CHAPTER 1

INTRODUCTION

1.1 GENERAL

Road accidents are one of the major causes of death, injury and disability in all over the world both in developed and developing countries. With a broad estimate, in every 1 min, 2 people are killed and 95 people are severely injured or permanently disabled in traffic accidents worldwide. Traffic accident related deaths and injuries result in not only substantial economic losses but also serious physical and mental sufferings. Developing countries are much more affected from traffic accidents than developed countries. According to the world health organization (WHO) statistics, 75% of deaths resulted from traffic accidents occurring in developing countries, although they own only 32% of the motor vehicles in the world. While the annual fatality per 10,000 vehicles ranges from 20 to 200 in low or middle income countries, it varies between 1.5 and 5 in industrialized countries. The estimated global economic cost of traffic accidents is $518 billion per year. The share of the developing countries is $100 billion which accounts for 1 to 3% of their gross national product (Peden et al 2004).

Road traffic crashes occur on all continents and in every country of the world. Every year they take the lives of more than a million people and incapacitate many millions more. Pedestrians, users of non-motorized vehicles–including bicycles, rick–shaws, carts and motor cyclists in low–
income and middle-income countries carry a large proportion of the global burden of road traffic death and serious injury.

Every person who is involved in an accident is to be charged under section 279, 337 and 338 of the Indian penal code and the person if found guilty in this regard, is fined by the court a maximum amount of 2500 rupees. It is to be noted that the Indian penal code was enacted in the year 1860 and the fine above mentioned was prescribed that year and has not at all been modified till date. Another reason is that almost all the vehicles are insured and the driver is aware that he is not at all liable for any compensation against the injured. It can be compensated by levying a portion of the burden on the part of the driver and the owner by the courts strictly.

1.2 WORLD ACCIDENT STATISTICS

India is estimated to have the second highest number of road accidents in a year, according to World Road Statistics (WRS) 2010 data. It is said that in India the total number of people killed in road accidents was 94,985, next only to China where 98,738 people were killed. In developing countries, the fatality rates (defined as road accidental deaths per 10,000 vehicles) are quite high in comparison to developed countries. India has recorded over 1,05,749 deaths in the year 2006 as against China’s toll of 89,455 as per the latest figures disclosed by the ministry of shipping road transport and highways.

Road traffic accidents and injuries are a major but often neglected public health problem in India. In 2007, the latest year for which data are available, 1,14,600 people died and 4,65,000 people got injured due to road accidents. In a dubious distinction, India is the only country in the world which faces more than 13 fatalities and 53 injuries every hour as a consequence of road accidents (Singh 2009).
Road accidents kill 33 people every hour in Southeast Asia in the year 2009 and the highest number of these deaths is reported in India. A World Health Organisation (WHO) report says “As many as 2, 88,768 people were killed on the roads in the region and almost 73 percent of this burden belongs to India”. This is reported by Sample Plianbangchang, Regional Director of WHO for Southeast Asia. The study also found that of the total number of road accident deaths, almost two-thirds were motorcyclists, pedestrians and cyclists. The report stated that the road accidents put a huge economic burden on the countries as most of the people killed on the roads are young aged between 15 and 44 years, which corresponds to the economically most productive segment of the population.

Tamilnadu and Maharashtra have earned the dubious distinction of having the largest number of road accidents in India, accounting together for one-fourth of the total 3.94 lakhs of such mishaps in 2006. The drivers do not want to give passage to any other vehicle. Everyone seems to be in hurry. Overtaking has become a common practice. And if the drivers hit someone or some vehicle they are so egoistic not to apologies. We do not hesitate to do such things and feel proud to play the blame game on others.

