iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VIII **Month of publication:** August 2017

DOI: http://doi.org/10.22214/ijraset.2017.8179

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, August 2017- Available at www.ijraset.com

Analysis of Road Traffic Accident using Causation Theory with Traffic Safety Model and Measures

Dr. Neeta Saxena
Assistant Professor, Amity University Madhya Pradesh

Abstract: The fast expansion of urbanization and the vehicle populace has brought about expanded number of accidents in different urban communities in India. Number of activity administration measures have been endeavoured to minimize the issue of street movement jam and to make the travel more secure. As per MORTH-2015 India has the most significant no of accident in the world. Accident Severity has been expanding step by step; subsequently road security is a most critical issue. Auto collisions have a noteworthy effect to Indian culture. The aggregate no. of road accidents expanded by 2.5 % from 4,89,400 of 2014 to 5,01,423 of 2015.[2] So there is a need of examination of road accidents causes and security measures must be taken to reduce road accidents. In this study Domino's Theory utilizes for investigation of road crashes and for traffic security uses Risk Homeostatic Theory(RHT) as well as accident prevention model with essential measure to reduce road accident.
Key Words: Road Traffic Accident, Road Safety, Domino's Theory, Risk Homeostatic Theory (RHT)

I. INTRODUCTION

Most remarkable automation growth rate in the world coupled by fast development in road system and urbanization throughout the years, our nation is confronted with genuine effects on road security levels. Road security is a standout amongst the most vital issues in our society. The aggregate number of road accident extended by 2.5 per cent from 4,89,400 in 2014 to 5,01,423 in 2015. The total number of persons killed in road accidents increased by 4.6 per cent from 1,39,671 in 2014 to 1,46,133 in 2015. Road accident injuries have also increased by 1.4 per cent from 4,93,474 in 2014 to 5,00,279 in 2015. Road accident wounds have additionally extended by 1.4% from 4,93,474 out of 2014 to 5,00,279 out of 2015.[2] The seriousness of road crashes, measured regarding number of people killed per 100 accidents has extended from 28.5 of every 2014 to 29.1 out of 2015. In the event that current patterns go on street auto collisions are anticipated to be third driving supporter of the worldwide weight of Disease and damage by 2020.[3]

II. ANALYSIS OF INDIVIDUAL ACCIDENTS

Examination of individual crash has two main roles: First, it can be utilized to decide the reason for a crash and the particular work factors that added to it. Following examination, one can evaluate the degree to which the risk has been perceived. One may likewise choose specialized and authoritative security measures and how much more employment experience may have pointed the risk. Besides, a clearer see is picked up of the possible activities that may have been gone out on a limb, and the inspiration that an employee must need to take these activities. Second, one can pick up learning which might be utilized for investigations of numerous comparable crashes at both the undertaking level and at more far reaching (e.g., association- wide or national) levels. In this association, it is essential to collect data, for example:[10]

The nature and the severity of the accident

Factors causing the accident, such as exposure sources, the way in which the accident occurred and the specific working situation causing the accident

General conditions at the place of work and the working condition.

A. Types of Analyses

There are five major types of analyses of accidents, each having an individual reason:[10]

1) Analyses and distinguishing proof of where and which sorts of accidents happen. The aim is to decide the frequency of the injuries, as associated, for example, with sectors, trade groups, enterprises, work processes and types of technology.
2) Analyses concerning checking improvements in the occurrence of accident. The object is to be cautioned of changes, both positive and negative. Measuring the impact of preventive activities might be the consequence of such investigations, and increments in new sorts of accident inside a predetermined area will constitute cautioning of new risk components.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, August 2017- Available at www.ijraset.com

3) Analyses to organize activities that call for high degrees of hazard estimation, which in turn include ascertaining the recurrence and reality of accidents. The objective is to set up a reason for prioritization to figure out where it is more critical to do preventive measures than somewhere else.
4) Analyses to determine how the accidents occurred and, especially, to establish both direct and fundamental causes. This information is then applied to the selection, expansion and implementation of concrete corrective action and preventive initiatives.
5) Analyses for explanation of special areas which have otherwise attracted attention (a sort of rediscovery or control analyses). Examples include analyses of incidences of a special injury risk or the discovery of a hitherto unrecognized risk identified in the course of examining an already known risk.

