaded	
72	3-82994	36 years	5 years	Grade 12	3 years			2	3,000	loaded	
73	3-05602	54 years	12 years	Grade 6	4 years		2	1	2,000	loaded	
74	3-32261	27 years	1 year	10+3	2 years			2	20,000	loaded	
75	3-17020	28 years	3 years	Grade 8	3 years	3	1	1	32,324.14		unloaded
76	3-83217	24 years	1 year	Grade 9	2 years	2	2		56,678.88	loaded	
77	3-81509	24 years	1 year	Grade 12	1 year	1	3	6	300,000	loaded	
78	3-58662	22 years	1 year	Grade 10	3 years		4	2	20,233.03	loaded	
79	4-05654	42 years	8 years	Grade 8	8 years	24	3	7	15,000	loaded	
80	3-40791	51 years	8 years	Grade 8	3 years	7		1	1500	loaded	
81	3-58956	32 years	2 years	Grade 6	2 years	1	3	2	38,000	loaded	
82	3-21495	22 years	1 year	University	1 year		5	6	60,000		unloaded
83	3-93855	23 years	2 years	Grade 8	1 year	3	2	2		loaded	
84	4-09655	33 years	5 years	Grade 10	3 years		1	1		loaded	
85	3-78822	22 years	1 year	College	2 years			3	10,500	loaded	
86	3-79373	24 years	2 years	Grade 12	2 years		4	2	12,000	loaded	
87	3-93851	55 years	12 years	Grade 8	5 years			1	17,752.22	loaded	
88	4-09622	53 years	14 years	Grade 6	7 years		1	2			unloaded
89	3-51958	27 years	4 years	Grade 10	3 years	1	2	3	19,000	loaded	
90	3-60335	45 years	7 years	University	5 years					loaded	
91	4-03855	37 years	5 years	Grade 8	3 years	3	2	1	7,700	loaded	
92	3-96917	36 years	8 years	Grade 10	6 years		2	2	15,000	loaded	
93	3-56862	21 years	1 year	Grade 12	1 year			3	23,344.33	loaded	
94	3-54426	32 years	3 years	College	2 years		1	2			unloaded
95	3-57516	55 years	16 years	Grade 8	7 years	1	2	1	55,231.67	loaded	

