CHAPTER-II
REVIEW OF LITERATURE

2.1. INTRODUCTION

During the past few decades, there has been an increasing demand for faster mobility which leads to increased vehicular usage which subsequently leads development of more number of highways. Such development brings benefits to society in terms of faster mobility and easy accessibility. However on the other hand it imposes its own cost directly on providing transport services such as infrastructure, personnel, equipment costs and indirectly in terms of the impact on the environment, most notably noise and air pollution; travel delay due to traffic congestion; and the loss of life and property damage as a result of road accidents. This thesis focuses on two major aspects of road transport activities namely: traffic congestion and road accidents in Mysore city.

The urge to reach the destination fast leads to reckless driving on the roads and negligence of traffic regulations which leads to less severe to fatal accidents. With no exception some parts of National Highway roads, State Highway and Major District Highway of Mysore are essentially Hotspots and some parts of the roads are particularly freeways. Hotspots of Road accident and traffic congestion to emphasis further have attracted the attention of many scholars of different parts of the world during the last four to five decades.

Both traffic congestion and road accidents entail a economical and emotional saddle on society, it is therefore important to reduce the impact of traffic congestion and accidents. An ultimate solution would be to reduce both the congestion and thereby accidents simultaneously. To establish relationship between traffic congestion and road accidents remains crucial. Several authors from UK researched on the relationship between the traffic congestion and road accidents. Shefer (1994) and Shefer and Rietveld, 1997 proposed a hypothesis that there is an inverse relationship between congestion and accidents. 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 increased traffic congestion may lead to more accidents due to increased traffic volume; however, those accidents may be less severe. This suggests that the total external cost of accidents may be less in a congested condition relative to an uncongested condition. As such, traffic congestion may improve road safety. However, traffic congestion reduces mobility which subsequently decreases economic productivity. Yet this hypothesis needs an empirical verification with real world data.

Several other authors Baruya (1998), Noland and Quddus (2005) and Kononov et al. (2008) who investigated the effects of traffic congestion on road accidents using real-world data and econometric models such Poisson or negative binomial regression models. However a weak proxy was used in their studies for traffic congestion, such as the “proportion of vehicles slower than half the speed limit”, differences between spatial locations, employment density and level of traffic flow. These proxies may not appropriately or truly represent levels of traffic congestion, and thus the results from econometric models may be biased. 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 parties:

(i) roads (for which government, local authorities and roadway infrastructure engineers are responsible);
(ii) vehicles (for which vehicle manufactures and vehicle owners are responsible); and
(iii) Road users (for which drivers, passengers and pedestrians are responsible).

Henceforth an accident analysis involving all the above said factors is the prerequisite for effective planning. 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 (in terms of both accident frequency and severity, see discussion below), 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 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.

2.2. ROADS AND ROAD USERS

Daganzo, C.F. (1997), formulated a Simple traffic analysis procedure. The study discussed a simple approximate procedure for traffic analysis that can be described geometrically without calculus. He divided article into two main parts: section one focuses on queued traffic, and section 2 which extends the results to mixed traffic. This yields the total vehicle-hours and vehicle-miles of travel in a time interval, and the vehicular accumulation as a function of time. The predictions made with this method should be practical and easy to test. The method is somewhat more complicated but also more general than that in Newell. The paper shows that the particular one works within certain tolerances, and that errors in the model parameters also have a limited effect. These results can help discriminate between model errors and calculation errors in a validation effort. The second part of the article examines traffic streams that include queued and unqueued traffic, as well as bottlenecks. In this model, simulation with multiple vehicle classes, drivers that wish to travel at different speeds and certain rules of a simulation with multiple vehicle classes. The bottleneck models are assumed to have a well-defined capacity and always to allow the maximum possible flow consistent with: the availability of upstream traffic, the presence of a downstream queue and the capacity. The capacity can be time-dependent and endogenous.

