CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

During the past few years, there has been high growth of demand for road transportation. The volume of road traffic has increased continuously over years due to the increase in the population, buying power, rented cab services, increasing economy activities and urbanisation. Road accidents and traffic congestion impose a burden on society. Reducing the traffic congestion and road accidents are very important for better road transportation. The vehicle population in Coimbatore has increased at an alarming rate. In the year 2009-10, around 27100 two wheelers, 4800 cars and 1800 other transport vehicles have been registered. In the year 2010-11, 33000 two wheelers, 6700 cars and 3040 other vehicles have been registered. The increase in the percentage comes to 20%, 40%, 40% respectively during the years 2009-10, 2010-11. Many bus stops are closely located to each other in the study area. Hence it is highly essential that bus stops has to be optimized to minimize traffic congestions and accidents

1.1.1 Road Accidents

Road accident is a global tragedy with the ever-rising trend. Almost every day, the news of the accidents are reported in television, radio
and internet. Many of the road users continue to neglect and ignore the road safety rules during driving and hence accidents happen. The possible causes and solution for the road accidents are discussed below.

To begin with, carelessness is one of the major causes of the road accidents. Usage of mobile phone while driving, violation of traffic rules and sudden entry of vehicles from the side road into the main road are some reasons that comes under carelessness. Furthermore, when inexperienced and untrained drivers and those with blur eyesight when drive at night the probability of accidents may increase. In addition few drive after drinking alcohol, which may lead to dangerous road accident.

Another reason for accidents is poor quality and maintenance of roads. To curb that are caused due to defects in road, authorities concerned must ensure that roads are well constructed and maintained. In addition, transport authorities should make sure that all commercial and private drivers should be well trained before they get the driving licence. Furthermore, passengers should also be vigilant enough to control drivers when they are over speeding and driving under the influence of alcohol. Police can play the pivotal role to decrease the incidents of accidents. To sum up, there are many causes for the road accidents. With good strategies and with the participation of the both government organizations and individuals, the number of accidents can be minimized.

1.1.2 Traffic Congestion

The congestion of traffic in most countries is on the rise due to the increase in the vehicle populations. Traffic congestion is caused due to excess volume of traffic than the capacity of roads. One of the main reasons for traffic jam is that the majority of people prefer using their own cars/ two
wheelers instead of using the public transportation. The main reason for avoiding the public transportation system is that the system is not efficient and reliable. Another factor is that most people live in the suburbs outside the city limits and they tend to travel at the same time of day. Many drivers violate the traffic rules and park their vehicles obstructing the traffic. These causes will lead to congestion of traffic.

There are several ways to mitigate this problem. In order to reduce the traffic many alternatives could be tried. The working hours of offices, schools and other institutions can be staggered. The internet can now be used to connect people. For instance, people can now work from home and meetings can be held through video conferences and workers could be given flexible timetables. Another solution would be to charge a congestion fee for every car that enter into a city centre during peak hours. This will discourage individuals from bringing vehicles into the city and be a motivating factors to use the public transport system. The revenue generated could be used for improving the public transportation. Finally, public transportation is the easiest way to solve this problem. If there is comfortable and affordable transportation system then, people will prefer to use it rather than driving. In fact, governments should provide much better public transportation facility and charge prices that are affordable to everyone.

In conclusion, the problem of traffic congestion can be tackled by improving public transportation, changing our habits and by charging drivers who enter into the city centre.

1.2 PROBLEM STATEMENT

As discussed earlier, both traffic congestion and road accidents impose a burden on society. Hence it is important to reduce the impact of traffic congestion and accidents. An ideal solution would be to reduce them
simultaneously. This may not be possible. However attempt should be made to minimize both. It is speculated that there may be an inverse relationship between traffic congestion and road fatalities (Shefer and Rietveld, 1997). Shefer and Rietveld (1997) suggested that in a less congested road network, the average speed of traffic would be normally high which is likely to result in more road fatalities; on the other hand, in a congested road network, traffic would be slower and may cause fewer fatalities. This suggests that the severity of accidents may be less in a congested areas relative to an uncongested areas. Even though the traffic congestion may improve the road safety, traffic congestion reduces the mobility which subsequently decreases economic productivity. This poses a potential dilemma for transport policy makers.

It is desirable to reduce traffic congestion, to improve the mobility but on the other hand this may lead to more severe road accidents, which may eventually increase the total costs associated with both congestion and accidents. In other words, the benefit of reducing congestion might be offset by more severe accidents. It is, therefore, important to understand the relationship between traffic congestion and road accidents so that effective policy can be implemented to control both congestion and accidents.

The relationship between traffic congestion and road accidents would however appear to lack attention in the current literature and the studies that exist tend to employ a proxy for traffic congestion or lack an appropriate econometric model. For example, the studies by Shefer and Shefer and Rietveld (1997) were based on simulation to test their hypothesized model, as such support from empirical evidence is required. Very few studies have looked at real-world data to provide solid empirical evidence using advanced econometric models. There were some exceptions, such as those studies by Robert and Quddus (2005) and Kazimierz Jamroz (2012) who investigated the effects of traffic congestion on road accidents using real-world data and
econometric models. Those studies, however, seem to use a weak proxy for traffic congestion, such as the “proportion of vehicles slower than half the speed limit”, differences between different spatial locations (e.g., Inner and Outer City Areas), employment density and level of traffic flow. These proxies may not appropriately or truly represent levels of traffic congestion.