III. BASIC THEORIES OF ACCIDENT CAUSATION

An accident can be defined as a short, sudden, and unexpected event or occurrence that results in an unwanted and undesirable outcome. (Hollnagel, 2004). Along these lines, the accident is not in reality expected and can cause negative outcomes, for example, fatalities, wounds, close misses, harmed materials or cracked nerves. Accident causation models were primarily formed keeping in mind the end goal to help individuals who needed to examine word related accidents, with the goal that such mishaps could be explored successfully. Knowing how accidents are caused is likewise valuable in a proactive sense keeping in mind the end goal to distinguish what sorts of disappointments or blunders by and large reason mishaps, thus move can be made to address these disappointments before they have the opportunity to happen. Behavioural elements have been perceived as an important supporter of 95.0% of traffic crashes and a conception of activity risk forecast and movement chance recognitions may forecast drivers' activities. It was revealed that a more elevated amount of perceived risk for a specific manner was related with a lower possibility of a person's contribution in that manner.[4]

The major perceived factors in charge of the accidents are - working states of drivers, risk recognition and submission to the inevitable, driver preparing and road utilize behaviour, nature and state of road network, nature and state of business vehicles, and traffic law implementation. The previously mentioned subjects which rose up out of the dataset are similarly the reasons for some motor vehicle accidents.

Crashes shirking have been normally dependent upon learning from crashes and what's more close crash. By explore each occurrence, we learn about reasons and can take actions towards moderating and eliminating the reasons. The issue may be that we bring not been capable to develop, in the lack of sufficiently high-quality theories, enquiry methods which might raise every last one of applicable components for averting. Assessment might provide for a logically beneficial picture about the reasons. However, this picture is generally related only for the specific evidence investigated. There may be some situations and issues which contributed to the accident whose connections the investigators do not identify or recognize. Generalize from one accident to other situations allow a degree of risk.

Accident causation models are different in many elementary ways, at one level, they may be different in their area of application, their reason and their focus. They may also be different significantly in their general structure, their inputs and outputs. (Lehto, 1991)

IV. THE DOMINO THEORY

In 1931, the late H.W. Heinrich (Heinrich et al, 1980) presented a set of theorems known as 'the axioms of industrial safety'. The first axiom dealt with accident causation, stating that 'the occurrence of an injury invariably results from a complicated sequence of factors, the last one of which being the accident itself.'

Alongside, he presented a model known as the 'domino theory' as this accident sequence was likened to a row of dominoes knocking each other down in a row. The sequence is:

Injury by an;

Accident, due to an;

Unsafe act and/or mechanical or physical hazard, due to the;

Fault of the Person, caused by their;

Ancestry and Social Environment.

88% of all accidents are caused by unsafe acts of people, 10% by unsafe actions and 2% by acts of God. Heinrich proposed a-five-factor accident sequence‖ in which each factor would actuate the next step in the manner of toppling dominoes lined up in a row.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, August 2017- Available at www.ijraset.com

The sequence of accident factors is as follows:
Ancestry and social environment: Those conditions that make us take or accept risk.
Worker fault or Undesirable Human Trait: Anger, careless, tiredness, lack of understanding, un-attention.
Unsafe act or condition together with mechanical and physical hazard: Poor planning, unsafe equipment, hazardous environment.
Accident: The accident occurs when the above events conspire (combine) to cause something to go wrong.
Damage or injury: Injury occurs when the person sustains damage.[4]

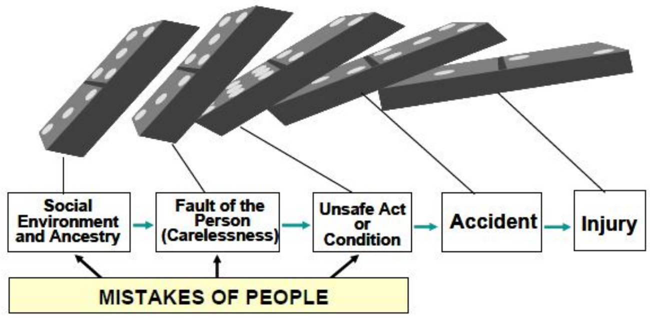


Figure 1: The domino theory developed by Heinrich H.

