

Accident Prediction on National Highways in India

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Abstract

This is an endeavour for advancement of Accident forecast model to decide the effect of expanding Accident rate in the High Speed Corridors on the Economy of India. The misfortune caused because of the Accidents is generally extremely more contrasted with the advancement of Indian Economy. For example, the Quarterly GDP by September 2010 is 8.40% however the misfortune because of the event of Accident is about 3%. The above subtleties show how the Accidents are hindering the advancement of Indian Economy. For the equivalent, it was proposed to create "Mishap expectation Model" for the High Speed Corridors in India and to work out the misfortune endured because of the Accidents by giving a reasonable rate for each sort of Accidents.

Keywords: Accident Prediction Model, Linear Regression Analysis, Accident Costing.

1.0.INTRODUCTION:

Road transport is imperative to the financial advancement and social combination of the nation. Simple availability, adaptability of activities, way to-entryway administration and unwavering quality have earned road transport an inexorably higher offer of both traveler and freight traffic opposite other transport modes. The development of vehicular traffic on roads has been far more noteworthy than the development of the expressways; thus the fundamental supply routes ie Trunk roads face limit immersion. Indian road organize is the second biggest on the planet cumulating to 33.00 lakhs Km out of which NH is about 2% to provide food 40% absolute road traffic in India. As of late, there is radical development in all the infrastructural offices, especially in road organize. All the storage compartment roads in India beginning from Kashmir to Kanyakumari and Mumbai to Kolkata are associated by fast passageways through different plans, for example, Golden Quadrilateral and North South Corridors by National Highway Development Project (NHDP), the aggressive venture of the Government covering 18,000 Kilometers of vigorously dealt national roadways which has been developed with the prescribed procedures in regard of structure, Construction, support, and review of road security. While feeling pleased with the abovementioned, Accidents and Road crashes had cost the Indian Subcontinent an enormous loss of about Rs.75000 crores consistently. It is difficult to acknowledge the way that the above figure is identical to the undertaking expenses of works finished under NHDP Phase-I and II. Consequently the mishaps and roadcrashes are one among the real obstructions to improvement of India.

2.0. ROAD SAFETY SCENARIO IN INDIA

Amid 2002, the Planning Commission had assessed that the misfortune endured by the country consistently constitute about 3% of the GDP. The death rate (passings/10000 vehicles) in India is almost 14% when contrasted with under 2% in created nations. Arranging Commission has estimated that the absolute number of passings in year 2015 to 154600. The rate offer of the mishaps in NH is differing from 26 to 32% though the rate offer of people murdered is changing from 35 to 39.7%. The fundamental explanation behind the equivalent is because of the speed of the vehicles which are cruising at a speed higher than the structure speed. The above figures on High mishap offer and casualty rates gives a disturbing sound to the partners of Indian Subcontinent for the quick prerequisite of road Safety on High Speed Corridors.

National Road Safety Council (NRSC) is the pinnacle body for road wellbeing set up under area 215 of MV Act 1988, which works with Ministry of Health and Ministry of Home Affairs to facilitate the execution of road security arrangement in the nation. In India, the attention to security in the roads are in extremely untimely stage. Anyway the equivalent in National Highways are persuading. On account of the exertion made by Ministry of Road Transport and Highways & National Highways Authority of India in observing Road Safety mindfulness for seven days from January first of consistently, which has tossed some spotlight on quick spotlight on road security. Festivity of Road Safety is by and large effectively actualized in all conditions of India with collaboration of District Administration, Police Department and Transport Department, who are the spines of the enormous accomplishment of the equivalent in taking to the Public.

3.0. METHODOLOGY

According to late practice, any improvement to a current stretch is being done dependent on the traffic development rate according to past patterns, which is simply founded on the development of vehicles. In any case, the equivalent does not assess mishaps in that extend. Misfortune because of mishaps are colossal contrasted with the expense of minor upgrades required which would have maintained a strategic distance from certain mishaps in the stretch concerned. The ideal yield expected out is advancement of an Accident Prediction Model, which can be utilized for foreseeing the mishaps expected to happen in future, which will be helpful to decide the measures and enhancements to be taken for guaranteeing security to road clients in National Highways.