Appendix 2: Speed Data Collected in the Field on Selected Road Sections

S.n	Plate no.	Speed (km/hr.)	S.n	Plate no.	Speed (km/h	S.n	Plate no.	Speed (km/hr.)
1	3-19746	63.53	43	3-92201	122.64	85	3-56909	85.34
2	3-85869	77.24	44	3-91095	87.98	86	3-94242	112.28
3	3-74446	72.35	45	4-03855	86.98	87	3-55677	123.33
4	3-61509	115.34	46	3-70670	67.55	88	3-49756	86.67
5	3-73464	92.45	47	3-94012	58.87	89	3-88285	67.62
6	3-84244	99.22	48	3-56969	115.59	90	3-932110	114.26
7	3-84371	102.38	49	3-48933	76.63	91	4-02390	77.38
8	3-15620	104.32	50	3-96687	116.62	92	3-54864	115.22
9	3-89679	109.44	51	3-91344	122.22	93	3-60055	94.56
10	3-51145	88.21	52	3-89624	118.56	94	3-69199	93.41
11	3-92249	67.66	53	3-48953	98.99	95	3-66817	122.6
12	3-86699	57.77	54	3-87177	114.44	96	3-57498	66.88
13	3-70776	96.93	55	3-72498	67.54	97	3-85551	98.99
14	4-05342	99.92	56	3-91913	113	98	3-78822	112.45
15	3-89181	104.44	57	3-52734	112.65	99	4-01686	116.66
16	3-96980	98.20	58	3-58441	85.45	100	3-82453	108.87
17	3-80823	56.73	59	3-71293	117.9	101	3-96940	81.11
18	3-82928	115.7	60	4-05070	86.98	102	3-96867	99.04
19	3-96557	120.37	61	3-17809	120.43	103	3-44124	82.27
20	4-00264	99.4	62	3-67911	114.45	104	4-58193	90.99
21	3-48300	110.67	63	3-60544	106.55	105	3-81011	98.91
22	4-03908	120.33	64	3-17896	99.8	106	3-70260	67.77
23	3-57566	98.99	65	3-78416	119.08	107	3-51283	124.6
24	3-77968	67.77	66	3-61149	122.88	108	3-80303	105.88
25	3-86200	88.99	67	3-56665	104.43	109	3-74000	84.44
26	3-74445	112.23	68	3-26983	110.23	110	3-56690	122.56
27	3-97142	99.9	69	3-61534	107.38	111	3-83310	109.94
28	3-82882	123.68	70	3-76981	119	112	3-86890	55.68
29	3-93217	77.89	71	4-03393	77.98	113	4-03371	84.83
30	3-93984	109.9	72	3-58193	94.98	114	3-68785	97.76
31	3-96877	110.22	73	3-55956	56.77	115	3-57346	67.77
32	3-52734	102.67	74	3-81733	98.46	116	3-79337	99.38
33	3-51152	118.88	75	4-10263	113.36	117	3-91786	118.88
34	3-56169	117.98	76	4-02392	97.42	118	3-81459	114.36
35	4-05075	98.88	77	3-70260	88.81	119	3-79485	90.08
36	3-96789	114.56	78	3-67934	94.34	120	3-75326	86.45
37	3-59486	109.67	79	3-55000	115.55	121	3-85630	119.95
38	3-92281	120.44	80	3-67763	122.39	122	3-92262	78.42
39	3-90219	89.94	81	3-56454	117.33	123	3-84236	112.67
40	3-86600	79.05	82	3-87929	107.11	124	3-92222	87.8
41	3-68671	105.55	83	3-44124	96.41	125	3-79351	103.6
42	3-77443	117.77	84	3-67763	82.35	126	4-09071	99.99

Appendix 3: Interview Questions in Amharic

[illegible]

[illegible]

[illegible]

"INVESTIGATING THE CAUSES AND COUNTER MEASURES OF HEAVY TRUCK ACCIDENTS: THE CASE STUDY OF SINO-TRUCK RELATED ACCIDENTS IN AMHARA REGION" [illegible]

[illegible]

[illegible]

1. [illegible]?
2. [illegible]?
3. [illegible] ([illegible])[illegible]?
4. [illegible]?
5. [illegible]?
6. [illegible]?
7. [illegible]?

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11. [illegible]?

12. [illegible]? [illegible]?

13. [illegible]?

14. [illegible]?

15. [illegible]?

16. [illegible]?

Appendix 4: Questionnaire Questions in Amharic

[illegible]

[illegible]

[illegible]

"INVESTIGATING THE CAUSES AND COUNTER MEASURES OF HEAVY TRUCK ACCIDENTS: THE CASE STUDY OF SINO-TRUCK RELATED ACCIDENTS IN AMHARA REGION" [illegible]

[illegible]

[illegible]

1. [illegible]
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2. [illegible]
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   - [illegible] 20-26 [illegible]
   - [illegible] 26-32 [illegible]
   - [illegible] 32-38 [illegible]
   - [illegible] 38-45 [illegible]
   - [illegible] 45 [illegible]
3. [illegible]
   - [illegible]
   - [illegible] ([illegible] 1-8[illegible])
   - [illegible] ([illegible] 9-12[illegible])
   - [illegible]/ [illegible]
4. [illegible]?
   - [illegible] 0-2 [illegible]
   - [illegible] 2-4 [illegible]
   - [illegible] 4-6 [illegible]
   - [illegible] 6-8 [illegible]
   - [illegible] 8 [illegible]
5. [illegible]?
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6. [illegible] 5 [illegible]
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7. [illegible]?

