



Evaluation of road traffic accident in Addis Ababa – Adama Expressway

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ABSTRACT

This study is aimed to evaluate Road Traffic accidents (RTA) in Addis Ababa– Adama Expressway which is the first modern expressway in Ethiopia. The study analyzed 1,137 accident data that occurred in the past three years and eight months since the launching of the project. The study investigated several characteristics of accidents. Among others this includes accident type and severity, time of accident occurrence and types and level of traffic. Advanced statistical tests were conducted to identify the contribution of accident instruments. Out of 1,137 RTA datasets 75% occurred during day time and about 24% accidents occurred at night. The highest fatality accident occurred in January. In total, 84 fatalities, 191 serious injuries, and 438 light injuries were registered. The highest number of serious injuries (about 38%) occurred during weekend. A total of 1,348 vehicles were involved in road accidents. About 33.5% of accidents occurred due to rear-end collision while about 31% occurred due to vehicle rollover. The remaining accidents occurred due to collision to guardrail and curbstone about 39% of accidents occurred due to unethical driving behavior while about 19% accidents occurred due to over speeding. In addition, driver fatigue, flat tires, poor vehicle brake performance, and steering problems, the presence of animals were also contributing factors to the reported accidents. The study recommended remedial Measures for safe operation of the expressway.

Keywords— Expressway, Road Accidents, Fatality and Injury

1. INTRODUCTION

A traffic accident is the most leading cause of fatality and serious injury globally, according to WHO 2015 road safety report traffic accident is the cause of death for 1.2 million people each year globally. Road traffic death rates in low- and middle-income countries are more than double those in high-income countries. Road traffic deaths and injuries in low- and middle-income countries are estimated to cause economic losses of up to 5% of GDP.

Ethiopia is one of the middle-income countries that traffic accidents occurred frequently and it cause death, serious injury and property damage to the nation, this shows the traffic accident rate is at a worrying stage. The Management of Commercial Road Transport in Ethiopia (2009) study shows that Ethiopia has a low number of road vehicles, and it is almost the first country in Africa in terms of its traffic accident rate.

Table 1: The Magnitude of Road Traffic Accidents (RTA's) in Ethiopia

Accident	Year of an accident recording								
	1996/7	1997/8	1998/9	1999/00	2000/1	2001/2	2002/3	2003/4	2004/5
Light injury	2080	2444	2173	2120	2134	2196	2365	2705	2731
Serious injury	1612	1762	1642	1771	1697	1712	1790	2072	2368
PD	6512	7783	6560	6666	6684	7188	8563	10569	10822
Death	1314	1313	1283	1274	1261	1659	1888	2111	2176
Total	11524	13302	11658	11831	11776	12755	14606	17457	18097
%of death	11.4 %	9.9%	11.0%	10.8%	10.7%	12.1%	12.9%	12.1%	12.0%

WHO (2015) traffic safety report estimate shows Ethiopia has road traffic fatalities 23,837 (95%CI 18 528–29 146) and have estimated rate per 100 000 population 25.3 and also loss Estimated GDP of 0.8–0.9% due to road traffic accident.

According to Zewude (2015), Ethiopia is losing over 400 million birrs yearly as a result of road accidents with the death rate of 136 per 10,000 vehicles and the share of Addis Ababa city in the total number of accidents was 60 percent in 1989 with annual average traffic accident growth of 31.4 percent. Nowadays, Addis Ababa is experiencing around 700 accidents per month resulting in various levels of injury, Getu S. Tulu et al. (2013) analyze Six years (July 2005 - June 2011) of police-reported crash data, consisting of 12,140 fatal and 29,454 injury crashes on the country's road network. The 12,140 fatal crashes involved 1,070 drivers, 5,702 passengers, and 7,770 pedestrians, totally 14,542 fatalities, an average of 1.2 road user fatalities per crash.

2. BACKGROUND OF THE STUDY

Ethiopian Road Authority (ERA) is responsible for all public roads construction in Ethiopia, they proposed the new and improved quality of road in safety and operating cost at Oromia region called Addis Ababa– Adama Expressway, which is the first modern road for Ethiopia and East Africa which finished and officially opened in September 2014. The new six-lane, the 12m-wide road was constructed along a different route but was placed adjacent to and 3.5km from the west side of the old Addis Ababa Adama road. The new road is 20km shorter than the old Addis Ababa Adama road, while the route is fenced on either side for protection from pedestrians and animals. The project was completed at an estimated cost of 11.2 billion birr and has a capacity more than 20,000 vehicles each day. Its facilities such as traffic cameras and variable message signs (VMS) enables effective traffic management and incident management control along with safe operations at the new complex road. This road has technologically advanced safety management system aiming to reduce traffic accident but traffic accidents occurred frequently.