3.1. IMPROVEMENT OF ACCIDENT PREDICTION MODEL

For improvement of Accident expectation model, a few stretches of NH road were recognized where more mishaps are accounted for and gathering of mishap information for recent years (2009, 2010, 2011 and 2012) in the above stretches were gathered. Accumulation of different Geometry highlights of the above stretch including path setup, nearness of shoulders, channels, trail, traffic signs, traffic signals, normal speed and vehicular traffic. No of Accidents to be anticipated will be the autonomous variable with the different parameters, for example, Road Section and Geometry, Vehicular traffic, sufficiency of traffic signs, accessibility of traffic signals and road lights, normal speed of vehicle in the above areas as reliant factors. Assurance of expected Vehicular development rate in advert to Whole deal value file by gathering the information for vehicles enrolled and Per Capita Domestic Product in the territory of Tamilnadu. Assurance of expense of Accidents of any

year as for Whole Sale Price Index(WPI). Assurance of Accidents expected to happen in a stretch with the Accident Prediction Model in any year and assurance of least measures to be taken to have a control on the mishap development rate. By and by any upgradation is being done just as for vehicular development rate. With the abovementioned, Accident cost will likewise be taken in to thought.

3.2. ASSURANCE OF EXPENSE OF ACCIDENTS OF ANY YEAR REGARDING WHOLE SALE PRICE INDEX (WPI).

Also, there are different kinds of mishaps, for example, Fatal, Grievous Injury, Minor Injury, Non damage & Damages to the property which might be either to vehicles or road highlights. Yet, each sort of mishap have distinctive effect on economy and additionally impact of one varies from the other. In that capacity, a wide range of mishaps must be changed over to a solitary unit ie Accident Severity Index (ACCI) by giving reasonable weightage. For the equivalent, weightage was given dependent on the expense of Accident. The above is taken as the Independent Variable which is reliant on the 15 subordinate factors which were distinguished dependent on which mishaps are inclined to occur.

Mishaps cause extensive monetary misfortune to the country. Tragically, the assessment of the mishap cost is somewhat a troublesome and disputable subject. The work done in India so far is of an amazingly constrained nature. Focal Road Research Institute has made an endeavor to decide the monetary expense of road mishaps in India. Different techniques are being received around the world. In India, Indian Road Congress has distributed the mishap costing in IRC SP:30-1990(Clause 6.8). The tasks under thought were put for open use by 2011 and subsequently every one of the information was made in the year 2011 to have homogenous assessment. Consequently, the expense of mishaps were raised to 2011 dependent on the Whole deal Price record of India and outlined as pursues:

Table 1: Accident Cost in 2011

Sl no	Type of accident	Amount in Lakhs in the year 1990	Updated cost of Accidents in 2011	Severity
1	Fatal	210000	880779	6.5625
2	Serious Injury(Grievous)	32000	134214	1
3	Minor Injury	1100	4614	0.034375
4	Car damage	4700	19713	0.146875
5	Two wheeler	1100	4614	0.034375
6	Bus	15800	66268	0.49375
7	Truck	18100	75915	

3.2.1. Regression Analysis and Determination of Variables for Development of a Mathematical Modelling for Accident Prediction

It has been proposed to utilize Regression Analysis for determining the model. It is useful in deciding the impact of a needy variable by differing one autonomous variable with the others kept consistent. Relapse examination is generally utilized for Prediction and Forecasting. The quantity of Accidents expected to happen is considered as the Independent Variable, which are contributed by the highlights of the road as Dependent factors. By fluctuating the qualities allotted for the needy factors, exertion could be made in down the mishap expected to happen. Truth be told, there are different sorts of Accidents occurring in the road, which are having diverse effects and cost as talked about above. Explicit weightage for each kind of Accidents are doled out dependent on the Accident Cost for the equivalent, to change over a wide range of Accidents in a solitary unit. So also, the components considered for assessing clumsy areas on road are as per the following:

- Lane design
- Presence of Median
- Median Width
- Safety Barrier in Median
- Shoulder width/type
- Service roads.
- Footpath
- Lighting
- Road Condition
- Operating speed as for Design speed
- Traffic signs ampleness.
- Traffic signals
- Traffic volume regarding limit of road.
- Safety in Major intersections.
- Fencing.