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20. [illegible]?
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21. [illegible]?
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22. [illegible]?
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23. [illegible]?
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24. [illegible]?
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25. [illegible]?
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    - ○ [illegible]

27. [illegible]

Appendix 5: Questionnaire Questions in English

BAHIR DAR UNIVERSITY

BAHIR DAR INSTITUTE OF TECHNOLOGY

FACULTY OF CIVIL AND WATER RESOURCES ENGINEERING

A questionnaire prepared to complete the thesis entitled "Investigating the Causes and Counter Measures of Heavy Track Accidents: The Case Study of Sino-Track Related Accidents in Amhara Region"

Notice

This questionnaire has been set up to investigate the growing Sino-Track road traffic accidents in the Amhara region and to suggest or recommend a solution to the problems. Therefore, I sincerely apologize to my dear party for checking out appropriate answers. The questionnaire is designed to collect the resources required to conduct a study on the subject mentioned above. The information you provide is for educational purposes only, based on your wishes and good will. The researcher also keeps the information private and if the questionnaire fails, quit at any time. Thank you very much for your kind cooperation.

Questionaries' Prepared for Sino-Track Drivers

1. Your gender
   - Male
   - Female
2. Your age
   - Bellow 20 years
   - 20-26 years
   - 26-32 years
   - 32-38 years
   - 38-45 years
   - Greater than 45 years
3. Your educational background
   - Illiterate
   - Primary Education (1-8)
   - Secondary education (9-12)
   - University/ College
4. How long have you been driving (experience) Sino-Track in Amhara region?
   - 0-2 years
   - 2-4 years
   - 4-6 years
   - 6-8 years
   - Above 8 years
5. Have you faced accident in your driving life of Sino-Track?
   - Yes
   - No
6. Is there a speed controller GPS on your Sino-Track?
   - Yes
   - No

7. If your answer is yes for question number 5, in which condition accident was faced?
   - Loading condition
   - Non loading condition
8. Do you think that Sino truck have its own problem by its nature that causes an accident?
   - Yes
   - No
9. Do you drive other vehicles which are less than Sino-Track in capacity and size before you drive Sino-Track?
   - Yes
   - No
10. How many total years did the Sino-Track you drive give service?
    - 0-2 years
    - 2-4 years
    - 4-6 years
    - 6-8 years
    - Above 8 years
11. What is your approximate average driving speed on roads in the town?
    - Less than 30 km/hr.
    - 30-40 km/hr.
    - 40-60 km/hr.
    - 60-80 km/hr.
    - Above 80 km/hr.
12. What is your approximate average driving speed on link roads in rural?
    - Less than 60 km/ hr.
    - 60-100 km/hr.
    - 100-120 km/hr.
    - Above 120 km/hr.
13. Do you drive at night time?
    - Yes
    - No
14. Have you challenged by drowsiness during driving during night driving if your answer is yes for question number 11?
    - Yes, always
    - Yes, sometimes
    - No
15. Which teaching method is more implemented in the institute during your training period?
    - Practical exercise
    - Dictation (vocabulary learning)
16. Is the time given for you for training of driving is good enough?
    - Yes
    - No
17. How do you rate traffic police commitment to their duties and responsibilities?
    - Very good
    - Good
    - Poor
    - Very poor
18. Is there a difference between training track and driving track (Sino-Track?
    - Yes
    - No
19. Is there a difference between the natures of training places and driving places?
    - Yes
    - No

20. Is the driver's capacity problem after training relates with the capacity problem of training institutes?
    - Yes
    - No
21. Which one is the foremost cause of your Sino-Track accident if you are facing accident?
    - Drivers related problem
    - Vehicle related problem
    - Road related
    - Environmental problem
    - Others
22. How often do you make overloading?
    - Always
    - Sometimes
    - Never
23. In your driving time which parts of the Sino-Track is difficult for you and vulnerable to accident?
    - Vehicle brake
    - Guider
    - Motor
    - Others
24. How often do you give attention during driving Sino-Track?
    - Always
    - Sometimes
    - Never
25. How often do you give a continuous and periodic service for your Sino-track as recommended by the company?
    - Always
    - Sometimes
    - Never
26. Do you think that Sino-Tracks have a controlling system problem?
    - Yes
    - No
27. Recommend some possible solutions to prevent and reduce Sino-Track related road traffic accidents?

    ____

    ____

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