For instance, Robert and Quddus (2005) used an indicator variable for inner city areas as a proxy for congestion, and no significant differences were found between inner city areas and outer city areas. They speculated that speed is generally low in both areas. This suggested that such proxies for congestion may not precisely represent levels of congestion, and therefore a more precise congestion measurement is required to more accurately represent congestion in an econometric model so as to provide more robust empirical evidence. Robert and Quddus (2005) suggested that instead of an area wide based study, a road segment based study can be used to improve the recording of variation of traffic congestion.

This thesis seeks to investigate the relationship between traffic congestion and road accidents (frequency and severity) using a suitable congestion measurement and appropriate econometric models. This has been achieved using a road segment based analysis (instead of other spatial units such as areas) as congestion measurement. It examines whether traffic congestion has any positive or negative impact on road safety, which will assist the transport policy makers with transport and safety planning.

Since improving road safety is an important objective for transport policy makers, considerable development has to be made in all aspects of the road transport system which involves three main entities: roads (for which government, local authorities and roadway infrastructure engineers are responsible); vehicles (for which vehicle manufactures and vehicle owners are responsible); and road users (for which drivers, passengers and pedestrians
are responsible). An accident analysis therefore needs to take account of all risk factors related to these parties and their interactions. Various other factors that may affect road accidents also need to be evaluated and controlled for, such as traffic flow and road geometry such as horizontal curvature, gradient and number of lanes. Therefore to effectively improve road safety, it is necessary to fully understand what and how these factors affect road accidents. Once the risk factors are identified, government or transport policy makers can develop corresponding measures to improve the road safety. As such, this thesis examines the impact of traffic congestion on road accidents while controlling for various other factors that may affect road accidents.

There are also technical issues in analysing accidents, notably the method to match accidents to the correct road segments. Due to the error in the location of both accident and roadway data, when the accident dataset is overlaid onto spatial road segment (centreline) data, mismatches between them are often observed. During this research, adequate care has been taken to map accidents onto correct road segments on major roads, which ensures the accident count for each segment and data (e.g., traffic flow) for each individual accident are correct.

In addition to the relationship between traffic congestion and road accidents, policy implications for improving road safety using the results and findings will also be offered. An important application of the accident prediction models in road safety management is site ranking, which aims to identify hazardous accident hotspots, has been explored in the thesis. Once accident hotspots are identified, further safety examination and remedial measures can be implemented on the hazardous locations in order to improve the safety of a road network. Researchers usually consider accident frequency models only in site ranking. In this thesis an innovative method has been developed and illustrated as to how to combine both accident frequency and
severity models in site ranking. This method is transferable and can be applied to other road networks.

1.3 RESEARCH AIM AND OBJECTIVES

In light of the research problems described above, the aim of this thesis is to identify the causes of accidents and congestions and to suggest solutions to reduce accidents and traffic congestion. The main objectives of the research work are given below

- To identify the accident risk zones using overlay analysis
- To suggest solutions to minimize the traffic congestion flow and accidents.
- To estimate the reduction in the risk zones in Coimbatore after implementation of proposed suggestions.
- To develop Web Information system for mobility view using Open layer 3 mapping library
- To develop Web Choropleth map for multiple services
- To build up a predefined Web Map Service for elements and support data framework for accidents.
- To configure the post GIS data for live accident updation.

1.4 OUTLINE OF THE THESIS

This thesis is organised into ten chapters. This section provides an overview of each following chapters.

Chapter 2 gives the details of the literature review carried in the following sections, black spot identification method, Accident Reduction Factor (ARF), accident prediction models, minimizing traffic
congestion, spatial analysis methods for traffic safety, traffic safety and built environment and Web GIS are explained briefly

Chapter 3 gives the details about the Study Area, ward boundary, police jurisdiction, Population and details of the population density. Topographical information about Coimbatore corporation are also given in this chapter. The details road network are explained in this chapter.

Chapter 4 Describes the details of the data collection and the methodology adopted during this research. This chapter also gives the details of the method to assign accidents to the correct road segments. Details of the models used for analyses are also presented. Accident frequency analysis, kernel density analysis, accident severity analysis and weighted overlay analysis models are employed for this research. The details of the data collection are also explained in this chapter.

Chapter 5 The details of accident spot and density analysis are given in this chapter. The consolidated accident count and the details of the fatal and non-fatal count are detailed for the period 2010-2016. The Risk zones in police Jurisdiction map and police limit map are also explained in this chapter.

Chapter 6 deals with accident severity analysis. This chapter explains the various reasons for accident, details of the buffer analysis and remedial measures to be adopted for minimizing accidents are given in this chapter.

Chapter 7 gives the details of the priority analysis, weighted overlay analysis for the prediction of accident risk zones and the details of the reduction in the risk zones after implementation of remedial measures are given in this chapter.
Chapter 8 Describes the details of the solutions suggested to reduce traffic congestion. Suggestions on the formation of new ring road, new traffic signals, new manned traffic signals, and additional speed breakers to reduce traffic congestions are explained in this chapter.

Chapter 9 deals with the Web Information System (WIS). This web GIS application has been designed for Administrators and Decision makers of road transport system. Using WIS they can see the accident location anytime through internet. WIS is better than paper map because user can get details about accident information anytime, anywhere through internet. This application was developed using an open layer software.

Chapter 10 gives the details of live Accident and Responsibility model developed during this study are presented in chapter 10. All spatial data were uploaded in PostGIS spatial database and this PostGIS spatial database was loaded in a separate virtual private server via static IP address. Authenticated user can access the PostGIS database from any place. Users having user id and password can update the accident details in PostGIS database via web. Once the new accident location is updated in local server, the details are automatically updated in Geoserver WMS layer.

Chapter 11 gives the conclusions drawn from this study and the scope for the future work.