As per the Domino's theory there were a number of aspects that contribute to an accident. These could be associated to a number of dominoes standing in a row—if one is knocked down the remaining also fall. Take out one of these dominoes and the chance of a loss occurring is reduced.
The different stages of dominos are described as follow:

A. Social Environment

people are brought up in specific surroundings. A few people have minimal worry for their or different people's wellbeing. This Might make contended to a chance to be an after effect of the society of the culture or association for which those individual will be efficient.

B. The Fault of the Person

this means that the person has specific tendencies to enter into unsafe situations. The psychological make-up of the person may escort to him or her to intentionally do something that is insecure, perhaps because he or she has not immersed training given or is unaware that he or she is carrying out an unsafe act. It is the person who is at fault— that person's psychology—as opposed to society's effect on the person concerned.

C. The Unsafe Act

this is the actual act that leads to the harm, such as the loss of balance on a horse or the failure to secure the stable door properly so that an animal escapes.

D. The Injury Itself

this is an injury to the person or to property. The domino model has been noted as a one-dimensional sequence of events. Accidents are usually multi-factor and develop through relatively extensive sequences of changes and errors'. This has led to the principle of multiple causation.
As stated by Peterson (1978), behind each crash there lie huge number of helping factors, causes and sub-causes. The hypothesis of multiple causation is that these factors consolidate together, in random fashion, causing accident. So, throughout accident investigations, there is a need to identify as many of these causes as possible, rather than just one for each stage of the domino sequence.[5]

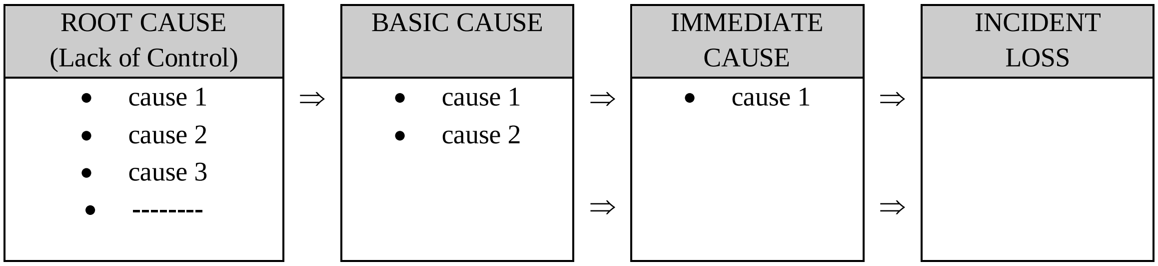


Figure2: The accident model is in reality an amalgam of both the domino and multi-causality theories.

According to above discussion following causes of accidents may be concluded
All accidents whether major or minor are caused, there is no such thing as an accidental accident!!
Very few accidents, particularly in large organisations and complex technologies are associated with a single cause.
The causes of accidents are usually complex and interactive.

V. ROLE OF HUMAN ERROR IN ACCIDENT MODELLING

Despite those part that human mistake plays in accident causation has been accepted to a large number years, it is only recently that a lot of concerted effort has been put into detailed research into human error in accidents. Accept the technical issues two general points emerged strongly from the inquiries into these accidents, which are:
The impact of human error in the chain of actions prompting those accident;.
Breakdowns in the management also association about safety.
Individuals can reason or contribute to accident (or reduce the consequences) in a number of ways (HSE, 1999) generally the improvement for safety has been largely reactive, concentrating looking into accident examination for those essential point of avoiding repeatable occasions. In part of this arose from too simple an approach to accident causation dependent upon evident importance set on the idea of a single primary reason; either an risky act or an risky condition (as an after effect of the domino theory)
Conventional models about accident causation set apparent emphasis on human factors. Where human factors were included, they were represented as linked to error occurring in the instant sequence of events leading to the accident. a batter considering for how, why and when human errors become involved in accident enhances our ability will make predictions regarding those part of human errors furthermore assistants to prevent accidents. A number of models have been placed ahead that effort to describe those major aspect that human errors assume over accidents.[7]