Table 2 severity of traffic accident in Addis Ababa Adama Expressway

Road traffic accident					
Severity	Fatality	Serious Injury	Light Injury	PD	Total
Number	84	191	438	870	1,137

Prefeasibility studies were conducted and construction is beginning for Adama Awash and Modjo Hawassa roads, along with the Addis Ababa Adama road project. Addis Ababa Adama was given ultimate priority as the road is a segment of Addis Ababa to Djibouti Highway. Djibouti is the country's hub for business, import and export activities.

This paper is written to identify the road traffic accident characteristics and assess the major cause of road traffic accident at this new typical road, if the accident rate is increased by this rate the road will be frustrate the driver and it will cause more casualty, and also the other extended expressways are under construction in different regions so this study will be helpful as an input for the newly constructed expressways for elimination of road traffic accident by calibrating the output of this study.

3. SIGNIFICANCE OF THE STUDY

The study has the importance of

- Offering information regarding the basic cause of road traffic accidents in this expressway;
- Findings of this study leading to new problems for further investigation;
- Providing policymakers, researchers, institutions, etc. with adequate and reliable data so as to implement feasible and appropriate engineering solutions to reduce the road traffic accidents in this Expressway.
- To create or design effective prevention and protection policy, strategy to Policymakers, transport authorities, road engineers, and other concerned bodies, to take countermeasures and monitor road safety problems.
- Thus, this research paper will give a clue to those who are interested in conducting research on traffic crashes.

4. RESEARCH METHODOLOGY

The study will assess accident characteristics and the major cause of road traffic accidents in Addis Ababa -Adama expressway by using secondary data obtained from Ethiopian toll road enterprise traffic accident database and engineering team. This secondary data contains historical road traffic accidents, traffic volume, and road engineering data recorded by the safety officers of Ethiopia toll road enterprise will be used for descriptive analysis.

5. RESULT AND DISCUSSION

5.1 identify road accident characteristics

It's the analysis of 1,137 road traffic accidents between September 4, 2007 and April 30, 2010(E.C). Depends upon the data obtained from Ethiopian toll road authority the distribution of traffic accident characterized into

- (a) Distribution of RTAs by Severity
- (b) Distribution of RTAs with Time of Occurrence
- (c) Distribution of RTA with Week of a day
- (d) Distribution of RTA with Month and Driving Direction
- (e) Distribution of RTAs with Types of Accident
- (f) Distribution of RTAs with Types of the vehicle involved

5.1.1 Distribution of RTAs with Climate condition

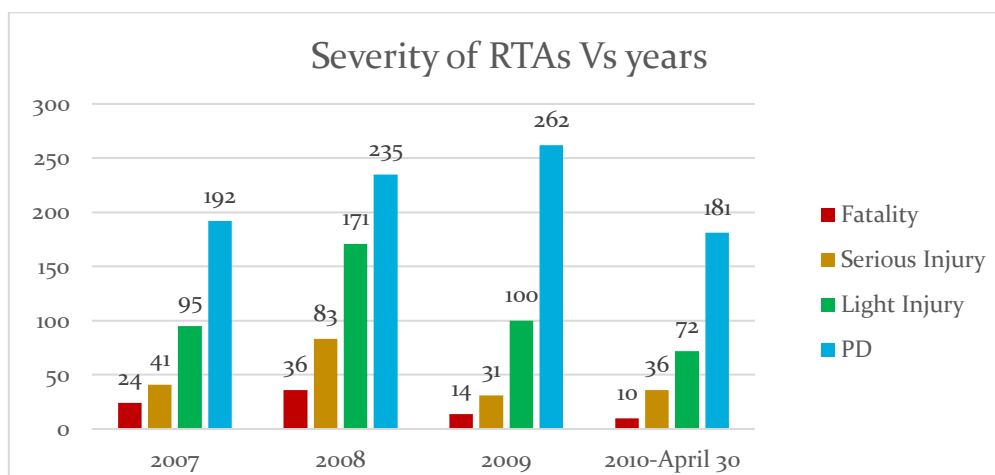


Fig. 1: Severity of RTAs with years

Totally from 1137 RTAs 5.3% fatality, 12.0 % serious injury, 27.7% light injury and 55% property damage were recorded throughout the study period of 3 years and 8 months.