No of Accidents to be anticipated will be the autonomous variable with the different parameters, for example, Road Section and Geometry, Vehicular traffic, sufficiency of traffic signs, accessibility of traffic signals and road lights, normal speed of vehicle in the above segments and other geometric parameters as needy factors. There are numerous explanations behind mishaps on roads chiefly because of Fault of driver, Fault of Vehicle, Features of road, atmosphere and different elements. Truth be told, the commitment of road mishaps by road highlights are under 10% yet it is expected that every one of the mishaps are affected by the road highlights. For instance, shortcoming of driver is affected by state of road, road signs, lighting and deficiency of vehicle is impacted by surface state of road and so forth. The above supposition that is made since the foundations for deficiency by driver and that of vehicle couldnot be evaluated and estimated, which needs Psychological angles and the equivalent is past the domain of this paper.

For decrease of the mishaps, three E's are required; to be specific Engineering, Education & Enforcement. The prime most significant factor for decrease of Accident could be diminished by

Engineering since the equivalent has basic impact on a wide range of People with the dimension of Education and Enforcement contrasts from individuals to individuals. Henceforth, the variables as referenced above add to the rate of mishaps in any task Highway.

4.0. PREPARATION OF MODEL

The model will be in the form of:

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8 + a_9X_9 + a_{10}X_{10} + a_{11}X_{11} + a_{12}X_{12} + a_{13}X_{13} + a_{14}X_{14} + a_{15}X_{15}$$

The constants can be solved in the following manner:

$$a_{13}\sum X_5X_{13} + a_{14}\sum X_5X_{14} + a_{15}\sum X_5X_{15}$$

$$\sum X_6Y = a_0 \sum X_6 + a_1 \sum X_6X_6 + a_2 \sum X_1X_6 + a_3 \sum X_2X_6 + a_4 \sum X_3X_6 + a_5 \sum X_4X_6 + a_6$$

$$\sum X_5X_6$$

$$+ a_7 \sum X_6X_7 + a_8 \sum X_6X_8 + a_9 \sum X_6X_9 + a_{10} \sum X_6X_{10} + a_{11} \sum X_6X_{11} + a_{12}$$

$$\sum X_6X_{12} + a_{13}\sum X_6X_{13} + a_{14}\sum X_6X_{14} + a_{15}\sum X_6X_{15}$$

$$\sum X_7Y = a_0 \sum X_7 + a_1 \sum X_7X_7 + a_2 \sum X_1X_7 + a_3 \sum X_2X_7 + a_4 \sum X_3X_7 + a_5 \sum X_4X_7 + a_6$$

$$\sum X_5X_7 + a_7 \sum X_6X_7 + a_8 \sum X_7X_8 + a_9 \sum X_7X_9 + a_{10} \sum X_7X_{10} + a_{11} \sum X_7X_{11} + a_{12} \sum X_7X_{12}$$

$$+ a_{13}\sum X_7X_{13} + a_{14}\sum X_7X_{14} + a_{15}\sum X_7X_{15}$$

$$+ a_{13}\sum X_7X_{13} + a_{14}\sum X_7X_{14} + a_{15}\sum X_7X_{15}$$

$$\sum X_8Y = a_0 \sum X_8 + a_1 \sum X_8X_8 + a_2 \sum X_1X_8 + a_3 \sum X_2X_8 + a_4 \sum X_3X_8 + a_5 \sum X_4X_8 + a_6$$

$$\sum X_5X_8 + a_7 \sum X_6X_8 + a_8 \sum X_7X_8 + a_9 \sum X_8X_9 + a_{10} \sum X_8X_{10} + a_{11} \sum X_8X_{11} + a_{12} \sum X_8X_{12}$$

$$+ a_{13}\sum X_8X_{13} + a_{14}\sum X_8X_{14} + a_{15}\sum X_8X_{15}$$

$$+ a_{13}\sum X_8X_{13} + a_{14}\sum X_8X_{14} + a_{15}\sum X_8X_{15}$$

$$\sum X_9Y = a_0 \sum X_9 + a_1 \sum X_9X_9 + a_2 \sum X_1X_9 + a_3 \sum X_2X_9 + a_4 \sum X_3X_9 + a_5 \sum X_4X_9 + a_6$$

$$\sum X_5X_9 + a_7 \sum X_6X_9 + a_8 \sum X_7X_9 + a_9 \sum X_8X_9 + a_{10} \sum X_9X_{10} + a_{11} \sum X_9X_{11} + a_{12} \sum X_9X_{12}$$