Harish, M. (2011), highlighted the status of traffic Management in Mysore city. The analysis suggested that a clear framework for traffic operations is necessary towards traffic delays, congestion, and parking and management functions. The unplanned urban growth has brought traffic problem in the urban area of Mysore. Harish, M. (2012) analyzed the importance of the road condition in Mysore city. It was suggested that poor road conditions and increased number of vehicles leads to the traffic condition. The measures taken by the urban department of Mysore was also highlighted which help the urban /town planners for may further planning. Harish, M. (2013), emphasize the great importance at present due to the poor state of traffic management in Mysore. Inspite of the technological developments in the past few decades in Mysore the traffic management is at primitive level. Being the crucial
need of the hour, the effective traffic management is challenging in terms of planning (with regard to faster mobility, easy accessibility, safety and security, economy and environment) and effective implementation. Dholiya, P. and Shinkar, P. (2016), conducted to identify the accident prone location on the selected stretch and improvement suggested based on Accident Servility Index (ASI) method and the authors identified top most 3 accident prone stretches.

Oulha, R. et al. (2013), adopt GIS for a case study at Wilaya, Mascara to Identify Accident Black Spots on National Highway. The study presents 2 approaches for identification of the hot spots in Wilaya of Mascara (Algeria) chosen as a study area. The first approach is based on mobility analysis of person and goods. The second approach used Kernel Estimation Approach with Arc Gis tool identifies High-risk-areas in order to bring about specific solutions in planning. Selvasofia, A.S.D. and Arulraj, G.P.(2016), made an assessment of traffic and accidents on three National highways namely, NH-209 from Gandhipuram to Annur, NH-67 Gandipuram to Mettupalayam and NH-47 Gandhipuram to Avinashi in Coimbatore District using Kernel and Overlay Analysis in GIS to identify the Black Spots on Mysore city Roads. In 2014, Shettar, J.S. and Gowda, K. (2014) reported on the usage of intelligent transport system in Mysore city. Mysore stood as the pioneer in adopting intelligent transport system which involves the GPS embedded buses along with Passenger Information System. The study was concluded with a demand of Policy changes for the effective implementation of intelligent transport system. Babu, A.M. (2016) discusses the Hyderabad to Yadagiri Gutta Section of NH-202 Telangana State. The author identified safety issues, accident data analysis and proposed measures to address the safety issues Surveys have been conducted for a safety issue investigation for the project corridor based on accident information collected from the police department, site analysis. The surveys have been conducted at place visit to identify safety issues and possible safety issues.

Apparao, G.et al (2013), stated that the advancement in GIS and GPS can be put forward to effective use in accident analysis. Although GIS has been used for over 30 years, its application in transportation sector started very recently. For identification of black spots GIS may serve as a best tool. A study was done on NH-58 to identify the accident black spots and safety deficit areas using GIS and GPS technology.
Goel, G. and Sachdeva, S.N. (2014), conducted small study on National Highway-1 Delhi to Ambala to Amritsar road. The road was divided into smaller subsections 5km of each and the data for road accidents for the past four years 2007 to 2010 was analyzed to identify the accident prone zone and the study resulted that the stretch between 140 -144 km is the risk zone prone to frequent accidents Morris .A. et al. (2010), made an attempt to develop an European Fatal accident database. It includes the topic levels like accident, road environment, vehicles and road user. The project had multidisciplinary information on the circumstances of fatal crashes to be interpreted to provide information on a range of casual factors and events surrounding the collisions. This has major applications in the areas of active safety systems, infrastructure and road safety.

Similarly Pandi, D.G. (2016) has reported that improper maintenance of roads in Tamil Nadu with pitches and humps might be one of the reasons for road accidents during night time. Lalitha, K., and Ruther, G.K., (2014) conducted a questionnaire survey among the college students of Guntur, Andhra Pradesh. The study revealed that around 70% of the students have limited awareness about the traffic regulations and accidents. This study throws a lime light on education and awareness that must be given to the younger generation to prevent them from fatal injuries and to safeguard their lives themselves. Due to the traffic congestion, the severity accidents also increase. Between the years 2003 – 2007 the rate of fatal accidents increased to 80% in Bangaluru, the capital city of Karnataka. This study also analyzed the number of fatal accidents took place major cities of India and recommended policy changes for the implementation of design alteration in buses (low floor buses) with mechanical doors, which may prevent overcrowding in buses, a strictly separate platform for bicycling and pedestrians (Kharol, P.S. et al., 2010).

