

ACCIDENT PREDICTIVE MODEL BASED ON ENVIRONMENTAL FACTORS  
AT FEDERAL ROUTE, MALAYSIA

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## DEDICATION

*Every challenging work needs self-efforts and blessing of Allah as well as guidance of elders especially those who were very close to our heart.*

*My humble effort I dedicate to my sweet and loving*

*Hjh. Enson binti Hj. Mohamed  
(Mother)*

*Normazida binti Mohamed Isa  
(Wife)*

*Hanis Izatty binti Hj. Mohad Fedder  
Mohamad Aiman Affendy bin Hj. Mohad Fedder  
Aimi Sabrina binti Hj. Mohad Fedder  
Aimi Syafiqah binti Hj. Mohad Fedder  
Aimi Syahmina binti Hj. Mohad Fedder  
(Children)*

*Whose affection, love encouragement and prays of day and night make me able to get such success and honour,*

*Along with all hard working and respected  
Lecturers & Staff of Universiti Teknologi Malaysia (UTM) and  
Staff of Jabatan Kerja Raya (JKR).*

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## **ABSTRACT**

In the world about 1.24 Million people die every year and 20-50 million sustain non-fatal injuries. Road tragic injuries estimated to be the eighth (8<sup>th</sup>) leading cause of death globally. In Malaysia about 18 deaths per day or 1 death every hour, which require serious attention in searching for preventive measures to minimize this problem. This study aims to investigate environmental factors that contribute to a higher potential of fatal accidents at Federal Route, Malaysia. The study attempted to identify the relationship among the severity of accidents and several identified environmental factors. 166 accidents reports were collected randomly based on serious collision and fatal of the Federal Roads in Peninsular Malaysia from year 2008 to 2015. Twenty eight variables were ranked according to the frequency. Then, Pareto analysis was used as a tool to select the most often contributing factors to the accidents severity. From the analysis, nine variables were then identified (78.4%) as the most contributing factors to the accidents. Logistic Regression was applied to develop accident predictive model based on data collected. It was expected that proactive measures can be taken by the respective authorities before the actual fatal accidents happen in the area under investigation.

## **ABSTRAK**

Di dunia sebanyak 1.24 juta orang mati setiap tahun dan 20-50 juta mengalami kecederaan parah. Kemalangan maut di jalanraya dianggarkan kelapan (ke-8) punca utama kematian di seluruh dunia. Di Malaysia, 18 kematian sehari atau 1 kematian setiap jam, yang memerlukan perhatian serius dalam mencari langkah pencegahan untuk mengurangkan masalah ini. Kajian ini bertujuan untuk mengkaji faktor-faktor alam sekitar yang menyumbang kepada potensi tinggi terhadap kemalangan maut di Laluan Persekutuan, Malaysia. Sebanyak 166 laporan kemalangan dikumpulkan secara rawak berdasarkan pelanggaran serius dan maut dari tahun 2008 hingga 2015. Dua puluh lapan pembolehubah telah disenaraikan mengikut kekerapan. Kemudian, Analisa Pareto digunakan untuk memilih faktor utama kepada kemalangan yang serius. Daripada analisa tersebut, sembilan pembolehubah (78.4%) telah dikenal pasti sebagai faktor utama yang menyumbang kepada kemalangan. Logistik Regresi telah digunakan untuk membangunkan model ramalan kemalangan. Dijangkakan bahawa langkah proaktif dapat diambil oleh penguatkuasa yang berkaitan sebelum kemalangan maut terjadi di kawasan yang dikaji.

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## LIST OF ABBREVIATIONS AND SYMBOLS

<i>APW</i>	=	<i>Accident point weightage</i>
<i>AP</i>	=	<i>Number of access points per kilometre</i>
<i>HTV</i>	=	<i>Hourly traffic volume</i>
<i>Gap</i>	=	<i>Amount of time, between the end of one vehicle and the beginning of the next in second, 85<sup>th</sup></i>
<i>PS</i>	=	<i>85<sup>th</sup> Percentile speed</i>
<i>Y</i>	=	<i>Number of Accidents</i>
<i>X1</i>	=	<i>Road cross-section dimensions</i>
<i>X2</i>	=	<i>Traffic volume</i>
<i>X3</i>	=	<i>Speed</i>
<i>X4</i>	=	<i>Road shoulder width</i>
<i>X5</i>	=	<i>Lighting conditions</i>
<i>X6</i>	=	<i>Traffic signs</i>
<i>X7</i>	=	<i>Traffic signals</i>
<i>e</i>	=	<i>Super elevation</i>
<i>f</i>	=	<i>Coefficient of friction</i>
<i>R<sub>min</sub></i>	=	<i>minimum radius of circular curve (m)</i>
<i>V</i>	=	<i>Design speed (km/hr)</i>
<i>P</i>	=	<i>Percentage of fatal accident happens</i>
<i>SM</i>	=	<i>Signing and Markings</i>
<i>RS</i>	=	<i>Road Safety</i>
<i>SH</i>	=	<i>Shoulders</i>

<i>TB</i>	=	<i>Traffic Barriers</i>
<i>SD</i>	=	<i>Sight Distance</i>
<i>PV</i>	=	<i>Pavement</i>
<i>DV</i>	=	<i>Development and Environmental Impact</i>
<i>LI</i>	=	<i>Lighting</i>
<i>HA</i>	=	<i>Horizontal Alignment</i>
<i>LR</i>	=	<i>Logistic Regression</i>
<i>SPSS</i>	=	<i>Statistical Package for the Social Sciences</i>
<i>MOT</i>	=	<i>Ministry of Transport</i>
<i>ADT</i>	=	<i>Average Daily Traffic</i>
<i>PDRM</i>	=	<i>Royal Malaysian Police</i>
<i>GIS</i>	=	<i>Geographic Information System</i>
<i>PWD</i>	=	<i>Public Work Department.</i>
<i>HPU</i>	=	<i>Highway Planning Unit</i>
<i>WHO</i>	=	<i>World Health Organization</i>
<i>JKR-KL</i>	=	<i>Jabatan Kerja Raya Kuala Lumpur</i>
<i>RSPM</i>	=	<i>Road Safety Plan of Malaysia</i>
<i>RIA</i>	=	<i>Road safety Impact Assessment</i>
<i>MIROS</i>	=	<i>Malaysian Institute of Road Safety Research</i>
<i>NHTSA</i>	=	<i>National Highway Traffic Safety Administration</i>
<i>SRV</i>	=	<i>Skid Resistance Value</i>
<i>MTD</i>	=	<i>Mean Texture Depth</i>
<i>SN</i>	=	<i>Skid Number</i>
<i>ATJ</i>	=	<i>Arahan Teknik Jalan</i>
<i>PDO</i>	=	<i>Property-Damage-Only</i>
<i>BSA</i>	=	<i>Black Spot Area</i>
<i>NBA</i>	=	<i>Not Blackspot Area</i>



## **CHAPTER 1**

### **INTRODUCTION**

#### **1.0 Introduction**

Time to time, half a million of Malaysians died because of road accidents. The highest cases of road accidents are caused by the driver's behaviour, equipment failure, road conditions and infrastructure. Road accidents affect government in which they have to repair for the broken infrastructure that caused by the accident like lamp stand, road divider, cleaning people blood from the road, and many more. According to Ministry of Transport (MOT-Malaysia, 2015), the total deaths caused by road accidents by year 2006 to 2015 for states of Malaysia, about 66,802 cases accident deaths by vehicles. According to the latest WHO data published in May 2014 Road Traffic Accidents Deaths in Malaysia reached 6,813 or 5.36% of total deaths. The age adjusted Death Rate is 25.25 per 100,000 of population ranks Malaysia number 34 in the world (WHO, 2014).

The first thing that contributes to the reason for the road accidents in Malaysia is the driver's behaviour. Based on a survey done by MUFORS (Malaysian Unite for Road Safety), 61.1% of respondents agreed that most of road crash takes place because of driver's attitude. Besides, based on the statistics by Royal Malaysia Police (RMP), they found 85.7% of road crash happened because of human factor, 10.6% because of road condition and environmental while the other 3.7% comes from the vehicle itself (Jumaat, 2016). According to Idris *et. al* (2015) they have concluded that a factor of personality 38% of the unique in aberrant driving behaviour have direct influences 55% of the variances in road accident among bus driver in Indonesia. Speeding, even if the vehicle is going five miles per hour over, in the wrong place at the wrong time, it can cause death to somebody. Speeding is also based on the traffic on an area, road conditions, weather and lighting. When driver speeding, they risk their lives, so they have to be alerted about what condition they will face. The faster a vehicle, the greater the risk of an accident.