VI. ROAD SAFTY AND RISK HOMEOSTASIS THEORY

Homeostasis is a flexible procedure that keeps the result near close to the target by compensating for alarming outer control. The term homeostasis doesn't refer to a fixed and constant end effect or to an unchangeable fix status of relationships, but to a particular kind of dynamic process that matches essentially output to a target. Risk homeostasis is the degree of risk taking performance and the amount of loss due to accidents and lifestyle dependent disease are maintained over the time unless there is a change in the target level of risk. From what has been said so far it will be clear that in attributing the causation of accident loss in nation to a homeostatic process.
The level of traffic accident risk that is professed by the individual person at any moment of time derives from three sources:
The person’s post experience with traffic.
The person’s assessment of the accident potential of the immediate situation.
The degree of confidence the person has in processing the necessary decision- making and vehicle-handling skill to cope with the situation.
The person’s post experiences hold unlimited verity of prior events: personal fear, arousing occurrences, traffic conflicts, close to accidents, limited escapes, bearing in mind other people’s accidents, discussion for others something like accident, presentation to accident reports these experiences clear out those driver for An general feeling of the level for risk of the road. As these occurrences are common place and correlate with the accident statistics as generated by police force and government, there is no require assuming that for homeostasis to occur, people have more than a very faint knowledge of the official statistics. The instant condition include those physical features of road environment, the drivers own speed and direction and the path and speed of other road where people read the risk implications of these feature.[4]

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, August 2017- Available at www.ijraset.com

At last the recognize level of risk will be moderately low though the individual is confident about having the essential coping skills higher in the case of individual who doubt their abilities.

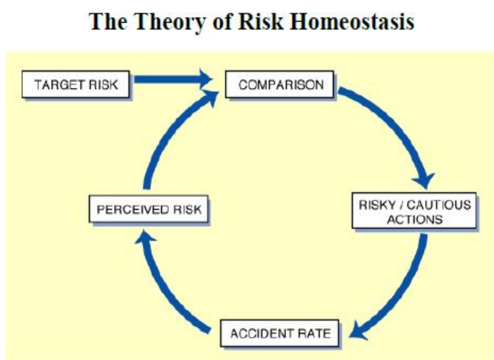


Figure 3: "circular causality" that links changes in perceived risk to changes in behaviour, while unexpected changes in the accident rate lead to changes in perceived risk, and thus to subsequent behaviour.[4]

As per to risk homeostasis principle due to those transform over's important cause and fear arousing obstruction with existing abilities road user over estimated the level of accident risk that is would created. Subsequently the observed level of risk surged on an surprising level that much surpassed the target level about risk. There are three types of skill that have an effect on the level of risk perceived and action performed: (i) Perceptual skills (ii) Decision making skills (iii) Vehicle handling skills.

skill determines the extent to which the person's subjectively perceived risk corresponds to the objective risk. This skill includes the ability to correctly assess one's level of decision making and vehicle handling skill. That is important, because it implies that persons with limited decision making or vehicle handling skills are at no greater accident risk provided they realise their limitations and act accordingly.

VII. FACTORS DETERMINING RISK

The factors which are of most important in determining risk are:

Factors which determine the presence or absence (or potential) of risks of any sort

Factors which either increase or minimize the probability of these risks resulting in accidents or injuries

Factors affecting the seriousness of accidents associated with these risks.