A questionnaire based survey was done among the adolescent school students of Malaysia who are involved in road accidents through a self-administered questionnaire 618 respondents. From the study it is understood that the students are allowed to handle cars without proper driving license and they don’t even wear the seat belts also. Henceforth the study emphasized that it is the duty of the parents to monitor their children and prevent mishandling of vehicles without proper licenses Rahman, H.A. et al. (2005)
Hammoudi, A.et al. (2014), made a study in Abu Dhabi, UAE to understand the scenarios of road accidents and significant factors that cause road accidents through a questionnaire based survey among 291 respondents. The results have identified in many factors as causes of road traffic accidents in Abu Dhabi and recommended ways to decrease the high road traffic accidents (RTAs) reported in the nation. In this paper finally come to know that the government be supposed to keep on encourage involvement of all relevant stakeholders for road traffic accidents (RTAs) reduction initiatives.

Shruthi, P. et al., (2013) approached her study regarding the road accidents in south Indian metropolitan cities in different dimensions. She researched the injury profile and mortality pattern of the autopsy cases to draw public attention and to create awareness among the public for accident free transportation. The records from the year 2010 to 2012 was used for the study. From the study it is revealed that around 55% of cases are accident cases, out of which 78 % are male cases. Moreover it is found that most of the accidents occur in the peak hours of the morning 6.00 AM to 12.00 PM. Around 30.22% of cases had fatal injuries involving head injuries, abdominal injuries and limb injuries. From this study it is recommended additional attention is needed at the high accident prone areas and strict legislations to prevent and control drunken driving.

Hussain, T. et al. (2011), made a questionnaire based survey among the people of Islamabad, Pakistan to understand the attitude of people towards road safety. It is understood that around 27% of people lack awareness on road safety measures, 21% lack awareness on seat belts and helmets and use them wrongly and most of them do not wear helmets while driving. Moreover 17% were underage people using licenses and most of the vehicles were registered without proper fitness. The study emphasized improvements in road safety regulations as accidents are 100% preventable.

Abojaradeh, M., (2015), made a study on Development of Traffic Accident Prediction Models to Improve Traffic Safety and to Reduce Traffic Accident Severity and Rate in Jordan. Recently Jordan country got many traffic accidents. This paper importantly focused the causes, analyze reduce number of traffic accidents and their severity in Jordan and also this study focused the effects of driver behavior mistakes on traffic accidents and severity. This paper deals with 10 years of traffic accident
data provided by Jordan traffic institute. During the year of 2000 to 2010 period this study investigates 3,94,188 total accidents with 5 independent variables like violation of speed limits, wrong passing, red light violation, close following and lane violation. The author used SPSS computer software for determine and build a prediction statistical regression model which relates the number of accidents, driver’s behavior mistakes. The first model predicted the total accident; the result shows that close following and lane violation are the majority causes of accidents. The second model is development for the fatal accidents and the result shows that the violation of speed limit and the violation are the majority causes of the fatalities. The 3rd and 4th models were developed for slight and sever injuries. The model result shows that the independent variables most causes of fatalities are applicable for injuries. This model is most predictable and it can used in traffic accidents reduction and especially reduce the fatal and injury accidents.

Vyas, P.R. et al. (2014), made an effort on State Highway (SH 85 from Tavarekere to Magadi town), Karnataka to identify the significant hotspots i.e., where occurs frequent accidents which is also termed as black spots. Sorate, R.R. et al. (2015), made a study on National Highway 4 to identify the black spots. On this highway a 34 km stretch within the pune limits (Mumbai to Bangalore Highway) has reportedly seen around 110 accidents in a period of three years (2012 - 2015), which claimed around 111 lives which quite high a number in three years. The stretch of NH4 from Katraj Tunnel to Chandani Chowk (14.5kms) is also identified as a potential blackspot. The study involves several analytical methods such as ranking method and severity index, density method, weighted severity index to process the primary and secondary data to identify the blackspots. A GIS based Weighted Severity Index method was used in this study to identify such blackspots.