The highest number of total RTAs occurred between 2 pm and 5 pm and the lowest number of RTAs was occurred between 1 am and 3 am, the data shows that 75% of total RTAs happened at day time between 7 am and 6 pm, and also 25% of total RTAs happened at night time between 7 pm and 6 am.

The relation between road traffic accident (RTA) and annual average daily traffic (AADT) with time of a day shows that between 6:01 am-2:00 pm 484 RTA and 5257 AADT, 2:01 pm-10:00 pm 504 RTA and 6923 AADT and between 10:01 pm-6:00 am 149 RTA and 5641 AADT was recorded throughout the study period so that RTAs were depended upon AADT with a time of a day. The total road traffic accidents were nearly equal distribution through the week of the day, the maximum number of the accidents occurred Saturday (178) 15.70% and the minimum was on Wednesday (143) 12.60%. when we see the relation RTA is independent of AADT with the day of the week.

Table 2: The relation between RTA and AADT with the day of the week.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
RTAs	153	175	143	165	175	178	148
AADT	18264	18813	18884	19518	19428	19211	17483
RTAs %	13.5%	15.4%	12.6%	14.5%	15.4%	15.7%	13.0%
AADT	13.9%	14.3%	14.3%	14.8%	14.8%	14.6%	13.3%

Totally the highest number of fatality (17) was recorded in January and the lowest fatality (3) were recorded in December and March, the highest number of serious injury (25) was recorded in January and the lowest serious injury (5) were go to December and March, the maximum light injury (61) were recorded April and the lowest light injury (10) were go to May, 632 (55.6%) of the RTAs occurred in Adama direction and 505 (44.4%) occurred in Addis Ababa direction. And also, RTAs in the months of a year were depended upon the AADT in the months of a year.

Table 3: The relation between RTA and AADT with the months of the year

Month's	RTAs	AADT	%RTAs	%AADT
September	100	17780	8.80	8.09
October	88	18561	7.74	8.45
November	91	16274	8.00	7.41
December	78	15948	6.86	7.26
January	101	18398	8.88	8.37
February	84	19410	7.39	8.83
March	91	20276	8.00	9.23
April	121	20107	10.64	9.15
may	79	18782	6.95	8.55
June	88	17416	7.74	7.93
July	106	18474	9.32	8.41
August	110	18290	9.67	8.32

From 1,137 RTAs the maximum number 381 (33.5%) were occurred due to Rear-end collision which is the front of vehicle with the other vehicle end or with stopped vehicles end, the next one was car overthrow or vehicle rollover it's 351 (30.9%), the other one is vehicles crush with the Expressway fixed property like guardrail and curbstone which is 317 (27.9%), out of Road or out of

control vehicles were 62 (5.5%), and the other one was side-impact collision 14 (1.2%) which means the front of vehicle hit to the side of the other vehicle, the minimum number of RTAs were due to Head on collision 12 (1.1%) which is face to face vehicles collision.

A total of 1,348 vehicles was involved in 1,137 RTA and the data were summaries in ascending order of axle configuration. Ethiopian toll road enterprise classifies vehicles into 7(V1-V7) based on Axle configuration for the use of charging road users' vehicle so this research uses this classification.

- V1=car & 4WD
- V2= mini bus
- V3= bus & small truck(2 Axle)
- V4= heavy truck (3 Axle)
- V5 = heavy truck with (4 Axle)
- V6 = different axle confirmation of heavy truck (5 Axle)
- V7= Truck & Trailer/Articulated Truck (6 Axle)

The highest number of fatality was occurred by V2 and V5 and V6 were not involved in the fatality crash.