$$+ a_{13}\sum X_9X_{13} + a_{14}\sum X_9X_{14} + a_{15}\sum X_9X_{15}$$

$$+ a_{13}\sum X_9X_{13} + a_{14}\sum X_9X_{14} + a_{15}\sum X_9X_{15}$$

$$\sum X_{10}Y = a_0 \sum X_{10} + a_1 \sum X_{10}X_{10} + a_2 \sum X_1X_{10} + a_3 \sum X_2X_{10} + a_4 \sum X_3X_{10} + a_5 \sum X_4X_{10} + a_6$$

$$\sum X_5X_{10} + a_7 \sum X_6X_{10} + a_8 \sum X_7X_{10} + a_9 \sum X_8X_{10} + a_{10} \sum X_9X_{10} + a_{11} \sum X_{10}X_{11} + a_{12}$$

$$\sum X_{10}X_{12} + a_{13}\sum X_{10}X_{13} + a_{14}\sum X_{10}X_{14} + a_{15}\sum X_{10}X_{15}$$

$$\sum X_{11}Y = a_0 \sum X_{11} + a_1 \sum X_{11}X_{11} + a_2 \sum X_1X_{11} + a_3 \sum X_2X_{11} + a_4 \sum X_3X_{11} + a_5 \sum X_4X_{11} + a_6$$

$$\sum X_5X_{11} + a_7 \sum X_6X_{11} + a_8 \sum X_7X_{11} + a_9 \sum X_8X_{11} + a_{10} \sum X_9X_{11} + a_{11} \sum X_{10}X_{11} + a_{12}$$

$$\sum X_{11}X_{12} + a_{13}\sum X_{11}X_{13} + a_{14}\sum X_{11}X_{14} + a_{15}\sum X_{11}X_{15}$$

$$\sum X_{12Y} = a_0 \sum X_{12} + a_1 \sum X_{1212} + a_2 \sum X_{1X12} + a_3 \sum X_{2X12} + a_4 \sum X_{3X12} + a_5 \sum X_{4X12} + a_6 \sum X_{5X12} + a_7 \sum X_{6X12} + a_8 \sum X_{7X12} + a_9 \sum X_{8X12} + a_{10} \sum X_{9X12} + a_{11} \sum X_{10X12} + a_{12} \sum X_{11X12} + a_{13} \sum X_{12X13} + a_{14} \sum X_{12X14} + a_{15} \sum X_{12X15}$$

$$\sum X_{13Y} = a_0 \sum X_{13} + a_1 \sum X_{1313} + a_2 \sum X_{1X13} + a_3 \sum X_{2X13} + a_4 \sum X_{3X13} + a_5 \sum X_{4X13} + a_6 \sum X_{5X13} + a_7 \sum X_{6X13} + a_8 \sum X_{7X13} + a_9 \sum X_{8X13} + a_{10} \sum X_{9X13} + a_{11} \sum X_{10X13} + a_{12} \sum X_{11X13} + a_{13} \sum X_{12X13} + a_{14} \sum X_{13X14} + a_{15} \sum X_{13X15}$$

$$\sum X_{14Y} = a_0 \sum X_{14} + a_1 \sum X_{1414} + a_2 \sum X_{1X14} + a_3 \sum X_{2X14} + a_4 \sum X_{3X14} + a_5 \sum X_{4X14} + a_6 \sum X_{5X14} + a_7 \sum X_{6X14} + a_8 \sum X_{7X14} + a_9 \sum X_{8X14} + a_{10} \sum X_{9X14} + a_{11} \sum X_{10X14} + a_{12} \sum X_{11X14} + a_{13} \sum X_{12X14} + a_{14} \sum X_{13X14} + a_{15} \sum X_{14X15}$$

$$\sum X_{15Y} = a_0 \sum X_{15} + a_1 \sum X_{1515} + a_2 \sum X_{1X15} + a_3 \sum X_{2X15} + a_4 \sum X_{3X15} + a_5 \sum X_{4X15} + a_6 \sum X_{5X15} + a_7 \sum X_{6X15} + a_8 \sum X_{7X15} + a_9 \sum X_{8X15} + a_{10} \sum X_{9X15} + a_{11} \sum X_{10X15} + a_{12} \sum X_{11X15} + a_{13} \sum X_{12X15} + a_{14} \sum X_{13X15} + a_{15} \sum X_{14X15}$$