Subbareddy, M. and Prasad .K.S.B. (2015) also investigated the accident black spots using mixed traffic sheets in developed cities. The authors also suggested suitable remedial measures to develop an accident prediction model which can reduce the life losses and injuries in the study area. Bobade, S.U. et al. (2015), in his attempt on identification of black spots on National Highways and Expressways reported that around 13 people die per day due to accidents. The study mainly focused on National Highway 9 (Pune to Solapur) and Mumbai to Pune Expressway. In this study an
Zhao, J. and Deng, W. (2012), made an attempt to study on China’s traffic accidents from 1995 to 2010 in Expressways and examined the characteristics of the accidents. This study is based on expressway accident data, which were collected from annual report for Road Traffic Accidents published by the Ministry of Public Security of China. The results of this article the expressway death increased by 10.2 fold from 616 persons in 1995 to 6300 persons in 2010, and average annual increase was 17.9 percent over the past 15 years. Expressway mileage data were obtained from the National Statistics Yearbook published by the National Bureau of Statistics of China. During the period 1995 to 2010 the average annual accident lethality rate for China’s accident deaths and accident injuries for China’s expressways was 27.76 percent. This was 1.33 times higher than the accident lethality rate of highway traffic accidents. This study concluded China government should attention in expressway construction and safety interventions rapid development period of expressways. The expressway should effective and scientific safety management services system composed of a speed monitoring system, warming system and emergency rescue system and also should be established in developed and underdevelopment provinces in China to improve safety on expressway.

Similarly, Gupta, R. and Singh, M. (2014), made an attempt to study accident black-spot validation using GIS in Chandigarh. The promising idea of this research is that the utilization of GIS tools for the study. The use of ArcGIS tools for accident mapping facilitated the easy recognition of accident spots. The spatial autocorrelation tools aided to derive more accurate results in identifying the significant hot spots termed as black spots which are the major risk zones that seeks immediate attention on mitigation measures to prevent frequent accidents.

Jayan, D. K. and Ganeshkumar, B. (2010), made a hotspot analysis using GIS to identify the spots where accidents occur more frequently at Kannur District, Kerala based on the available database for the year 2006, 2007 and 2008. The database constitutes the details of the accidents such as date of occurrence, time of accident, type of vehicle involved number of persons injured/died. Kernel density was adopted
in this study to identify the accident patterns and road geometry at the accident prone zones. The study presented an insight about the major accident prone roads in the district and also facilitated data sharing with the transportation agencies and other concerned government agencies. Saleh, S. (2014), has done a Geographical Information System based analysis to identify road traffic accident black spots in Federal capital territory of Nigeria. A complete database of road traffic and accident data and other relevant information was developed, which will be needful and useful for Nigeria Police, Federal Road Safety Commission and Road Traffic Services and other stakeholders. From the developed database coupled with GPS, the black spots were identified where 247 accidents occurred in 2010. The severity of injured were also presented in which 52 people accounted for fatal accidents, 59 people were serious victims, 98 people got minor injuries.

Augustus, O., (2012), conducted model on road traffic accidents in Warri and Environs, Nigeria, Africa. This study examined and surveyed 10 years data from 1990 to 2009. One way ANOVA was used to analyze the data using time series and it was identified the trends of accidents fluctuated up and down, however in 2009 a total of 3475 accident cases were recorded. This model resulted in an upward trend of RTA in the study area with a value of 3.728 and it is predicted that this value may increase by 66.68% in 2015. Zhou, J. et al. (2007), has made an investigation on Road Traffic safety of the Mountain areas in southwest china based on Wulong Country, Chongqing Municipality. The study portrays the present situation, characteristics, and main problems of the traffic safety in the mountain areas of southwest china. The mountainous region since 2000 was facing a complex and serious road traffic situation and serious traffic safety, with a high incidence of severe and very severe road traffic crashes eventually leads to the increase in number of victims. The imperfect road design, defective execution of traffic laws, imperfect management, and environmental factors were the major setbacks that lead to traffic crashes.

Oguchi, T. et al. (2003), made a detailed analysis of traffic congestion and route choice behavior influenced by traffic information. They attempt to analyze driver’s route choice behavior together with traffic information about traffic conditions on a road network is analyzed to evaluate the effect of traffic information provided by traveler information system technology. The main difficulties in this practical
analysis are caused by interaction between the traffic conditions which results from driver’s behavior and the change of driver’s behavior depending on the traffic conditions. The author gave a particular example at a critical section of the Tommie express way west bound in Japan. Where, the information on variable message sign boards, traffic congestion, and route choice behavior can be observed. **Kumar, V. and Bansal, R. (2016)**, conducted a study regarding the Analysis of Road Accident in Hisar district, Haryana state. The main objective of the study is to identify the scenarios behind road accidents, spots where accidents occur frequently in Hisar Sirsa Road and Hisar Delhi Bye pass. The study suggested policy upgradations such as traffic management, re-designing of acceleration deceleration tracks were suggested.