The issue of road accidents is an increasing problem in developing countries. This could be due to increasing road traffic/vehicle occupancy. This has been increasing over years. Regulating traffic on roads is an important task. There by reducing accidents in accident prone zones. The accident was drastically increased over a decade from 4% to 31%. This is an alarming issue. The analysis and proof of identity of such road accident prone zones is essential to reduce the accidents. The factors influencing such accidents are to be analysed for remedies.

Methodologies for predicting accidents have been widely studied in the past. The prediction models are mostly causative types in which the number of accidents is taken as a function of number of independent variables. Several studies have been conducted to identify accident-prone locations using Geographic Information System (GIS), fuzzy and neural network classifier approaches. However such methods are

highly dependent on traffic flow data like Average Daily Traffic (ADT) and the data collected by the traffic police from the accident sites. Moreover the traffic police may not be able to collect all the data to carry out analysis on road accidents.

Considering all the factors mentioned above, it is necessary to develop a model which can assist in forecasting black spots on a given road network based on data collection from expertise forensic department of Public Work Department (PWD). In the current practice in Malaysia, black spot area is identified as 5 or more types of accident in radius 50m in the 3 years or 3 or more same types of accident in radius 50m in the 3 years (Baguley, 1995). The accident predictive model developed in this study predicts the probability of fatal accidents occur based on the environmental factors.

## **1.2 Problem Statement**

Malaysia's accident rate is ranked as the one of the highest in the world. In 2014, there were more than 25.1 million registered vehicles in Malaysia (MOT-Malaysia, 2015). Problems such as traffic congestion are the norm for urban areas. Fatal accidents are no longer new as they happen on daily basis. Road infrastructure construction and maintenance takes huge chunk of national budget. The outcome has been about a staggering RM 9.0 billion in social cost annually around RM 1.3 million/death (MOT-Malaysia, 2014).

Bad habits of Malaysian drivers who like to speed without considering the risks is one of the contributory factors for the high accident rate in the country. On the average, there are 19 deaths each day due to road accidents (MOT-Malaysia, 2015).

The World Top 25 Countries In Car Accidents Ranking 2016 has ranked Malaysia at number 18 in its list of countries with the most deaths caused by road accidents with estimated road traffic death rate 25 per 100 000 population (worldatlas.com 2016). This situation is very worrying and that the government is confident that the best way to handle the issue is to educate the public and create awareness of the importance of road safety and road courtesy at grass root levels.

In Malaysia the main accident occurs by head-on collision and out of control. It is accounted for 79.0% of all collision types. The related accident above is environmental factors contribution. Besides that, most of complaints related to road accidents received from road users are based on environmental situations such as road light, pavement conditions, etc. This situation that occurs since few years ago have intrigued the need to conduct this study, hence the proactive measures or mitigation actions can be taken to avoid the fatal accidents.

### **1.3 Objective**

This study aims to investigate environmental factors that contribute to a higher potential of fatal accidents at Federal Route, Malaysia. To achieve the aim, the study will be defined based on following objectives:

- i) To identify the accident patterns on Federal Route,
- ii) To determine the contributing factors to accidents,
- iii) To develop a model by relating the probability of accident severity (Y) with independent variables identified in (ii) above.

## **1.4 Scope of Study and Analysis**

Some limitations that involve in this study are below:-

- i) Involve accident history from year 2008 to 2015.
- ii) This study only investigates environmental factors in road accidents. Other factors such as human factors and vehicle factors are not considered.
- iii) The speed limit of the federal road is 90km/hr or 60km/hr depend on gazetted by government of Malaysia.
- iv) Type of federal roads for this study is the standard R5/U5 or R4/U4.
- v) All environment parameters were identified by forensic expertise of Public Works Department (PWD) Malaysia.

## **1.5 Expected Contribution**

In the current practice in Malaysia, black spot area is identified as 5 or more types of accident in radius 50m in the 3 years or 3 or more same types of accident in radius 50m in the 3 years (Baguley, 1995). The accident predictive model developed in this study predicts the probability of fatal accidents occur based on the environmental factors.

The findings from this study would be useful in predicting black spot area before accident occurred. Therefore, it is expected that the proactive measures can be taken or considered by the respective authorities before the actual fatal accident happens on the area.

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