To clarify the first point, it is necessary to identify the causes of the accident—namely, exposure sources and other harmful factors; the two latter points constitute the factors which influence the measurement of risk. Whether we ignore transient variances in the accident rate Furthermore other variables that impact it, we might find a major result of risk homeostasis: those annual accident loss may be the result of the hourly risk people are willing to take times the time they spend on the road times the number of people in the population. To calculate total numbers of accidents across the entire road network in a jurisdiction, across the entire population, and over an extended period of time (such as one year), the total traffic accident loss (A) = the target risk (R) multiplied by the average number of hours (h) spent in traffic multiplied by the number of members in the population (N).[4]

A. *Risk Homeostasis: Simple Equations*

Basic equation: **A = R x t x N** ------------- (i)

Cross-sectional deduction: **km/hour = R ÷ [A / (n x km)]** -------------(ii)

Longitudinal deduction: **km/N = (R x t) ÷ (A/km)** --------------------- (iii)

Where: **A** = accident loss in traffic

t = time spent in traffic per person (in hours)

km / hour = moving speed

km / N = total distance driven per head of population

n = number of people in the population

R = target level of risk

The information essential for direct testing of these equations are, undesirably, missing at exhibit. While the quantity of individuals in the population (N) can be evaluated with extensive dependability, and a few appraisals of the measure of time spent in activity (h) are in presence, the estimation of the objective level of risk (R) remains resistant to quantification, therefore, have to resort to validate the main idea by testing the derivatives, by equation (ii) and (iii). As far as the total loss due to traffic accidents (A) is concerned, practically reliable accident data exist for fatalities only Road accidents with property damage only, and even those with physical injury, are usually not reported in a reliable manner. Deductions is *cross*-sectional in nature (Equation (ii)) It says that the average moving speed in different road sections is inversely proportional to the accident rate per passing vehicle in those road sections.

The *longitudinal* deduction from the basic equation (iii) is different in that it involves comparisons between *different time periods* within the same jurisdiction over a sequence of years which are marked by different spatial accident rates. This deduction states that one should be able to observe an inverse proportional relationship between, on the one hand, the accident loss per unit distance of mobility (A/km) and, on the other, the amount of mobility per head of population (km/N), which may vary from one year to another. In other words, as the accident rate per km drops from year to year, the kilometrage per head of population should show sufficient increments. Moreover, the accident loss per inhabitant (A/N) should remain unchanged for the simple reason that it is the product of the two: (A/km) x(km/N) = A/N.

The risk homeostasis theory is to be acceptable on the premise of actualities, two conditions must be satisfied. To start with, it should be found that accident countermeasures that don't reduce the target level of risk don't reduce the accident loss per head of population, regardless of whether they reduce the accident rate per unit distance of mobility**.** Second, accident countermeasures that do diminish the objective level of risk should prompt perceptible decreases in per capita accident loss.[4]

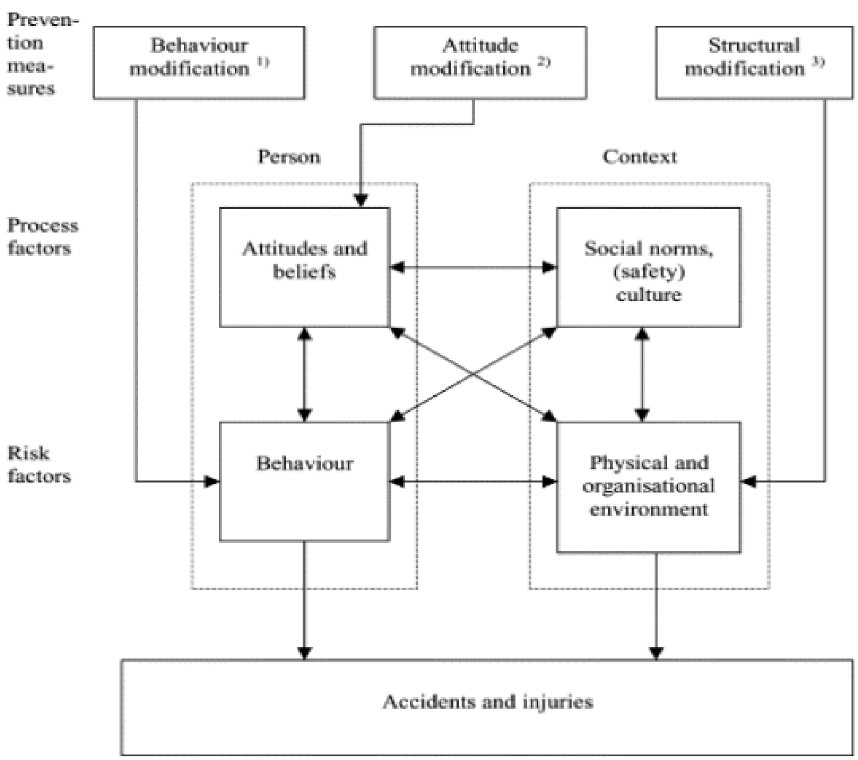


Figure 4: Accident Prevention Model (Source: Lund and Aaro 2004)