**Want, J. et al. (2015)** in his research on Predictability of road traffic and congestion in urban areas. In this article the author discussed time explore the predictability of urban traffic and congestion by using comprehensive record of Global position system (GPS) devices installed in vehicles. The data provide the velocity and locations of a large number of taxis in real time, enabling investigation and quantification of the predictability of segments in main roads in an urban road network. In particular, they establish a mapping from the degree of congestion on a segment of road into a time series of symbols and measuring its entropy. They find a relatively high daily predictability of traffic conditions despite the absence of any prior knowledge of driver’s origins and destinations and quite different travel patterns between weekdays and weekends. Thus, the article presents a general and practical approach for understanding the predictability of real time urban road traffic and for devising effective control strategies to improve the roads level of service.

**Jain, V. et al. (2012)**, conducted the study on “Road Traffic Congestion in the Developing World”. They majorly noticed road traffic congestion level through image processing mechanism of the picture taken by CCTV camera and with these videos they recognized the noisy traffic and multiple signals location in Brazil and Kenya cities. Within a tiny area they present a local de-congestion protocol and co-ordinates traffic signals behavior then they avoid locally congestion collapse sustaining time variant traffic bursts. **Pate, J. and Gundaliya, P.J. (2016)**, studied the Estimation of Level of Service through traffic congestion in Ahmadabad city, Gujarat. This paper presents methodology for quantification of congestion on urban mid-block division.
The authors focused gurukul-manavmandir road in Ahmadabad city. In this model for traffic congestion they measure helpful combining volume and operational characteristics 6 level of services have been defined with 20, 40, 60, 80, 100 percents unique LOS (A-E) inside the firm zone. The authors analyzed that the heterogeneous traffic composition enlarge in travel demand, political intervention, government policies are mainly caused for traffic congestion and also traffic congestion resulting economic loss, user cost and additions delay. In this model traffic and control condition are primarily causes to different congestion can be impression.

**Florido, E. et al. (2015)** stated that the traffic congestion occurs mainly for two reasons. One is high volume of vehicles crossing the city at the same time and some uncertain incidents like vehicles breakdowns, accidents, rain, snow, spills of opposite on the road. In this study algorithms like ANN and NN have been adopted to predict the congestion spots earlier and to get prepared with alternatives. The traffic data will be relied by the sensors to the stations of data collection. **Baishya, S.S. et al. (2013)**, conducted a study regarding Traffic Congestion Alleviation in Mandi, Himachal Pradesh, India. Mandi is a pleasant tourist attraction which attracts a lot of visitors that eventually lead to traffic congestion. A questionnaire based survey was performed among the stake holders to generate the recommendations to mitigate traffic congestion and make the Mandi city a safer destination for tourists.

**Oluwaseyi, O.S. et al. (2014)**, made an attempt to study and understand the problems for street parking and traffic congestion problems in Lokoja, Nigeria. The increasing number of vehicular usage leads to street parking in Nigeria which inturn leads more congestion of traffic in the city. A questionnaire based survey was done among the shop owners vehicle owners and commuters constituting a total of 727. From the results it is revealed that inadequate parking lots, infectiveness of traffic deicers, absences of loading and offloading bays etc have caused on-street and traffic congestion in Lokoja. The study also recommended the use of intelligent transport system using sustainable devices like Bluetooth, mobile device for the better traffic management and improved parking as such to avoid congestion.

**Islam, M.B. and Kanitpong, K. (2008)**, have worked on “Identification of factors in road accidents through in-depth accident analysis”. In this article the author, attempt to establish the linkage between the causes and consequences with event classification
of an investigated case by highlighting the dynamic driving situation with initial travelling speed pre-impact and post-impact speed of the involved vehicles to describe the crash scenario. Moreover, inaccurate risk assessment and late evasive action, absence of street-light facilities, inadequate lane marking and visibility were also outlines as major risk factors increasing the severity of crash and injury in this investigated case. The benefits of such in depth study envisioned with better understanding of the interrelationship of the system components in road crashes eventually could be followed in other developing centers in Asia.

