International Journal of Theoretical and Applied Mechanics.
ISSN 0973-6085 Volume 12, Number 1 (2017) pp. 153-165

http://www.ripublication.com

Accident Prediction on National Highways in India

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Abstract

This is an attempt for development of Accident prediction model to determine the impact of increasing Accident rate in the High Speed Corridors on the Economy of India. The loss incurred due to the Accidents is relatively very more compared to the development of Indian Economy. For instance, the Quarterly GDP by September 2010 is 8.40% but the loss due to the occurrence of Accident is about 3%. The above details show how the Accidents are retarding the development of Indian Economy. For the same, it was proposed to generate "Accident prediction Model" for the High Speed Corridors in India and to work out the loss suffered due to the Accidents by giving a suitable rate for each type of Accidents.

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

INTRODUCTION

Road transport is vital to the economic development and social integration of the country. Easy accessibility, flexibility of operations, door-to-door service and reliability have earned road transport an increasingly higher share of both passenger and freight traffic vis-à-vis other transport modes. The growth of vehicular traffic

on roads has been far greater than the growth of the highways; as a result the main arteries ie Trunk roads face capacity saturation. Indian road network is the second largest in the world cumulating to 33.00 lakhs Km out of which NH is about 2% to cater 40% total road traffic in India. In recent times, there is drastic growth in all the infrastructural facilities, particularly in road network. All the trunk roads in India starting from Kashmir to Kanyakumari & Mumbai to Kolkata are connected by high speed corridors through various schemes such as Golden Quadrilateral and North South Corridors by National Highway Development Project (NHDP), the ambitious project of the Government covering 18,000 Kilometers of heavily trafficked national highways which has been

Constructed with the best practices in respect of design, Construction, maintenance, and audit of road safety. While feeling proud of the above, Accidents and Road crashes had cost the Indian Subcontinent a huge loss of about Rs.75000 crores every year. It is hard to accept the fact that the above figure is equivalent to the project costs

of works completed under NHDP Phase-I & II. Hence the accidents and roadcrashes are one among the major hindrances to development of India.

ROAD SAFETY SCENARIO IN INDIA

During 2002, the Planning Commission had estimated that the loss suffered by the nation every year Constitute about 3% of the GDP. The mortality rate (deaths/10000 vehicles) in India is nearly 14% as compared to less than 2% in developed countries. Planning Commission has forecasted that the total number of deaths in year 2015 to 154600.The percentage share of the accidents in NH is varying from 26 to 32% whereas the percentage share of persons killed is varying from 35 to 39.7%. The main reason for the same is due to the speed of the vehicles which are cruising at a speed higher than the design speed. The above figures on High accident share and fatality rates gives an alarming sound to the stake holders of Indian Subcontinent for the immediate requirement of road Safety on High Speed Corridors.

National Road Safety Council (NRSC) is the apex body for road safety established under section 215 of MV Act 1988, which works with Ministry of Health and Ministry of Home Affairs to coordinate the implementation of road safety policy in the country. In India, the awareness of safety in the roads are in very premature stage. However the same in National Highways are convincing. Thanks to the effort made by Ministry of Road Transport & Highways&National Highways Authority of India in celebrating Road Safety awareness for a week from January 1st of every year, which has thrown some limelight on immediate focus on road safety. Celebration of Road Safety is being successfully implemented in all states of India with cooperation of District Administration, Police Department & Transport Department, who are the backbones of the huge success of the same in taking to the Public.