As far as the government is concerned, it should come up with a better enforcement of traffic laws and avoid myopic policies on the part of politicians because these road accidents not only cost human lives but also affect approximately three percent of Gross Domestic Product (GDP) of India (as estimated by World Bank). Speedy medical assistance is also required to minimize the death toll. Measures taken by the government just a pinch of sugar in the sea. Traffic laws are needed to be enforced strictly and it is our duty to follow them. These reasons are enough for us to come forward with road safety measures.
Ever increasing congestion of our roadway system has also caused a rapid increase in the number vehicular crashes increases. As a direct result of this alarming safety statistics, there has also been a welcome increasing interest in enhancing roadway safety through safety research and safety conscious design, which are both mainly concerned “with reducing the number of consequences of vehicle crashes”

1.3 ROAD ACCIDENTS

Road deaths and injuries are a global problem of massive proportions. Of all the systems that people have to deal with on a daily basis, road transport is the most complex and the most dangerous. In recent years, some important and major studies on the subject of road accidents and fatalities carried out by World Bank, World Health Organization (WHO), Transport Research Laboratory (TRL), and others have highlighted the growing significance of road crashes as a cause of death particularly in developing and transitional countries (Mittal 2008).

1.3.1 World Wide Accident Situation

According to the World Health Organization (WHO 2007), in many developing countries, increase in number of traffic accidents and related economic and social outcomes in Turkey force authorities to develop new alternative transportation policies for reducing traffic accidents. From 2006 to 2008, all over the country approximately 2.5 million traffic accidents were recorded and nearly 14,000 people lost their lives and more than 541,000 people got injured. In other words, each year in the last three years, an average of 4,622 persons were killed and about 181,000 persons were injured on Turkish highways. Fatality and injury rates due to traffic accidents in Turkey are 2 to 5 times higher than those in most European countries. This is an apparent result of concentration of freight and passenger transportation on highways in Turkey. In fact, the share of freight and passenger transportation
on highways increased from 29 to 91% and from 50 to 95%, respectively, between 1950 and 2007. A rapid increase in the number of vehicles is also another major reason behind road traffic accidents and fatalities in the country. The number of vehicles increased from 2.5 to 10.5 million (more than threefold increase) between 1986 and 2005, while the population of the country increased from 52 to 72 million (only 38.5% increase) during the same period (Akgungor and Dogan 2009b).

According to WHO, every year more than 1.17 million people die in road crashes around the world. WHO and World Bank in its report released on World Health Day, 2004 estimated the number of people killed in road traffic crashes at almost 1.2 million, while the number of injured is as high as 50 million (WHO 2004). According to WHO, road traffic injuries are the leading cause of death by injury worldwide (20.3% of all deaths from injury). Road traffic injuries rank second to HIV / AIDS as the leading cause of ill-health and premature death for adult men aged 15-44 years. The study by WHO in 1996, ‘Global Burden of Disease’ showed that in 1990, out of 10 cases of deaths and injuries, road crashes were ninth on the list. However, forecast for 2020 shows that the road crashes are expected to move up to third place in terms of disability adjusted life years (DALYs) The DALY is an indicator of the time lost by an individual in living with a disability and the time lost due to premature death. Jacob and Aeron – Thomas suggested that for 2010 the likely range of global road deaths will be between 900,000 and 1.1 million and between 1 million and 1.3 million in 2020. It is estimated that without additional efforts and new initiatives, the total number of road traffic deaths and injuries worldwide is forecast to rise by some 65% between 2000 and 2020 and in low-income and middle-income countries, the deaths are expected to increase by as much as 80% (Mittal 2008).

As per the commission for Global Road Safety in the year 2009, road traffic accidents kill an estimated 1.3 million people and injure 50
million people per year globally, and global road fatalities are forecast to reach 1.9 million by 2020. It is estimated that the number of deaths from road accidents in Asia is about 700,000 per year, accounting for more than half of the world’s road fatalities even though Asia accounted for only 43% of the global vehicle population in 2007 (Road Accidents in India 2009).