2.3. VEHICLES

An attempt was made at Mangalore, Karnataka, to understand the scenario behind the two wheeler accidents in Indian roads. Around 5 years data (2000-2004) with respect to number of accidents, time at which accidents occur, type of vehicle, sex and age of the victims, severity of the injury, was used for the present study. From results it is observed that around 231 accidents were reported in the Regional Transport Office; around 77% of the victims fall under the age group 18-44 years; around 83% of the victims were male, 81% of the vehicles are geared vehicles and most of the accidents took place in the peak hours in the evening i.e., 6 PM to 10 PM. The study also recommended first aid measures to be taken at the spots with high accident frequency and also recommended a legal policy that the accident cases may be recorded as medico-legal cases to bring down the legal formalities and speed up the treatment process (Jain, V. et al., 2009).

Rodriguez, J.M. et al. (2015), has done a time series analysis to identify Road traffic injury trends in the city of Valledupar, Colombia (2008 to 2012). An observational study, was conducted based on records from the Colombia national legal medicine and forensic science institute regional office in Valledupar. Different variables were analyzed, such as the injured persons sex, age, education, level and type of road user; the time frame, place and circumstance of crashes and the vehicles associated with the occurrence. Time series analysis using an auto-regressive integrated moving average was performed. As a result it is observed that 105 events per month on an average accidents. In that 82% men and they were 18 to 59 years of age most involved and accident more on Sunday. Here, the time series showed a seasonal pattern and a significant trend effect. By this article they suggest the need to design and implement
specific measures for that type of road user and for the promotion of road safety. Vehicular model also and speed of the vehicle also plays an important role in the severity of the accidents.

In a study Chinnaswamy, G.K. et al. (2007), made an attempt to assess the accident characteristics of flat-fronted commercial vehicles (eg: MANL 2000) with respect to pedestrian safety. When analyzing the scenarios behind the heavy vehicles against pedestrian accidents and the kinematics involved using a derived “Aggressivity Index”, it is found out that the child pedestrians are more vulnerable to accidents than the adults.

Amarasingha, N. (2015) conducted a study on characteristics of three-wheeler crashes in Sri Lanka. The main objective of this study is examining the characteristics of crashes involving three-wheelers in Sri Lanka. The author in this article analysis and were identified three-wheeler crashes in several way 2004 to 2013 as follows urban/rural nature, distribution of vehicles involved , weekdays and weekend, road surface condition, roadway section, weather condition, light condition , gender of drivers, age of drivers and crash severity. The author concluded that During the day light condition and clear weather condition most number of the three- wheeler crashes were originate and all three-wheeler crashes is most common with two-vehicle crashes. The ages of 21 and 40 of male are large number of three-wheeler crashes when they are driving the three-wheeler.

Another noteworthy study on road accidents was conducted by Misra, A and Singh, S.K., (2004). Patna is one of the most noisy, crowded, polluted, and typically chaotic city. The roads in the city are congested and encroached by other activities. Bus services in particular have deteriorated and their efficiency and quality of service have been declining thus inducing passengers to turn to personalized motors. Since motor vehicle population is increasing with greater rates than the expansion of road network and traffic flow the accidents are also eventually increasing. The data used was collected from 14 Police Traffic stations. The study revealed that the total number of fatal accidents was increasing in the city on average 45 per year in 2000 to 100 per year in 2004. It is also observed in the study that 16 buses out of 1000 buses faces fatal accidents per year. NH -38 was found be most accident prone location and besides buses trucks and three-wheelers are the second and third most risky vehicles.
respectively. The recommendation given by this study was, an individual road safety audit for this location should be carried out by a multi-disciplinary team of experts to suggest corrective measures.

2.4. SPATIO-TEMPORAL ANALYSIS OF ACCIDENT DATA

Svetlana (2013) made a Temporal Analysis of the Traffic Accidents Occurrence in Province Of Vojvodina. The road accident data for a period of 9 years from 2001 to 2009 in Vojvodina was used for the present study. This paper analyzed different time aspect and tries to identify day and hour or month, day and critical day. This paper also importantly shows temporal analysis as a method for visualization and finding particular patterns in time for decision making process which interventions, such as drink driving control, pedestrians and cyclists improvement of school zones and traffic safety. Whichever authors represent the maps it is easy to compare values at different point in time. The temporal analysis for time mapping modeling approach in analysis of traffic safety should fine an important place.

Ivan, K. and Haidu, L. (2012), also made a similar study to understand distribution of road accidents in different moments in time and their location in the Cluj-Napoca city. This study observes and analyzed the data between 2010 to 2012 a total of around 190 accidents. This accidents highest registered during day time, rush hours, during spring and autumn. The spatial-temporal distribution of road accidents map can understand easily and it can give more accurate solution for reduce the traffic accident in Cluj-Napoca city.

Soltani, A., and Askari, S. (2014), made an attempt to study on analysis of intra-urban traffic accidents using spatiotemporal visualization techniques. Iran is one of the city with highest road traffic and accident mortality rates. The study was done during the period of 2011-2012 a spatiotemporal analysis of intra-urban traffic accidents data in metropolitan Shiraz, Iran. The Kernel Estimation Density (KED) method is used for identification of highest accident locations and deficient area. The investigation and analysis of KED method resulted that the highest accident occurs on the main roads, which play a meta-region functional role and act as a linkage between main destinations with high trip generation rate.
2.5. GIS FOR ROAD NETWORK AND ACCIDENT ANALYSIS

The study by Sun, Z. and Yang, Z. (2004), used GIS platform to analyze the network database for the period of three years with OLE connection between MapInfo and Visual basic. Map Info software is used to develop the road network of the city, and the study resulted in hazardous zone mapping to delineate frequent traffic accident spots. Ioannis, B. et al. (2012) made an attempt to develop a GIS-Based Methodology for Managing and Analyzing Road Traffic Accident Data in Greece. The data was collected from several entities like Road Traffic Police Department, Hospital, organizations or insurance companies and used as a ground database for decision making process in the field of road safety in Greece.

Wang, C. (2010) made an attempt to establish the relationship between traffic congestion and road accidents by using an econometric and GIS approach. The data used was between 2003 to 2007 data from the M25 motorway and its adjacent roads. Econometric models like Bayesian spatial model and the mixed logit model are used to establish the relationship between the above. UK adopt speed limit in road way for reducing traffic congestion and accidents this also prospers a new map-matching technique for road segments and accident frequently then identify the hazardous accident hotspots for road safety and control measures. Unpredictable driving behaviors during traffic congestion may also be one of the reasons for fatal injuries.

Iyyappan, S. and Nandagopal, V. (2013), conducted research on automatic accident detection and ambulance rescue with intelligent traffic light system. In their discussion the main scheme is to provide a soft flow for emergency vehicles like ambulance to reach the hospitals in time and thus minimizing the interruption caused by traffic congestion. Then the plan coming after this method is to execute ITLS which would control automatically the traffic lights in the lane of the ambulance. The ambulance is proscribed by the manage component which furnishes sufficient way to the ambulance position and thus reaching the hospital securely. The organizer identifies the place of the accident spot from side to side the antenna systems inside the vehicles which gritty the accident and thus the organizer walks through the ambulance to the spot. This scheme is wholly mechanical; therefore it finds the accident spot controls the traffic lights, helping to reach the hospital in moment.
Manyazewal, A.L. et al., (2014), adopted GIS to develop an advanced information system for planning and maintenance of rural roads of Warangal District, Telangana. Rural transport consists of roads, tracks and their associated bridges. A GIS based digital rural road network was developed initially for the benefit of planners, decision makers, researchers and other different level authorities in the rural road sector. Statistical analysis such as dijkstra algorithm was used in the present study to identify the shortest/alternative paths from different villages towards growth centers. A network analysis was also performed to select shortest path in terms of travel time, between two locations in the study area.