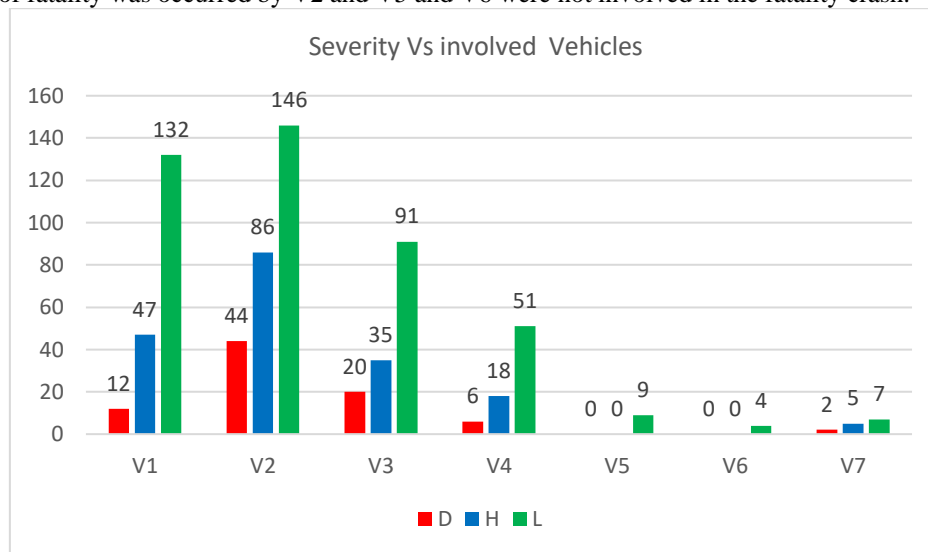


Fig. 2: Severity of RTAs with involved vehicles

In this expressway, the type of involved vehicles in RTAs was depended upon the AADT of the type of vehicles.

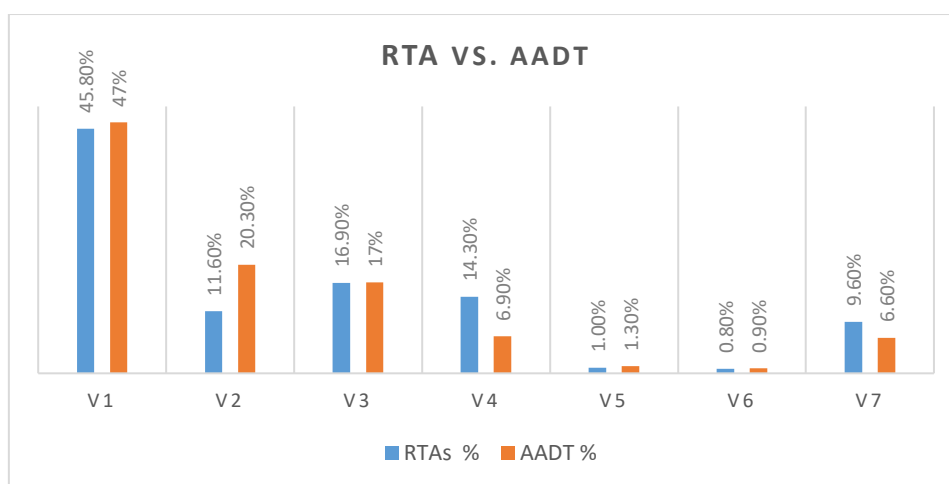


Fig. 3: The relationship between RTAs and AADT with involved vehicles

Totally 644 (56.6 %) RTAs have occurred in normal or good climate condition for driving, and 168 (14.8 %) have occurred in rainy climate condition and 152 (13.4 %) of RTAs have occurred in sunny climate condition and also 173(14.2 %) of the RTAs have occurred in a cloudy climate.