The above equations are solved with the solver in Microsoft Excel 2007 to determine the values of each variable and the accident Prediction model is obtained as detailed below:

$$ACCI = 0.512L + 37.32L + 4.091M - 0.09MW + 0.781SB - 58.5SW - 41.40SR - 3.46FP + 116.2LT + 28.39RC + 0.012DS + 18.8TS - 1.39TSG + 0.006TV - 5.09MJ - 0.22F.$$

Where,

ACCI means Accident Severity Index.

Table 2: Comparison of Accident Predicted vs Actual number of Accidents

Sl No	Stretch of National Highways	Accidents in the year 2011		Deviation in Percentage
		ACCI as per Actuals	ACCI as per Prediction Model developed	
1	Padalur Trichy Section of NH 45	634.56	637.76	(-) 0.505
2	Thanjavur Thuvakudi section of NH 67	350.12	350.353	(-) 0.066
3	Thuvakudi Trichy Section of NH 67	174.52	178.51	(-) 2.286
4	Trichy Thuvankurichi section of NH 45B	511.75	515.48	(-) 0.773

5	Tindivanam Ulundurpet section of NH 45	756.09	511.22	(+) 32.38
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It is observed that there is an accuracy up to 1% to 2% except in the stretch from Tindivanam Ulundurpet High way of NH 45, which implies that the accidents occurring in the above stretch are mainly influenced by the fault of drivers, which is also in line with that of Police report.. Model developed is holding good for four stretches out of total five stretches under review , which is due to the other factors such as wrong side driving, over speed, drunken driving, fault of Pedestrians, climatic conditions (As observed from Police reports) which contributed to the accidents.Model was also checked with the accuracy for the next year and it fits in. Factors such as Lighting, lane configuration, shoulder width, service roads, Road condition, Traffic signs contribute to accidents mostly.

5.0. CONCLUSION

1. Model created is holding useful for four stretches out of complete five stretches under audit. The variety in the fifth stretch was because of different factors, for example, wrong side driving, over speed, smashed driving, deficiency of Pedestrians, climatic conditions (As saw from Police reports) which added to the mishaps.
2. Factors, for example, Lighting, path design, bear width, administration roads, Road condition, Traffic signs add to mishaps for the most part.
3. Rate of Accidents in a stretch which is proposed for upgradation and any improvement will be considered notwithstanding the current parameters.
4. Coordinated endeavors of different organizations associated with transport, traffic the executives, road designing, road improvement and upkeep, mishap care (injury care/salvage) are expected to decrease mishaps and mortality. In a perfect world, there ought to be one single office to deal with every one of these perspectives for successful decrease in mishaps/fatalities.
5. Create position for road security experts in associations, for example, Road Construction Departments, Municipalities, police and so on.
6. Collection and Reporting of Accident information is powerless in India, which should be improved a ton for assessment. Hencethere is critical need to audit and reinforce instrument for mishap information accumulation, investigation and dispersal of data.
7. Contracts for development/upkeep of National Highways and State Highways must incorporate road wellbeing reviews and road security experts as a required to guarantee usage of undertaking securely. The road security review on all National Highways ought to be made compulsory at various phases of the undertakings, for example, attainability organize, fundamental structure arrange, nitty gritty building stage, pre and post opening phase of the road office. The insufficiencies distinguished at various stages ought to be corrected in that organize as it were.
8. Facilities must be accommodated powerless road clients, for example, restrictive bike track, raised stages, select parking spots on all urban blood vessel roads and traffic quieting procedures on all roads

9. Highway watching framework along the whole National Highways ought to be made obligatory so as to improve security on roads. Ambulances ought to be given up and down the National Highways.
10. Substantial number of fatalities can be diminished if unfortunate casualties are gone to inside the sensible time following the mishap. It is consequently fundamental to build up injury care focuses at proper areas up and down the National Highway arrange.
11. All clumsy spots along the National Highways system ought to be recognized and appropriate building measures as far as progress of road geometrics and so forth ought to be taken.
12. Implementation of Intelligent Transport System(ITS) to be affected in rapid hallways.

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