LITERATURE REVIEW

FajaruddinMustakim and Ismail Yusuf (2008) developed an accident prediction model for Federal Route 50, Malaysia by using multiple linear regression analysis. HarriPeltola&RistoKulmala, VTT, Technical Research Center of Finland have developed Accident Prediction models for roads in Finland.RobEenink, Martine Reurings(SMOV), Rune Elvik(TOI), Jao Cardoso, Sofa Wichert (LNEC), Christian Stefan(KFV) have developed accident Prediction Model for Netherlands Rural & Urban ways comparing the same with Austria & Portugal Motorways by January 2005. KIM, Se Hwan, CHUNG, Sung Bong, SONG, Ki Han and CHON, Kyung Soo from Seoul, Republic of Korea have developed accident Prediction model using Generalized Log Linear Model(GLIM) during 2005.In India, Accident Prediction Model was developed for two lane undivided highways by Dr A. Veeraragavan, Department of Civil Engineering, IIT, Chennai & RR Dinu, Doctoral Research Student, Department of Civil Engineering, IIT, Chennai during 2011. Dr Rokade S Singh, Katiyar S.K. and Gupta S of Maulana Azad National Institute of Technology, Bhopal have developed Accident Prediction model for Ahemadabad City.

METHODOLOGY

As per recent practice, any improvement to an existing stretch is being done based on the traffic growth rate as per past trends, which is purely based on the growth of vehicles. But the same does not take in to account of accidents in that stretch. Loss due to accidents are huge compared to the cost of minor improvements required which would have avoided some accidents in the stretch concerned. The desired output expected out is development of an Accident Prediction Model, which can be used for predicting the accidents expected to occur in future, which will be useful to determine the measures and improvements to be taken for ensuring safety to road users in National Highways.

DEVELOPMENT OF ACCIDENT PREDICTION MODEL

For development of Accident prediction model, some stretches of NH road were identified where more accidents are reported & collection of accident data for past 4 years (2009,2010,2011 & 2012) in the above stretches were collected. Collection of various Geometry features of the above stretch including lane configuration, presence of shoulders, drains, footpath, traffic signs, traffic signals, average speed and vehicular traffic. No of Accidents to be predicted will be the independent variable with the various parameters such as Road Section and Geometry, Vehicular traffic, adequacy of traffic signs, availability of traffic signals & street lights, average speed of vehicle in the above sections as dependent variables. Determination of expected Vehicular growth rate in advert to Whole sale price index by collecting the data for vehicles registered and Per Capita Domestic Product in the state of Tamilnadu. Determination of cost of Accidents of any year with respect to Whole Sale Price Index(WPI). Determination of Accidents expected to occur in a stretch with the

Accident Prediction Model in any year and determination of minimum measures to be taken to have a control on the accident growth rate. Presently any upgradation is being done only with respect to vehicular growth rate. With the above, Accident cost will also be taken in to consideration.

Determination of cost of Accidents of any year with respect to Whole Sale Price Index (WPI).

Moreover, there are various types of accidents such as Fatal, Grievous Injury, Minor Injury, Non injury &Damages to the property which may be either to vehicles or road features. But each type of accident have different impact on economy and moreover effect of one differs from the other. As such, all types of accidents has to be converted to a single unit ie Accident Severity Index (ACCI) by giving suitable weightage. For the same, weightage was given based on the cost of Accident. The above is taken as the Independent Variable which is dependent on the 15 dependent variables which were identified based on which accidents are prone to happen.

Accidents cause considerable economic loss to the nation. Unfortunately, the evaluation of the accident cost is rather a difficult and controversial subject. The work done in India so far is of an extremely limited nature. Central Road Research Institute has made an attempt to determine the economic cost of road accidents in India. Various methods are being adopted worldwide. In India, Indian Road Congress has published the accident costing in IRC SP:30-1990(Clause 6.8). The projects under consideration were put for public use by 2011 and hence all the data was made in the year 2011 to have homogenous evaluation. Hence, the cost of accidents were escalated to 2011 based on the Whole sale Price index of India and summarized as follows:

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	

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

It has been proposed to use Regression Analysis for deriving the model. It is helpful in determining the effect of a dependent variable by varying one independent variable with the others kept constant. Regression analysis is widely used for Prediction & Forecasting. The number of Accidents expected to occur is considered as the Independent Variable, which are contributed by the features of the road as Dependent variables. By varying the values assigned for the dependent variables, effort could be made in down the accident expected to occur. In fact, there are various types of Accidents happening in the road, which are having different impacts & cost as discussed above. Specific weightage for each type of Accidents are assigned based on the Accident Cost for the same, to convert all types of Accidents in a single unit. Similarly, the factors considered for evaluating accident prone locations on road are as follows:

a) Lane configuration
b) Presence of Median
c) Median Width
d) Safety Barrier in Median
e) Shoulder width/type
f) Service roads.
g) Footpath
h) Lighting
i) Road Condition
j) Operating speed with respect to Design speed
k) Traffic signs adequacy.
l) Traffic signals
m) Traffic volume with respect to capacity of road.
n) Safety in Major junctions.
o) Fencing.

No of Accidents to be predicted will be the independent variable with the various parameters such as Road Section and Geometry, Vehicular traffic, adequacy of traffic signs, availability of traffic signals & street lights, average speed of vehicle in the above sections and other geometric parameters as dependent variables. There are many reasons for accidents on roads mainly due to Fault of driver, Fault of Vehicle, Features of road, climate & other factors. In fact, the contribution of road accidents by road features are less than 10% but it is assumed that all the accidents are influenced

by the road features. For example, fault of driver is influenced by condition of road, road signs, lighting & fault of vehicle is influenced by surface condition of road etc. The above assumption is made since the causes for fault by driver and that of vehicle couldnot be quantified and measured, which needs Psychological aspects and the same is beyond the purview of this paper.

For reduction of the accidents, three E's are required; namely Engineering, Education & Enforcement. The prime most important factor for reduction of Accident could be reduced by Engineering since the same has common effect on all types of People with the level of Education & Enforcement differs from people to people. Hence, the factors as mentioned above contribute to the rate of accidents in any project Highway.

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:

$$\sum Y = n\,a_0 + a_1\sum X_1 + a_2\sum X_2 + a_3\sum X_3 + a_4\sum X_4 + a_5\sum X_5 + a_6\sum X_6 + a_7\sum X_7 + a_8\sum X_8 + a_9\sum X_9 + a_{10}\sum X_{10} + a_{11}\sum X_{11} + a_{12}\sum X_{12} + a_{13}\sum X_{13} + a_{14}\sum X_{14} + a_{15}\sum X_{15}$$

$$\sum X_1Y = a_0\sum X_1 + a_1\sum X_{12} + a_2\sum X_1X_2 + a_3\sum X_1X_3 + a_4\sum X_1X_4 + a_5\sum X_1X_5 + a_6\sum X_1X_6 + a7\sum X1X7 + a_8\sum X_1X_8 + a_9\sum X_1X_9 + a_{10}\sum X_1X_{10} + a_{11}\sum X_1X_{11} + a_{12}\sum X_1X_{12} + a_{13}\sum X_1X_{13} + a14\sum X1X14 + a15\sum X1X15$$

$$\sum X_2Y = a_0\sum X_2 + a_1\sum X_{22} + a_2\sum X_1X_2 + a_3\sum X_2X_3 + a_4\sum X_2X_4 + a_5\sum X_2X_5 + a_6\sum X_2X_6 + a7\sum X2X7 + a_8\sum X_2X_8 + a_9\sum X_2X_9 + a_{10}\sum X_2X_{10} + a_{11}\sum X_2X_{11} + a_{12}\sum X_2X_{12} + a_{13}\sum X_2X_{13} + a14\sum X2X14 + a15\sum X2X15$$

$$\sum X_3Y = a_0\sum X_3 + a_1\sum X_{33} + a_2\sum X_1X_3 + a_3\sum X_2X_3 + a_4\sum X_3X_4 + a_5\sum X_3X_5 + a_6\sum X_3X_6 + a7\sum X3X7 + a_8\sum X_3X_8 + a_9\sum X_3X_9 + a_{10}\sum X_3X_{10} + a_{11}\sum X_3X_{11} + a_{12}\sum X_3X_{12} + a_{13}\sum X_3X_{13} + a14\sum X3X14 + a15\sum X3X15$$

$$\sum X_4Y = a_0\sum X_4 + a_1\sum X_{44} + a_2\sum X_1X_4 + a_3\sum X_2X_4 + a_4\sum X_3X_4 + a_5\sum X_4X_5 + a_6\sum X_4X_6 + a7\sum X4X7 + a_8\sum X_4X_8 + a_9\sum X_4X_9 + a_{10}\sum X_4X_{10} + a_{11}\sum X_4X_{11} + a_{12}\sum X_4X_{12} + a_{13}\sum X_4X_{13} + a14\sum X4X14 + a15\sum X4X15$$

$$\sum X_5Y = a_0\sum X_5 + a_1\sum X_{55} + a_2\sum X_1X_5 + a_3\sum X_2X_5 + a_4\sum X_3X_5 + a_5\sum X_4X_5 + a_6\sum X_5X_6 + a7\sum X5X7 + a_8\sum X_5X_8 + a_9\sum X_5X_9 + a_{10}\sum X_5X_{10} + a_{11}\sum X_5X_{11} + a_{12}\sum X_5X_{12} +$$

$a_{13}\sum X_5X_{13} + a14 \sum X5X14 + a15 \sum X5X15$

$\sum X_6Y = a_0 \sum X_6 + a_1 \sum X_{66} + a_2 \sum X_1X_6 + a_3 \sum X_2X_6 + a_4 \sum X_3X_6 + a_5 \sum X_4X_6 + a_6 \sum X_5X_6 + a7 \sum X6X7 + a_8 \sum X_6X_8 + a_9 \sum X_6X_9 + a_{10} \sum X_6X_{10} + a_{11} \sum X_6X_{11} + a_{12} \sum X_6X_{12} + a_{13}\sum X_6X_{13} + a14 \sum X6X14 + a15 \sum X6X15$

$\sum X_7Y = a_0 \sum X_7 + a_1 \sum X_{77} + a_2 \sum X_1X_7 + a_3 \sum X_2X_7 + a_4 \sum X_3X_7 + a_5 \sum X_4X_7 + a_6 \sum X_5X_7 + a7 \sum X6X7 + a_8 \sum X_7X_8 + a_9 \sum X_7X_9 + a_{10} \sum X_7X_{10} + a_{11} \sum X_7X_{11} + a_{12} \sum X_7X_{12} + a_{13}\sum X_7X_{13} + a14 \sum X7X14 + a15 \sum X7X15$

$\sum X_8Y = a_0 \sum X_8 + a_1 \sum X_{88} + a_2 \sum X_1X_8 + a_3 \sum X_2X_8 + a_4 \sum X_3X_8 + a_5 \sum X_4X_8 + a_6 \sum X_5X_8 + a7 \sum X6X8 + a_8 \sum X_7X_8 + a_9 \sum X_8X_9 + a_{10} \sum X_8X_{10} + a_{11} \sum X_8X_{11} + a_{12} \sum X_8X_{12} + a_{13}\sum X_8X_{13} + a14 \sum X8X14 + a15 \sum X8X15$

$\sum X_9Y = a_0 \sum X_9 + a_1 \sum X_{99} + a_2 \sum X_1X_9 + a_3 \sum X_2X_9 + a_4 \sum X_3X_9 + a_5 \sum X_4X_9 + a_6 \sum X_5X_9 + a7 \sum X6X9 + a_8 \sum X_7X_9 + a_9 \sum X_8X_9 + a_{10} \sum X_9X_{10} + a_{11} \sum X_9X_{11} + a_{12} \sum X_9X_{12} + a_{13}\sum X_9X_{13} + a14 \sum X9X14 + a15 \sum X9X15$

$\sum X_{10}Y = a_0 \sum X_{10} + a_1 \sum X_{1010} + a_2 \sum X_1X_{10} + a_3 \sum X_2X_{10} + a_4 \sum X_3X_{10} + a_5 \sum X_4X_{10} + a_6 \sum X_5X_{10} + a7\sum X6X10 + a_8 \sum X_7X_{10} + a_9 \sum X_8X_{10} + a_{10} \sum X_9X_{10} + a_{11} \sum X_{10}X_{11} + a_{12} \sum X_{10}X_{12} + a_{13}\sum X_{10}X_{13} + a14 \sum X10X14 + a15 \sum X10X15$

$\sum X_{11}Y = a_0 \sum X_{11} + a_1 \sum X_{1111} + a_2 \sum X_1X_{11} + a_3 \sum X_2X_{11} + a_4 \sum X_3X_{11} + a_5 \sum X_4X_{11} + a_6 \sum X_5X_{11} + a7 \sum X6X11 + a_8 \sum X_7X_{11} + a_9 \sum X_8X_{11} + a_{10} \sum X_9X_{11} + a_{11} \sum X_{10}X_{11} + a_{12} \sum X_{11}X_{12} + a_{13}\sum X_{11}X_{13} + a14 \sum X11X14 + a15 \sum X11X15$

$\sum X_{12}Y = a_0 \sum X_{12} + a_1 \sum X_{1212} + a_2 \sum X_1X_{12} + a_3 \sum X_2X_{12} + a_4 \sum X_3X_{12} + a_5 \sum X_4X_{12} + a_6 \sum X_5X_{12} + a7 \sum X6X12 + a_8 \sum X_7X_{12} + a_9 \sum X_8X_{12} + a_{10} \sum X_9X_{12} + a_{11} \sum X_{10}X_{12} + a_{12} \sum X_{11}X_{12} + a_{13}\sum X_{12}X_{13} + a14 \sum X12X14 + a15 \sum X12X15$

$\sum X_{13}Y = a_0 \sum X_{13} + a_1 \sum X_{1313} + a_2 \sum X_1X_{13} + a_3 \sum X_2X_{13} + a_4 \sum X_3X_{13} + a_5 \sum X_4X_{13} + a_6 \sum X_5X_{13} + a7 \sum X6X13 + a_8 \sum X_7X_{13} + a_9 \sum X_8X_{13} + a_{10} \sum X_9X_{13} + a_{11} \sum X_{10}X_{13} + a_{12} \sum X_{11}X_{13} + a_{13}\sum X_{12}X_{13} + a14 \sum X13X14 + a15 \sum X13X15$

$\sum X_{14}Y = a_0 \sum X_{14} + a_1 \sum X_{1414} + a_2 \sum X_1X_{14} + a_3 \sum X_2X_{14} + a_4 \sum X_3X_{14} + a_5 \sum X_4X_{14} + a_6 \sum X_5X_{14} + a7 \sum X6X14 + a_8 \sum X_7X_{14} + a_9 \sum X_8X_{14} + a_{10} \sum X_9X_{14} + a_{11} \sum X_{10}X_{14} + a_{12} \sum X_{11}X_{14} + a_{13} \sum X_{12}X_{14} + a14 \sum X13X14 + a15 \sum X14X15$

$\sum X_{15}Y = a_0 \sum X_{15} + a_1 \sum X_{1515} + a_2 \sum X_1X_{15} + a_3 \sum X_2X_{15} + a_4 \sum X_3X_{15} + a_5 \sum X_4X_{15} + a_6 \sum X_5X_{15} + a7 \sum X6X15 + a_8 \sum X_7X_{15} + a_9 \sum X_8X_{15} + a_{10} \sum X_9X_{15} + a_{11} \sum X_{10}X_{15} + a_{12} \sum X_{11}X_{15} + a_{13} \sum X_{12}X_{15} + a14 \sum X13X15 + a15 \sum X14X15$

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= 0.512+ 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 Thuvarankurichi section of NH 45B	511.75	515.48	(-) 0.773
5	Tindivanam Ulundurpet section of NH 45	756.09	511.22	(+) 32.38

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.

FINDINGS AND CONCLUSION

1. Model developed is holding good for four stretches out of total five stretches under review. The variation in the fifth stretch was 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.
2. Factors such as Lighting, lane configuration, shoulder width, service roads, Road condition, Traffic signs contribute to accidents mostly.
3. Rate of Accidents in a stretch which is proposed for upgradation and any improvement shall be considered in addition to the existing parameters.
4. Coordinated efforts of various agencies involved in transport, traffic management, road engineering, road development and maintenance, accident care (trauma care/rescue) are needed to reduce accidents and mortality. Ideally, there should be one single agency to take care of all these aspects for effective reduction in accidents/fatalities.
5. Create position for road safety professionals in organizations such as Road Construction Departments, Municipalities, police etc.
6. Collection & Reporting of Accident data is very weak in India, which needs to be improved a lot for evaluation. Hencethere is urgent need to review and strengthen mechanism for accident data collection, analysis and dissemination of information.
7. Contracts for construction/maintenance of National Highways and State Highways must include road safety audits and road safety professionals as a mandatory to ensure implementation of project safely. The road safety audit on all National Highways should be made mandatory at different stages of the projects such as feasibility stage, preliminary design stage, detailed engineering stage, pre and post opening stage of the road facility. The deficiencies identified at different stages should be rectified in that stage only.
8. Facilities must be provided for vulnerable road users such as exclusive bicycle track, raised platforms, exclusive parking spaces on all urban arterial roads and traffic calming techniques on all roads

9. Highway patrolling system along the entire National Highways should be made mandatory in order to enhance safety on roads. Ambulances should be provided all along the National Highways.
10. Substantial number of fatalities can be reduced if victims are attended within the reasonable time immediately after the accident. It is therefore essential to establish trauma care centers at appropriate locations all along the National Highway network.
11. All accident prone spots along the National Highways network should be identified and proper engineering measures in terms of improvement of road geometrics etc. should be taken.
12. Implementation of Intelligent Transport System(ITS) to be effected in high speed corridors.

LIMITATIONS

The limitations of the above way of predicting the Accident rates are as below:

1. Accidents are not caused by a single factor, which are normally due to the combination of various factors. This model would address the accidents occurrence due to the Geometric features of the road, but the other factors such as Engineering features, Driver behavior, climate, fault of Pedestrians are only due to the Geometric features, which may lead to the improvements more than that of required one. However, any means which reduce or control accidents are good one.
2. Indian traffic condition is of heterogeneous type ranging from high speed SUVs to small LCVs & animal drawn vehicles. Hence the behavior of driver depends on the situation.
3. Indian Roads are more prone to Accidents due to the negligence of road rules due to lack of enforcement and awareness. A wholesome approach has to be made to change the present attitude of the drivers & road users.
4. Concept of road sharing among the road users in India is much far from the desired one, which is one of the main reasons for accidents.
5. Classification of accidents are commonly under or over reported. For instance, damages caused to a vehicle are not considered at the time of a fatal accident.
6. Giving way for the slow movers such as Pedestrians, Disabled people are uncommon.
7. Reporting & collection of Accident data is not projecting the actual figures and in most of the stretch, they are rather unavailable.

Considering the above facts, the scope of further study on the above are as detailed below.

1. Based on the prediction of the Accidents in a particular year, the same may be utilized for determination of the Accidents expected to occur in the above stretch in the oncoming years by projecting the same with respect to the expected GDP growth rate. Economic loss due to the no of accidents in the stretch expected to occur in the near future are arrived with cost of Accidents which was also updated to the year of determination. With the above, one can decide the improvement which needs to be done to have control over the increasing accident rate.
2. Accident Analysis shall be linked with the GPS coordinates for accuracy and proper reporting, which may also facilitate the requirement of improvements to be made.
3. Accident Prediction model shall be developed for each section of National Highways to have more accuracy.
4. Artificial Neural Network Programming shall be made to determine the effect of each variable on the accidents reported and the variables that are having less/no impact shall be removed.

ACKNOWLEDGMENT

The corresponding Author acknowledges the valuable inputs & contributions made by the Co Authors in bringing this article to a shape from a raw rock to sculpture. The authors also acknowledges the inputs & feedbacks given by various quarters of people from Eminent professors, practicing Engineering experts, Local Non-Government Organizations, Police Department, Regional Transport Offices&staffs of National Highways Authority of India.

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