In arranging any interventions to alleviate the impact of road traffic crashes, the concentrate should not exclusively be on tending to addressing structural but rather likewise the parts of the inactive variables that encourage road user's purpose should be coordinated to accomplish important outcomes. In the light of the foregoing, an integrated model for designing accident countermeasures proposed by Lund and Aaro (2004) will be instructive. This model is especially relevant because human factors have been found to represent about 90% of accident causal factors (Dekker, 2002). The model is self explanatory and can be applied in many situations and contexts.

The conventional policy toward improvement of road safety—although the denominator of safety has rarely been clearly identified—goes under the common label of the *"Triple E"* approach: ***E***ngineering, ***E***ducation and ***E***nforcement. Note that in this approach there is no specific reference to the concept of motivation-the concept that, according to risk homeostasis theory (RHT), is the most relevant to safety of all.[4]

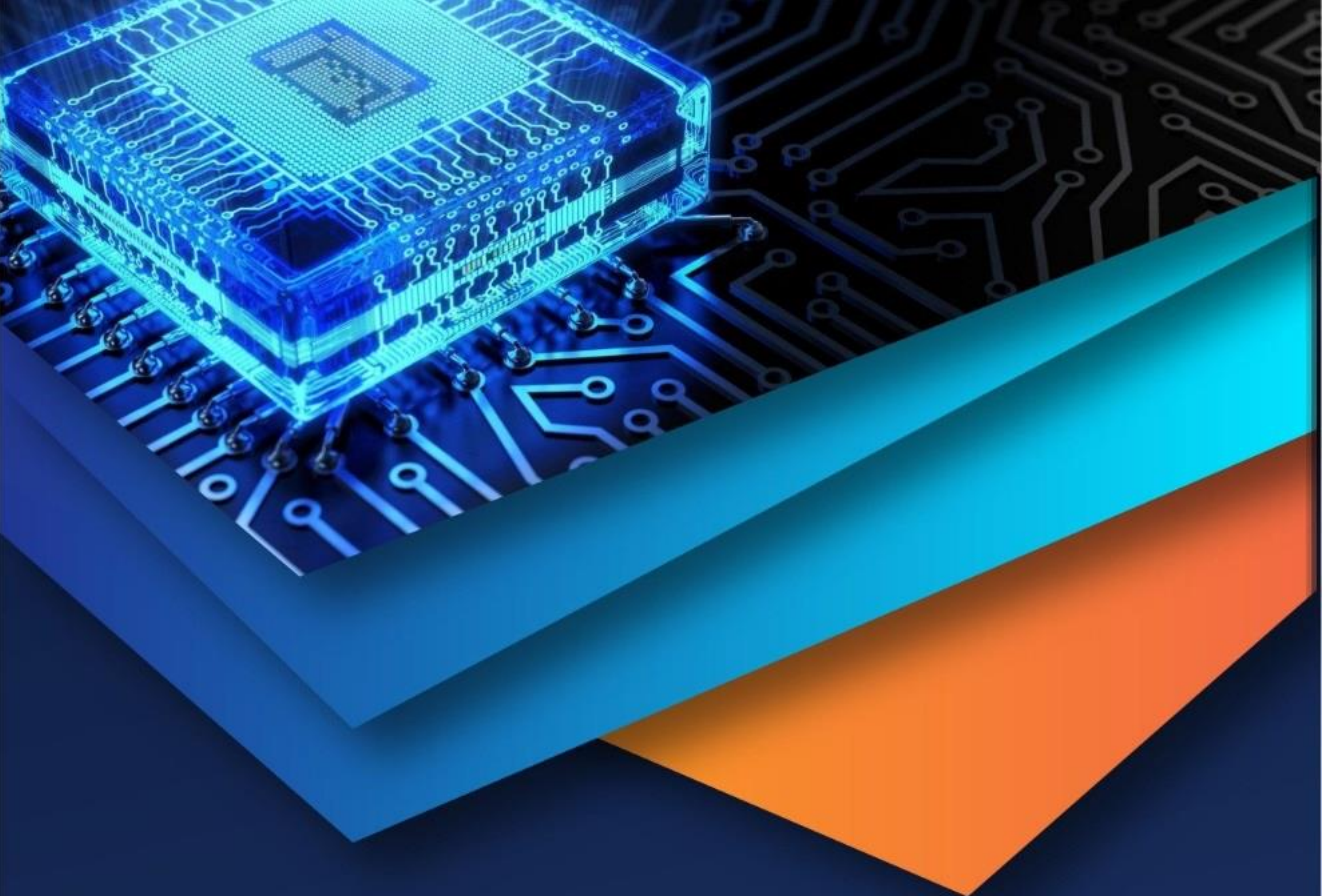
VIII. CONCLUSION

In this study Domino's Theory has discussed for analysis of road traffic accidents and for traffic safety Risk Homeostatic theory and accident prevention model have discussed. Apart from this road accident is a random phenomenon and it is very difficult to do the exact prediction of future trends of accidents by using any model or theory. "Accidents are not natural but they are caused," is a common saying in the area of traffic safety. To make our roads safer and accident free, we have to take a few important steps in this direction such as:[11]

A. Make Road Safety Assessment in India a compulsory part of the syllabus in schools as the children should learn about the rules and safety of roads early in life.
B. Strict implementation of the traffic rules- The defaulters should be fined heavily for breaking the rules.
C. Make licensing and driving tests stricter.
D. Enforcing the heavy vehicles to fix reflective tapes over them to be clearly visible during night time.
E. Mandatory registration of criminal cases if the vehicle is overloaded.