The majority of road crash deaths, about 70% occur in developing countries. Sixty – five percent of deaths involve pedestrians and 35% of pedestrian deaths are children. Over 10 million are crippled or injured each year. It has been estimated that at least 6 million more will die and 60 million will be injured during the next 10 years in developing countries unless urgent action is taken. The majority of road crash victims (injuries and fatalities) in developing countries are not the motorized vehicle occupants, but pedestrians, motor cyclist, bicyclists, and Non Motorized Vehicles (NMV) occupants. In high-income countries, deaths among car occupants continue to be predominant, but the risks per capita that Vulnerable Road Users (VRUs) face are high (Mittal 2008).

1.3.2 Accident Situation in India

India's record in road deaths has risen to at least 14 deaths per hour in 2008 against 13 the previous year. The total annual deaths due to road accidents have crossed 1.18 lakh, according to the latest report of National Crime Records Bureau (NCRB). While trucks/lorries and two-wheelers were responsible for over 40% deaths, the rush during afternoon and evening hours were the most fatal phases. Traffic experts are alarmed over the shooting trend of fatalities on roads between 2003 and 2008, and progressive states having a significant share of road fatalities. While the toll was only 84,430 in 2003, it crossed 1.18 lakh in 2008, an increase of nearly 40% in Andhra Pradesh, Maharashtra and Tamilnadu reported 12%, 11% and 10.8% respectively of total road accident deaths in the country. In India, statistics on road accidents
indicate over 1, 30,000 deaths and 5, 00,000 injuries occur annually. In 2007 Tamilnadu recorded over 59140 road accidents in the followed by Maharashtra 51975, Karnataka 46334, Andhra Pradesh 43,594 and Kerala 39861 (NCRB 2007). We all know that total road network is 3.34 million kms but the road infrastructure is not up to the mark of international level and India is a middle developed country. India cannot put vast resources on road security. Something should be done for the safety of the passengers as 40% of accidental deaths are caused due to road accidents (Mishra 2009).

During the year 2009 there were around 4.9 lakh road accidents which killed 1,25,660 people and injured more than 5 lakh persons in India. These numbers translate into one road accident every minute and one road accident death every four minutes in India. Road traffic injuries and fatalities impose a huge economic burden on developing economies in particular (Road Accidents in India 2009).

Mohan (2009) states that road traffic fatalities have been increasing about 8% annually for the last ten years and show no sign of decrease. Road safety policies in India must focus on the following issues to reduce the incidence of road traffic injuries; pedestrians and other non-motorist in urban areas; slow vehicles on highways; motorcycles and small cars in urban areas; over-involvement of trucks and buses; night-time driving; and wrong way drivers on divided highways. India specific countermeasures will be possible through continuous monitoring and research, which will require the establishment of road safety research centres in academic institutions and a National Road Safety Board (NRSB) that could help move towards a safer future as outlined above.

Growth in urbanization and in the number of vehicle in many developing countries has led to the increase in traffic accidents on road networks which were never designed for the volumes and types of traffic that
are urgently required. Road traffic accident is a rare, random, multi factor event always preceded by a situation in which one or more road users have failed to cope up with their environment resulting in a collision on the public highway be recorded by police. Transportation is an essential part of modern existence, linking the various activities in which people participate especially at home, work, school and go to shopping or recreation (Mustaqim et al 2008).

1.3.3 Cost of Road Accident

In economic terms, the cost of road crash injuries is estimated at roughly 1 percent of Gross National Product (GNP) in low-income countries, 1.5 percent in middle-income countries and 2 percent in high-income countries. The direct economic costs of global road crashes have been estimated at US $ 518 Billion, with the costs in low income countries estimated at US $ 65 Billion (World Report on Road Traffic Injury Prevention, WHO 2004). These estimates take account only of the direct economic costs – mainly lost productivity – rather than the full social costs often recognized by industrialized countries. For India the socio-economic cost of road accidents in 1999-2000 was estimated at 3 % of GDP (Road Accidents in India 2009).

At national level, over 100,000 persons die every year in road transport accidents in India. In addition, about 1.5 million people are hospitalized and approximately 7 million suffer minor injuries. The estimated annual loss to the country is to the tune of Rs.550 Billion annually (Jain 2009). These are resources that no country can afford to lose, especially those with developing economies. It is estimated that developing countries currently lose about $ 100 billion every year. This is almost twice as much as the total development assistance received worldwide by the developing countries. These losses undoubtedly inhibit the economic and social development of developing countries. An estimate of the total national cost of road accidents
will help governments to realize the heavy economic losses being incurred annually as described in the “gross output” method of accident costing and socio economic aspects of road accident in developing countries. In Tamilnadu, the total cost of accidents is gigantic more than 800 crores in 2005 price level. Governments must try to reduce these losses by providing road safety improvements and should see expenditure on road safety as an investment and not as a cost.

Using the human capital approach that focuses on the gross output of road accident victims, costs are classified into three main components, namely: Victim related cost; Property damage; and Administration cost. Deleon (2005) estimated that 3.5 million Philippines lost their lives by fatal road accidents which affect their economic growth. In addition, the sufferers due to pain or grief by fatal accidents which are alarmingly high.

1.4 ROAD ACCIDENT INFORMATION AND ROAD SAFETY POLICIES

Reducing road traffic accidents is not an easy job. Not only human beings are responsible for accidents but also the road layout and planning that influence the accident rate. Moreover, analyzing accidents is not simple as calculating the price of goods. There are many related factors which cause the accidents. Statistical techniques can help people to understand better the effect of every kind of road layout or geometry features on road safety.

Road traffic safety deals exclusively with road traffic crashes – how to reduce their number and their consequences. A road traffic crash is an event involving a road vehicle that results in harm. For reasons of clear data collection, only harm involving a road vehicle is included. A person tripping with fatal consequences on a public road is not included as a road-traffic fatality. The pedestrian fatality is counted as the victim struck by a road vehicle.
Road accidents have variant causes, such as passengers, unsafe activities, driver’s bad behaviour, incomplete road infrastructure, speed, weather conditions etc. People who are involved in transport can directly or indirectly influence road safety; therefore they have responsibilities for safety. Government, local authorities, police officers, civil engineers and car makers have a role in creating the conditions for safe travel (Zheng 2003).

Several countries gather information on traffic behaviour, road user’s knowledge, skill and opinion. However data on these variables are lacking in India. When planning traffic safety measures, an analysis of the present situation is not always sufficient and safety experts should attempt to prepare for the future. For example, in several countries the aging of the population, the growing economy, and the rising volume of traffic pose new challenges for traffic safety analysis. On the other hand, new technology offers opportunities for speed restriction, traffic management, and mitigation of collision consequences.

**1.4.1 Background**

When an accident occurs, various accident causing elements interact. Figure 1.1 shows the interaction of accident causing elements. There are separate traffic and accident measures to describe traffic conditions and accidents respectively. But very often, the traffic elements and measures do not show any relationship with accident cause and condition. This leads to the need of measures which describe traffic as well as accident conditions. The study involves understanding of the traffic and accident conditions before and after the accident, traffic measurements which describe both traffic and accident conditions have to be developed and measured.
Figure 1.1 Interaction of Accident Causing Elements (Cheol et al 2000)

The background section is divided into two sub sections. The first section, discusses accidents and measures. In brief, accident studies involve concepts like types of congestion, accident statistics and measures like accident rates and their use. The second section involves a discussion of traffic measures to describe the traffic and accident conditions. The measures, Angular Second Moment (ASM), contrast and entropy which are second order statistics measures, describe properties like smoothness, homogeneity, regularity, and randomness of both traffic and accident conditions. These properties have more advantages compared to properties derived from first order statistic measures and these have been taken in the research.

1.4.2 Accidents – A Brief Description

Accidents lead to congestions. Thus, we start with a discussion on congestion. Two types of congestions are more prevalent in freeways. They are recurring congestions and non-recurring congestions. Congestion is said to
be recurring when it is triggered by a daily event or a periodic event. Congestion is said to be non-recurring when the actual congestion occurs periodically within a day, but at a well known problem location.