Acarman, T. et al., (2010), stated that use of Control Authority Transition (CAT) system may facilitate in preventing collision and may avoid accidents. The CAT system is the latest technology that is programmed and designed in such a way that the automated system help the driver to make the vehicle under his control according to the driving habits, skill levels, capapabilities thereby he can make quick decisions to prevent accidents on a real time basis Lagunzad, L.V. and Mcpherson, K. (2003), have worked on using the GIS in road management. The study describes how GPS, GIS and the traditional database applications will help in the management of the highway network using a common locational referencing system (LRS) that will integrate all data on road and bridge inventories for the Philippine national road network. The LRS centerline survey uses a comprehensive GPS and video for the collection of road data; it establishes an accurate location for the identified nodes and sections to determine the exact length of our national road network. Kundakci, E. (2014), adopted GIS for the Identification of urban traffic accident hot spots and their characteristics in Ankara district, Turkey for the year 2008 - 2010. Near Neighborhood Hierarchical (NNH) clustering was used to identify the hotspots in the region and Kernel Density Estimation Method is used for Traffic safety analysis.

Molla, M.M. et al. (2014), made a geo-statistical approach to detect traffic accident hot spots and clusters in North Dakota. Ordinary Krigging is used for hotspot analysis, and a clustering analysis to identify the traffic crash data. The data of around 37 years (1975 to 2011) were analyzed to identify the critical threshold zones for higher accident prone areas in North Dakota country. Seyedhossenic, S.M. et al (2016), attempt study on application of fuzzy TOPSIS for identifying and analyzing
black spots suburban area in Iran. In this study fuzzy technique for order preference by similarity to ideal (TOPSIS) for ordering miscellaneous black spots was applied for a case study of high way between 2 cities of Qazvin and Saveh in Iran. This paper studied firstly find out the accident black spot to improve road traffic safety. This study performed ranked based on 2 groups; one is tangent distance another one is horizontal curve, network access load and utility, shoulder width, roadway width, traffic volume, percentage of vehicle, equivalent property damage only (EPDO) the number of latitude curves, this all performed in ranking wise. The authors terminate that the study is compared based on frequency of indicants and more analyzed.

Steenberghen, T. et al. (2011), used point pattern analysis to identify accident clustering in intra urban roads of Belgium. The location of road accidents is based on dynamic segmentation, address geo-coding and intersection identification. One dimensional (line) and two-dimensional (area) clustering techniques for road accidents are compared and discussed on advantages and drawbacks in relation to network and traffic characteristics. Linear spatial clustering techniques were used for identification of traffic flow along with certain routes. For dense road networks with diffuse traffic patterns, two- dimensional techniques were used to identify accident prone areas.

Lai,, P.C. and Chan, W.Y. (2009), made an attempt to understand the road accidents in Hong Kong with the help of GIS. Point pattern analysis is used to visualize the road accidents and the results may be useful for more comprehensive planning. The future scope of the study is to develop a digital database on road systems of Hong Kong with a standardized structure and coherent naming conventions in both Chinese and English.

2.6. POLICIES

Ndung’u, C.W. et al. (2015) made a research on Causes of road accidents and response strategies of road traffic accidents in Kenya. The study reveals that lot of innocent people become victims for the road accidents. This study based on secondary data resources like Newspapers, books, Bank reports, Police reports, internet World, Kenya Road Safety and other relevant sources, and also information collected from daily users of the roads in Nairobi. A descriptive statistics of the obtained data was
Policy level changes and government efforts must be involved to uplift the Kenyan situation as the terrain of Kenya does not readily support proper development of roads. Hence new policies must be adopted to identify specific interventions to overcome the current situation in Kenya. **Fang, K., and Zhu, X., (2015)**, made a research on the cost incurred by Congestion of traffic in Beijing. In this article the author analyzes the congestion cost of Beijing by listing the policy implementation and its effect and also put forth the possible/practical congestion control measures suitable for Beijing.

**Yang, B.M. and Kim, J. (2010)**, have worked on Road traffic accidents and policy interventions in Korea. Frequent accident spots are identified in conjunction with the absence of order on the road, has long been considered a critical social problem in Korea. The data from government sources are used and the results revealed that crashes in Korea increased nearly eight fold from 37,000 in 1970 to 290,481 in 2000. The study involved two sections, the first main section deals with the analysis of the burden of road traffic injuries and crashes and their trends from 1970-2000 and second main section is a description of the results achieved through multiple policy interventions instituted in 2000.

This chapter has provided a sensible length of a review and judgment of literature could be background for the sympathetic of what is being done in the present study. Many of the authors in their research work used GIS applications for identification of road accident black spots and traffic congestion through image processing and traffic analysis.