5.2 Cause of RTAs in Addis Ababa Adama Expressway

The major causes of RTAs of Addis Ababa-Adama Expressway were

- Unethical driving
- Tire problem
- Break problem
- over speed

- sleeping
- steer problem
- the technical problem of the vehicle

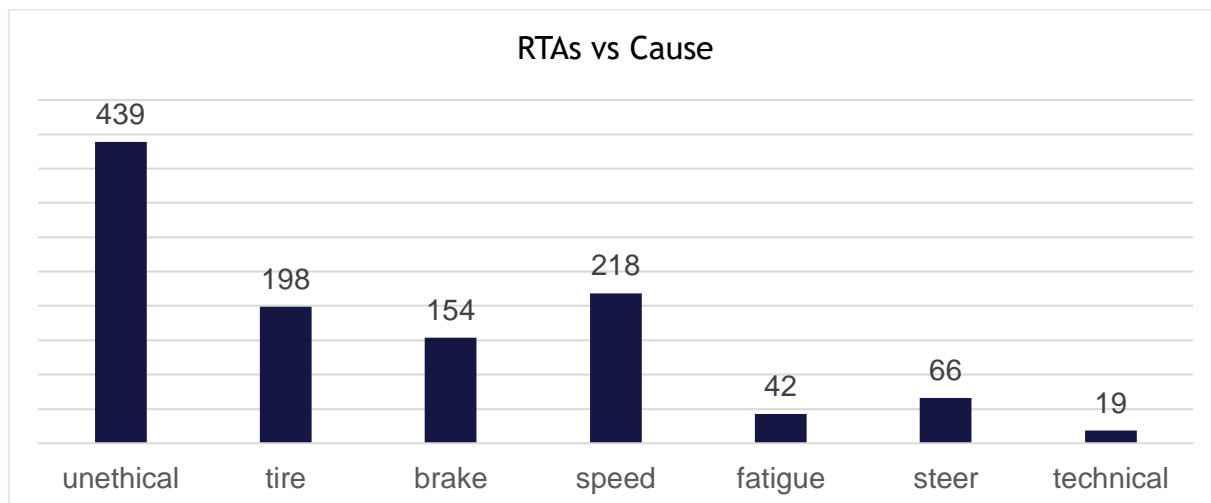


Fig. 4: Cause of RTAs in Addis Ababa Adama Expressway

The major cause of RTA severity in Addis Ababa –Adama expressway

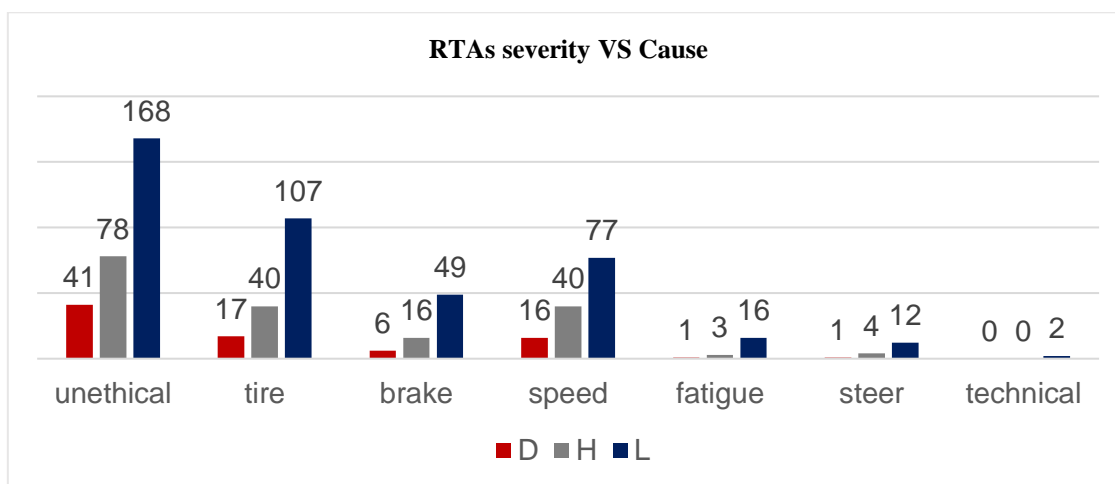


Fig. 5: Cause of RTAs in severity in Addis Ababa Adama Expressway

(a) Unethical driving

Driving has its own ethics because it difficult task that must need to control the vehicle, follow the road, predict the motions of other road users and decide an action to avoid the accident, Unethical driving means not morally acceptable driving behavior. Due to unethical driving 439 RTAs was occurred, some behaviour typically associated with unethical (aggressive) driving include:

- Exceeding the posted speed limit,
- Following too closely,
- Erratic or unsafe lane changes,
- Improperly signaling,
- Failure to obey traffic control devices (stop signs, yield signs, traffic signals, railroad grade cross signals, etc.),
- Rude gestures or language,
- Threatening another driver with a weapon or chasing a vehicle to do harm.

(b) Tires problem

In Addis Ababa Adama expressway 198 RTAs were recorded due to tire problems with in the study period. The major factors of tire failure are

(c) Tire Aging

Any rubber begins to break down over time. Heat accelerates this process. The rubber in your tires also breaks down over time, a process referred to as tire aging. Some tire manufacturers recommend replacing tires that are 6 to 10 years old, regardless of tread wear.

(d) Tire and Loading Information Label

All passenger cars, light trucks, and vans that are the Model Year 2006 or newer have this label. Located on the driver's side door edge or door post, the placard provides information about proper tire inflation pressure and maximum load for the specific vehicle. For older vehicles, a black-and-white label may be located in the glove box.

- **Proper Tire Inflation pressure:** Follow the recommended tire pressure in pounds per square inch (psi) for every vehicle. This information is found on the vehicle placard and in-vehicle owner's manual. Remember that the correct inflation pressure for the vehicle is found on the vehicle placard, not on the tire sidewall and Understand that tires may lose 1 psi every month.

(e) Brake problems

Due to brake problem 154 RTAs occurred in Addis Ababa Adama expressway within the study period.

Brake fade is the loss of performance result from the lining friction decreasing as the lining rotor or drum rises in temperature

(f) Speed Management

Speed management is a critical cause for RTAs, 218 accidents were occurred in Addis Ababa Adama Expressway within the study period due to speeding. The major components of speed are

- **Stopping:** When doubling the speed from 20 to 40 mph, the impact is 4 times greater. The braking distance is also 4 times longer, High speeds greatly increase the severity of crashes and stopping distances.
- **Adjusting Speed:** The faster the vehicle is going, the more time and distance it will take for turning, slowing or stopping.
- **Adjusting to Roadway Conditions:** There are road conditions were to be safe one must reduce speed, such as reducing speed before a sharp curve, when the roadway is slippery or when there is a potential for animals standing on the roadway.
- **Adjusting to Traffic Conditions:** Keeping pace with traffic – If one going faster than traffic flow patterns, it will have to keep passing other roadway users. Each time if pass one another; there is a chance for a collision. Excessive speed does not save more than a few minutes an hour and often leads to high-risk decision making.
- **Obeying Appropriate Speed Limits:** Excessive vehicle speed has disastrous effects in a crash, because of speed:
 - (a) Reduces the ability to negotiate curves or maneuver around obstacles in the roadway
 - (b) Increases the distance a vehicle travels while the driver reacts to a hazard
 - (c) Decreases the ability of guardrails and barriers to protect occupants
 - (d) Increases tread wear on tires and wear on braking systems
 - (e) Increases the risk of crashes because other roadway users and pedestrians may not be able to judge distance accurately
 - (f) Increases the level of fatigue for the driver
- **Space Ahead:** Rear-end crashes are very common this expressway. Drivers following too closely, and then being unable to stop before hitting the vehicle ahead when decrease speed quickly causes these types of crashes.
- **Space to the Side:** Space is needed on both sides of the vehicle to communicate properly prior to a turn or a change of lanes.
- **Space to Pass:** When passing another vehicle, pass the vehicle as quickly and safely as possible. The longer the vehicle stays alongside the other vehicle, the longer vehicles are in danger of the other vehicle moving toward the lane.

(g) Sleeping and Night Driving

Due to fatigue 42 RTAs were occurred in this expressway, Fatigue is gradual decline of physical and mental alertness that can lead to sleep. This state jeopardizes a driver's ability to perform tasks that require attention, judgment, and good reflexes. Work schedule, Work shift, Sleep disorder, Alertness and Work cycle are the Factors of fatigue.

(h) Steering wheel

Due to steering problems, 66 RTAs have occurred; in a car ensure that wheels are pointing in the desired direction of motion Convert rotary motion of the steering to the angular turn of the wheel smallest error can be dangerous. Steering depending on vehicle type, driver preferences Electric eliminates the problems of dealing with leakage and disposal of the hydraulic fluid.

(i) Technical problem

Due to technical problem of the vehicle 19 RTAs were occurred, which includes Engine Repair, Transmission failure, Manual Drive Train and Axles, Suspension, Electrical/Electronic Systems, Heating and Air Conditioning, and Engine Performance

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Totally from 1,137 RTA datasets, 75% occurred during day time and about 24% accidents occurred at night. And the highest fatality accident occurred in January, 1,348 vehicles were involved in road traffic accidents, 39% of accidents occurred due to unethical driving behavior while about 19% accidents occurred due to over speeding, 38% of RTAs were occurred because of vehicles problem, The highest percentage (62%) of RTAs was occurred due to direct human-made (driver) problem.

6.2 Recommendation

Ethiopian toll road enterprise has to conduct a study on road safety audit and inspection, road asset management and also has to carefully prepare on-site emergency care, standby firefighter and Tier serves center around Entrance.

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