1.4.3 Accident Rates

Accident statistics studies are most often used to describe three principal informational elements. They are accident occurrence, accident involvements and accident severity (Baerwald 1998). Simple statistics citing the total numbers of accidents could be misleading. An increase in the number of accidents, for example, 10% from one year to the next year appears to depict a serious problem. However, if in the same year, vehicle-miles of travel increase by 25%, the rise in accident total does not appear to be as serious even though this situation depicts the same seriousness in the problem. For this reason, many tallies are presented in the form of rates.

Accident rates may generally fall into one of two broad categories: population–based rates and exposure-based rates. Some common references for population-based rates include area population, number of registered vehicles, and number of licensed drivers. Exposure-based rates attempt to account for the amount of travel as a surrogate measure for the individual’s exposure to potential accident situations. The two most common references used for exposure–rates are vehicle–miles of travel and vehicle–hours of travel.

Significantly important, is accident reducing remedies. Accident reducing remedies at locations are of two general kinds: those to prevent specific kinds of accidents and those to prevent accidents in general. The customary way to assess the effect of improvements has been to count the number or estimate the percent of accidents likely to be avoided by the improvement in a specified period, regardless of severity of the accidents.
Often there is no alternative to this simple procedure, because the only information available is the total number of accidents.

1.4.4 Accident Analysis

This chapter explains in brief the study site, accident data collection and verification. Also included in this chapter are an explanation of accident data characteristics and precursory traffic conditions. The data collection is a crucial stage in this research study.

1.4.5 Study Site

Traffic surveillance systems are important components in the implementation of intelligent transportation systems. As the data collection procedures and technologies are continuously being improved, the real time information is being streamed as well as stored with more ease. This study would have been impossible without these changes in technology. The study was conducted with the data collected from all the 29 out of 31 districts of Tamilnadu, India. Figure 1.2 shows a Road map of Tamilnadu.

1.5 PROBLEM ANALYSIS

Road traffic accident data analysis is an important tool for determining the main safety problems towards which measures should be directed. These days, road safety has become a major concern in most modern societies. Road accidents can never be totally stopped, but with the help of reduced speed limits, increasing the safety of vehicles, the determination of road locations that are more dangerous than others, Pavement marking, finding the accident rates and increasing the minimum age to drive can all help in preventing road accidents and road safety policies (Mittal 2008).
Figure 1.2 Road Map of Tamilnadu
1.5.1 Study Objectives

The main goal of this research is to reduce the road accidents by accomplishing the eight main objectives.

1. To develop a probabilistic model for estimating accident reduction factor due to pavement marking.

2. A Bayesian approach is adopted to eliminate the expected accident rates.

3. To calculate the accident ranking among the districts of the Tamilnadu state in India using accident rate to take remedial measures for reducing accidents.

4. To identify the black spots on selected roads of Tiruchirappalli, a district within Tamilnadu state, India.

5. To calculate the accident rates using regression equations correlating the registered vehicles and population.

6. To develop Accident Risk Index (ARI) for various districts of Tamilnadu in order to calculate the prevailing probability for an accident taking place in the district.

7. To develop Accident Severity Index (ASI) and compare it across the districts of Tamilnadu in India to enhance highway safety.

8. To compare the ARI, ASI and accident rate.

1.5.2 Research Efforts

The road accident problem has acquired urgency with inadequate roads, increasing population and growing number of vehicles plying on the
roads. Road accidents are increasing alarmingly year after year. Many researches and studies are going on to reduce the accidents. Accidents cannot stop but the same can be reduced with the help of enforcement, education and engineering techniques. Accident analysis and prevention are the most important aspects of transportation studies, because they are associated with human life. Thus, a part of the literature review is concerned with various accident studies. Some of the findings of various studies conducted on road accidents are summarized in the following chapter.