Hazard Identification Risk Analysis and Risk Control of Road Accidents at UiTM Shah Alam

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Article Information	Abstract
	Road accident analysis has come to attention as traffic fatalities has increased significantly. There are few causes of road accidents which are preventable. The number of accidents in the main campus, UiTM Shah Alam is high due to its large population. The aim of this study is to assess the trend of road accident in UiTM Shah Alam. The findings could determine the hot spots where accidents frequently occur by mapping road accident at the campus site and evaluate the related physical risks. For this purpose, traffic accident data from 2009 until 2013 had been collected and tabulated in Geographical Information System (GIS) for analysis. GIS is identifies accident hotspot in UiTM Shah Alam. At the hotspot locations, HiRARC (Hazard Identification Risk Analysis and Risk Control) was conducted. The study reveals that the trend of road accidents in UiTM Shah Alam from 2009 to 2012 has been decreasing. Despite the descending trend in the overall number of accidents, incidents in hotspot location identified by GIS however has increased. From the GIS Melati College, Delima College junction, Perindu College junction and Seroja College junction was found to be hotspots for accidents in UiTM Shah Alam. Results from HiRARC in descending order showed that Melati College recorded the highest score of risk which is 55, followed by Delima College junction (39), Perindu College junction (29) and finally Seroja College junction (22) with motorcycles being the main vehicle involved. Although road accident pattern in UiTM Shah Alam is decreasing, hotspot locations needs attention.

INTRODUCTION

Road accidents represent as one of the major social problems in the world. Accident are relatively known as uncommon and unpredictable, sometimes it is direct observation and often not possible. Road accidents increase year by year in developing countries. According Ameratunga, Hijar, & Norton, (2006) the increasing number of accident is due to the vehicle demand over time and the high growth of populations in urbanization in many develop countries. The growth of vehicles volume on the road has become a main factor that contribute to the road accident.

World Health Organization (WHO) in it's WHO, Evidence, Information and Policy Report 2000 claimed that the road traffic injuries are among the leading cause of death and injuries and in the year 1998 it has ranked as the ninth leading contributor to the burden of disease worldwide based on disability adjusted life years.

The numbers of death resulting from road traffic crashers have been projected to reach 8.4 million in the year 2020 (Peden et al., 2004). In Malaysia, traffic accidents have been increase at the average rate of 9.7% per annum over the last three decades. The number of fatalities also increases but at slower rate compared to total road accident from 2,303 in 1974 to 6,200 in 2005 (Mustafa, 2005).

UiTM Shah Alam is an open campus travelled by an estimated 35,000 to 40,000 people each day. Since then, traffic accidents and number of traffic congestion have become common. The increased the numbers of road accidents are directly proportional to the increasing number of traffic flows. The intervention has to be considered from many angles. Some factors that may contribute to the road accidents are related to the driver's carelessness such as driving error, illness or vehicle problems. In UiTM Shah Alam, there are 5 one way routes, 6 main routes, 4 entrances and 47 road junction, and 15 roundabouts. This kind of road network shows how busy is UiTM Shah Alam and indicates high potential accidents to happen.

METHODOLOGY

The study was conducted in Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor Darul Ehsan, Malaysia. It is a cross sectional study analyzes the trend of road accident which happened in UiTM Shah Alam. Peak hours, population and volume of vehicles are the independent variables while the dependent variable is cases of accidents. Primary data was obtained from qualitative technique which included direct personal observation and interviews while secondary data comprised of a retrospective review of records of road accidents at UiTM Shah Alam from 2009 until 2012.

The collected data was then tabulated by using GIS in order to identify the location that recorded high accident cases during the four year period. Traffic volume count was carried out manually in a particular hot spot location. Hazard Identification, Risk Assessment and Risk Control (HiRARC) was conducted to obtain information on the physical risk through onsite observation with the aid of Risk Matrix. Risk Matrix (Table III) is products of severity and risk which are obtained from Table I and Table II. HiRARC is a method adapted from Department of Occupational Safety and Health Malaysia where it is used to assess risks of hazards in occupational setting.

TABLE I
RISK RATING

LIKELIHOOD (L)	EXAMPLE	RATING
Most likely	The most likely result of the hazard/event being realized	5
Possible	Has a good chance of occurring and it is not unusual	4
Conceivable	Might be occur at some time in future	3
Remote	Has not been known to occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

TABLE II
SEVERITY RATING

SEVERITY	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage and productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non-fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasion, bruise, cuts, first aid type injury	1

TABLE III
RISK MATRIX

LIKELIHOOD (L)	SEVERITY (S)				
	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

High
Medium
Low

Average daily traffic (ADT), the average number of vehicles two-way passing a specific point in a 24-hour period was carried out at hotspots that had high risks for accidents. ADT is a method used by Public Works Department (PWD) Malaysia to identify whether a road is congested or not. The calculations for ADT are as follows:

Traffic Volume/Count
It is defined as the procedure to determine mainly volume of traffic moving on the roads at a particular section during a particular time. It is obtained by counting passenger car unit per hour (pcu/hour). The multiplication factor for various class of vehicles given by PWD are Motorcycle = 0.5, Car = 1.0, Van = 1.0, Lorry = 2.0 and Bus = 3.0.

Traffic volume = [n(motorcycle)x0.5 + n(car)x1.0 + n(lorry)x2.0 + n(lorry)x3.0 + n(bus)x3.0]/hour

Traffic volume count was conducted in two locations which is Melati College and Delima College Junction to observe the real situation of traffic volume in this location area. The volume of vehicle (motorcycle, motorcars, van, and lorry) was taken twice per day for duration of 1 hour each for peak hour (12.00 – 1.00 p.m.) and off peak hour (3.00 – 4.00 p.m.).

Traffic Volume/Count Degree
Traffic volume degree is traffic volume divided by road load. Road load is the force (function of speed, road slope and acceleration) required to move a vehicle. The load value for roads in UiTM Shah Alam is 1000 as determined by PWD Malaysia. If the results are ≥ 0.7 it is regarded congested and if it is < 0.7 it's not congested.

RESULTS AND DISCUSSIONS
Figure 1 below shows the trend of road accident in UiTM Shah Alam from 2009 until 2012. Overall there were a total of 268 accidents with average 67 accidents per year.
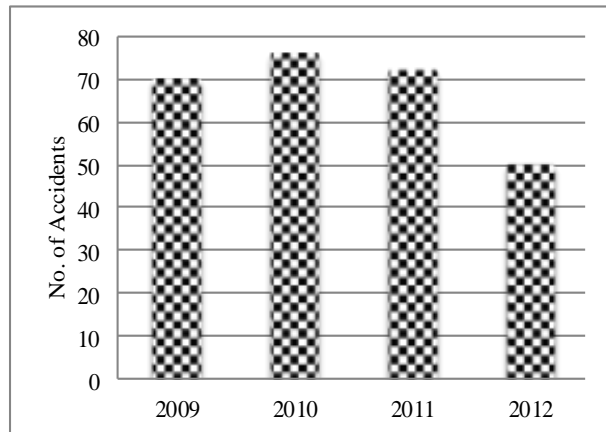

FIG.1.
ROAD ACCIDENT TREND AT UiTM SHAH ALAM 2009 TO 2012

Proportionally students recorded the highest number involved in road accidents followed by UiTM staff. The numbers of visitors involved were minimal. Table IV shows the distribution of road users involved in accidents within the vicinity of UiTM Shah Alam.

TABLE IV
DISTRIBUTION OF ROAD USERS INVOLVED IN ACCIDENTS

Year / User	2009	2010	2011	2012	TOTAL
Student	40	42	38	34	154
Staff	27	29	33	16	105
Outsider	3	5	1	0	9
Total	70	76	72	50	268

From Table V below it is evident that motorcycles recorded the highest number of road accident from 2009 to 2012 with 245 cases. Pedestrian are the lowest with only 6 recorded cases.

TABLE V
TYPE OF VEHECLES INVOLVED IN ACCIDENTS

Year / Vehicle	2009	2010	2011	2012	TOTAL
Motorcycle	55	67	78	45	245
Car	34	54	56	38	182
Lorry	4	3	4	4	15
Pedestrian	2	4	-	-	6
Bus	3	3	3	4	13
Total	98	131	141	91	461

The integrated accident hotspot map at UiTM Shah Alam (2009 – 2012) is shown in Figure 2 below. It represents the spatial distribution of accident data for the year of 2009 until 2012 and was obtained by using computerized GIS. It can be seen that the size of black circle is proportional to the accident point weightage. It shows four locations generally classified as hotspots namely in front of Melati College; Delima College junction; Perindu College junction; and Seroja College junction.

FIG.2.
GIS MAPPING OF ROAD ACCIDENTS IN UITM SHAH ALAM 2009 TO 2012

HiRARC had been conducted based on four areas that have been identified as location that prone to cause an accident that generated by geographical Information System (GIS) from 2009 to 2012. Results of the risk analysis for the four areas are as shown in Table VI.

TABLE VI
SUMMARY OF HIRARC CONDUCTED FOR THE HOTSPOT AREAS

No	Study Area	Hazard	Effect	Existing Risk Control	Risk	Recommended Control Measure
		HAZARD IDENTIFICATION (19 JUNE 2013)		**RISK ANALYSIS**		**RISK CONTROL**
1	Melati College	Sharp corner	Overturn	Warning signage, road stud and double white lines	15	Maintenance of safety control measure and increase road user's awareness. Install a mirror so that the user may see the other vehicles that come up.
2		Insufficient width of road	Narrow passage. Overturn	Road stud with double white lines	20	Clear white lines on the road. Install warning signage.
3.		Steep road	Vehicle loses control. Vehicle travels fast.	Blind Spot Convex Mirror	20	Increase road safety awareness Install warning signage. Construct bumper and slow line speed.
				TOTAL (Melati College)	**55**	
4.	Delima College Junction	High vehicle volume	Congestion	None	15	Safety awareness campaign. Carpooling
5.		Steep road	Vehicle loses control. Vehicle travels fast.	Bumper	12	Construct bumper and slow line speed.
6.		Too many junction	Vehicle congestion	None	12	Install blind spot convex mirror. Install a traffic light
				TOTAL (Delima College Junction)	**39**	
7.	Perindu College Junction	Steep road	Vehicle loses control	None	15	Construct bumper to slow vehicles. Install low speed lines.
8.		High volume of vehicle	Congestion	None	12	Road safety awareness. Carpooling
9.		Vision blocked (during crossing)	Knocked down by vehicles.	None	8	Install blind spot convex mirror.
				TOTAL (Perindu College Junction)	**35**	
10.	Seroja College Junction	Insufficient width of road	Narrow passage	None	6	Signage. Clear white lines on the road.
11.		High volume of vehicle	Congestion	Bus provided	9	Increase student's awareness to encourage commuting by buses. Carpooling
12.		Transport buses parked abruptly	Congestion	None	4	Provide designated place for buses. Allocate/enforce specific time period for parking (allow parking for few minutes).
				TOTAL (Seroja College Junction)	**19**	

Results from Average Daily Traffic calculations prooved that there exists elements traffic congestions as a compounding factor to cause accidents in hotspot area Melati College and delima College junction.

TABLE VII
ADT FOR HIGH RISK HOTSPOTS

Hotspot	**MELATI COLLEGE**						**DELIMA COLLEGE JUNCTION**					
Vehicle	Motor-cycle	Car	Van	Lorry	Bus	**ADT**	Motor-cycle	Car	Van	Lorry	Bus	**ADT**
Peak (12.00 – 1.00 p.m.)	650	395	7	13	22	0.82	518	422	1	2	6	0.70
Off peak (3.00 – 4.00 p.m.)	178	131	3	0	3	0.23	157	147	2	1	3	0.24

Previous study had found that the road conditions contributed to 5% of road accidents (Conche & Tight, 2006). It is not easy to identify the unique factor of a single risk factor that controlling perfectly for all other risk that tend to go together with the risk factor of interest. Several studies have shown that roadway design is associated with accident rate (Ben-Bassat & Shinar, 2011).

Based on the HiRARC study, it was found that poor road conditions in UiTM Shah Alam are one of the main factors for accidents. Road design becomes one of the most concerned issues which affect the behavior of a driver and perceived safety. Another point that causes the high risk is the sharp cornering that has been identified as accident prone area as high number was reported in that location. From the GIS map sharp corner was identified at Melati College Road and is considered as one of contributor to the road accident. Driving at

high speed and not realizing the severity of a turn can cause drivers to lose control their cars, leave the road and slam into a barrier or tree. Besides that, it also may cause high risk to the pedestrian who use the road.

The contour of the road itself also contributes to the accident from happen. There is certain location of the road in UiTM Shah Alam which is hilly and this condition may cause accidents. Vehicles are difficult to control when it goes downhill as speed increases. In UiTM Shah Alam there are a lot of junctions. With high number of populations in UiTM Shah Alam it is not easy for people to dross the junction.

Unskilled driving and poor awareness of motorcyclist also causes accidents (Li et al., 2008). Vehicle system failures is also one of the risk factor that contributes to increasing road accident (Christensen & Elvik, 2007). Condition of vehicles particularly the tires and brakes increases the risk of accidents (Clarke, Ward, Bartle, & Truman, 2010). High volumes of traffic also contribute to the cause of accident due to the road congestions (Kayhanian et al., 2003).

CONCLUSION

This study will provides new information and serves as a baseline reference for future studies in road safety in UiTM Shah Alam especially for institution authority of UiTM Shah Alam itself. Based on the results, it can be stated that even though the pattern of road accidents in UiTM Shah Alam has been decreasing but from the hotspot that have been identified by using geographical information system shows the increasing number of accidents per year. The authority need to take an attention into this matter by improve the counter measure and proper traffic management should be considered during planning to ensure road safety and thus minimizing road accidents in UiTM Shah Alam.

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