F. Imprisonment and heavy penalty for drunken driving.
G. Mandatory annual fitness checks of the school buses as well as drivers.
H. Mandatory vehicle fitness checks for all vehicle owners.
I. Road infrastructure-The automobile population in India has grown up to 170 times in the past 50 years but the country's road has grown only about 9 times. So there is a dire need to improve the quality of the roads in India.
J. Road Safety Awareness in India is very poor therefore there is a need to educate and make people aware of the road safety through various events and programs, This can be done with the help of schools, colleges, NGOs, transport and trade unions.
K. Installation of more CCTV cameras for better monitoring of traffic.
L. Highway patrolling using radar to detect overspending vehicles.
M. Highway advisory radios, center to center communications, weather monitoring stations.

REFERENCES

[1] Analysis of relationship between road safety and road design parameter of four lane national highway in India. By Ravi Shenker, Arti Chowksey and Har Amrit singh sindhu May 2015.
[2] Road Accident in India 2015: Report by Ministry of Road Transport & Highways Transport Research Wing.
[3] Road safety and accident prevention in india: a review by Pawan Deshpande April- June 2014.
[4] Risk Homeostasis in Everyday Life: By Gerald J.S. Wilde Digital Edition (Version 2014.03.20)
[5] Accident Analysis and Modeling on NH-55(India): By A.N. Dehurey, A.K. Patnaik, A.K. Das and other three Authors. May 2013.
[6] Review of Accident causation models used in Road Accident Research: By Hermitte Thierry January 2012
[7] Traffic risk behavior and perceptions of Thai motorcyclists: A case study by Prathurng Hongsranagon Theerachai Khompratya and other three authors. March 2011.
[8] Risk Perception, Traffic Attitudes and Behaviour among Pedestrians and Commercial Minibus Drivers in Ghana: A Case Study of Manya Krobo District. May, 2011
[9] Microscopic Traffic Flow Modeling NPTEL May, 2007.
[10] Accident Prevention: Encyclopaedia of occupational health and safety part VIII.
[11] Health & Safety Management Lecturing Resource



10.22214/IJRASET

45.98

IMPACT FACTOR:
7.129

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY