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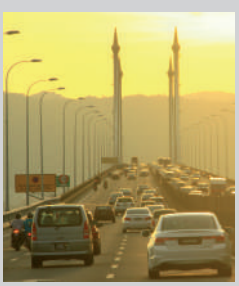

## Research Report

# Vehicle Kilometres Travelled (VKT) Study of Goods Vehicles: Pusat Pemeriksaan Kenderaan Berkomputer Sendirian Berhad (PUSPAKOM)


Nurulhuda Jamaluddin
Ho Jen Sim
Nusayba Megat Johari
Hawa Mohamed Jamil
Azzuhana Roslan
Sharifah Allyana Syed Mohamed Rahim



MIROS
MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
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| ix. | Siti Nazura Mohd Salleh | - | MIROS |
| x. | Ahmad Sharil Mohd Yusof | - | MIROS |
| xi. | Noraida Jamaludin | - | MIROS |

# Abstract

This is a report of a study of the Vehicle Kilometres Travelled (VKT) for goods vehicles. From a previous study by MIROS data collected by the postcard method for commercial vehicles resulted in a low response rate because the vehicles is owned by companies. Therefore in the present study, approaching drivers directly led to more accurate data collected more quickly and effectively.

The purpose of the study was to collect the VKT for goods vehicles and improve the quality of information about exposure data. VKT is considered the best indicator to measure the level of road safety and is crucial for road safety stakeholders to address road fatality issues. In this study, the type of goods vehicles, age of vehicles and frequency of service were selected as variables of VKT data to be studied.

Respondents were selected from two (2) of PUSPAKOM's branch offices namely PUSPAKOM at Wangsa Maju and at Gopeng to represent the Central and Northern Regions respectively. 463 respondents were involved in this survey exceeding the valid sample size of 350. The comparison between the two (2) PUSPAKOM branches were made, although both showed a similar trend for VKTs.

Findings were that the VKT kilometres per day for goods vehicles is close to 200 kilometres and the Average Annual VKT (AAKT) is approximately 70,000 kilometres. The total VKT calculation revealed that PUSPAKOM Wangsa Maju had higher total VKT than PUSPAKOM Gopeng and this difference was reflected in the crash records of each branch, thus supporting the theory that the more we travel the higher the probability of being in a crash.

# 1. Introduction

Goods vehicles, which consist of rigid and articulated vehicles as well as light commercial vehicles like vans, are commonly used for transporting various types of goods for the commercial sector in Malaysia. Crash data from the Royal Malaysian Police (also know by its Bahasa Melayu acronym PDRM) showed that in 2012, 6,917 people are killed in road crashes in Malaysia of which approximately 1,000 were as a result of collisions with goods vehicles**.** The fact, that the number of fatal cases involving goods vehicles and light vehicles is worrying.

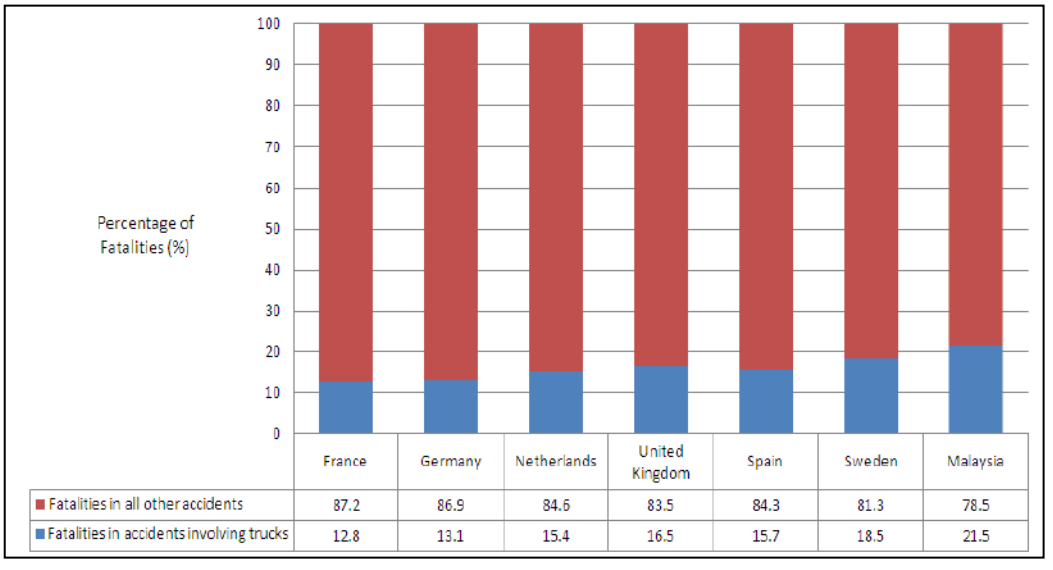
As shown in Table 1, motorcyclist fatalities in Malaysia are the main contributor to the high fatality numbers. They account for more than 58% of road deaths yearly.

**Table 1** Fatalities in Malaysia by type of road user (PDRM, 2011)

| Road users | Year and proportion | | | | | | % change over | |
|---|---|---|---|---|---|---|---|---|
| | 2006 | % | 2010 | % | 2011 | % | Previous year | 2006 |
| **Pedestrians** | 595 | 9.46 | 626 | 9.11 | 530 | 7.71 | -15.34 | -10.92 |
| **Motorcyclists + pilion rider** | 3693 | 58.74 | 4036 | 58.73 | 4173 | 60.68 | 3.39 | 13.00 |
| **Cyclists** | 228 | 3.63 | 192 | 2.79 | 172 | 2.50 | -10.42 | -24.56 |
| **Car drivers** | 677 | 10.77 | 1421 | 20.68 | 1389 | 20.20 | -2.25 | 105.17 |
| **Bus drivers** | 11 | 0.17 | 77 | 1.12 | 29 | 0.42 | -62.34 | 163.64 |
| **Drivers of goods vehicles** | 142 | 2.26 | 202 | 2.94 | 247 | 3.59 | 22.28 | 73.94 |
| **Passengers** | 794 | 12.63 | 152 | 2.21 | 163 | 2.37 | 7.24 | -79.47 |
| **Others** | 147 | 2.34 | 166 | 2.42 | 174 | 2.53 | 4.82 | 18.37 |
| **Totals** | 6287 | 100 | 6872 | 100 | 6877 | 100 | 0.07 | 9.38 |

Besides motorcyclists drivers of goods vehicles were the only other road users (excluding "Others") where there was an increase in the overall number of fatalities from the year 2006 to 2011. This hints at there being an increase in crashes involving good vehicles. This is relevant because overseas statistics show that in crashes involving goods vehicles, it is road users other than the drivers and other occupants of goods vehicles who are most at risk where 87% of fatalities for the rigid type and 78% of fatalities for the articulated type goods vehicles crashes were other road users (Rechnitzer et al., 1991).

Figure 1 indicates the relative importance of goods vehicles crashes with respect to road deaths In the statistics in Figure 1, truck crashes is taken as a proxy for crashes involving goods vehicles. A comparison between the number of fatalities from goods vehicle crashes and fatalities from all other crashes reveals a similar distribution in seven (7) countries, ranging from 12.8% to 21.5% of fatalities due to goods vehicles crashes, with Malaysia having the highest percentage (21.5%). The period of observation for Malaysia is from 2006 to 2008 while other countries are from 1995 to 2001.




| | France | Germany | Netherlands | United Kingdom | Spain | Sweden | Malaysia |
|---|---|---|---|---|---|---|---|
| Fatalities in all other accidents | 87.2 | 86.9 | 84.6 | 83.5 | 84.3 | 81.3 | 78.5 |
| Fatalities in accidents involving trucks | 12.8 | 13.1 | 15.4 | 16.5 | 15.7 | 18.5 | 21.5 |

**Figure 1** Average number of fatalities in truck accidents compared with the average number of fatalities in all other road accidents (Anderson et al., 2006)

## 1.1 Aim and Objectives of the Study

Since 2007, the Malaysian Institute Road Safety Research (MIROS) has been trying to determine what would be the most effective method to estimate Vehicle Kilometres Travelled (VKT) in Malaysia. Estimating VKT is important as studies have found that the greater the distance a driver travels, the higher the chance of him being involved in a crash (Laapotti et al., 2001).

However, there are limitations in the readily available exposure data. Exposure data such as the kilometre travel and trip per day is important to measure level of risk on the road. The present study for VKT produces a limited information from the survey, only measures the motorcar and motorcycle. Although, there are exposure data from some of commercial company, but others exposure data, such as trip purpose, time, income, Origin Destination is confidential. The lack of exposure data, affects the quality of decision and policy making.

The aim of this study is to determine the significant of Vehicle Kilometer Travelled (VKT) for goods vehicle and gether the information about the exposure among the goods vehicle drivers.

In order to archieve the aim, the objectives of this study are as follows:

i. To determine VKT of goods vehicles in relation to vehicle characteristic such as type of vehicle, age of vehicle and frequency of service of the vehicle.
ii. To define the more effective method to collect the exposure data.

In doing so, it would also improve the quality of information about the exposure data for goods vehicles.

## 1.2 Scope and Limitations of the Study

The study was conducted only of goods vehicles which were inspected at PUSPAKOM and although PUSPAKOM is the only vehicle inspection company appointed to do all mandatory inspections for commercial and private vehicles in Malaysia, the data was collected from only two PUSPAKOM branches; one covering certain areas in the Northern Region and the other covering areas in the Central Region of Peninsular Malaysia.

# 2. Literature Review

The focus of the literature review is studies and reports on road exposure and VKT and to determine the variables for road safety.

## 2.1 Road Exposure

Exposure refers to the amount of travel during which a crash may occur (Al-haji, 2005 & Harrison et al., 2005). The theory is that the more we travel the higher the probability of a crash occuring. Harrison found that there was a relationship between exposure and crash risk (crash/km). For example, those who are involved in a crash, but have had little exposure (travel), are at a higher crash risk (crash/km) than those not involved in a crash but had travelled more i.e. had higher exposure and will have the higher probability to involved in a crash. Al Haji (cited in Rumar, 1999) described three basic dimensions of road exposure namely *exposure* (E), *accident risk* (A/E), and *injury risk* (I/A) that influence the size of the road safety problem (Figure 2).

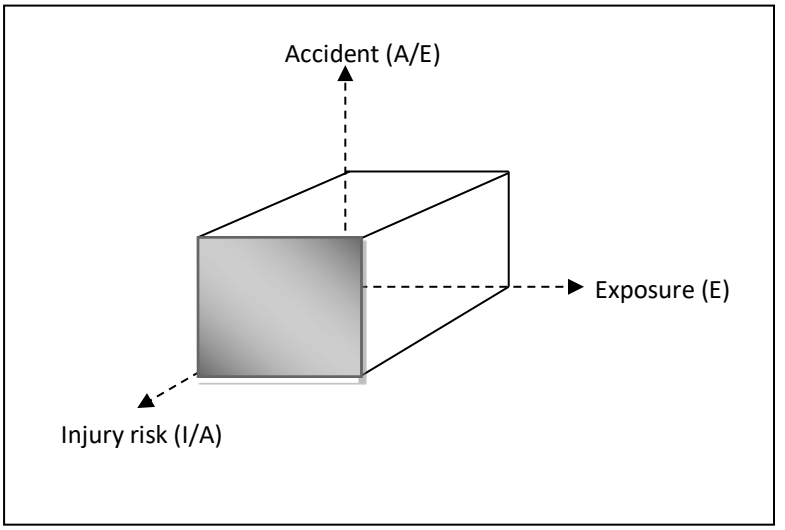



**Figure 2** Volume represents the total number of persons killed or injured in road traffic (Rumar, 1999)

Based on Anderson et al. (2008) study in the United States, a onepercentage point increase in light truck share of the vehicle fleets increases annual traffic fatalities by approximately 143 deaths or 0.34% per year. Of this, an increase of four-fifths accrues to the occupants of other vehicles and pedestrians. It is posited, that light trucks are a significant hazard to other users. In Malaysia, the average distance travelled by a goods vehicle is three times higher than a private vehicle (Nurulhuda et al., 2010). In 2012, 459 fatal accidents involved trucks. Although crashes involving goods vehicles are rare in Malaysia, it has an impact on their exposure to risk to other types of vehicles on the road.

## 2.2 Vehicle Kilometres Travelled (VKT)

VKT is essential for determining accident exposure and accident rates for vehicles (Patricia, 1991 & Mohd Fauzi, 2004). Chipman et al. (1992) highlighted that the number of crashes increases with the growth of the annual VKT (exposure). Laapotti et al. (2001)

underscored that drivers with high mileage tend to be involved in more crashes compared to drivers with low mileage.

VKT is also widely used in transport planning and as an international proxy for the pressures on road transport systems that impact the environment and human health. In addition, VKT contributes vital information for infrastructure investment decisions and road safety policies (Bureau of Infrastructure, Transport and Regional Economics, 2011).

In Malaysia, VKT can describe true exposure data of vehicle travel on Malaysian roads (Mohd Fauzi, 2004). Radin Umar (2005), determine new safety targets based on deaths per billion kilometres travelled to describe the actual involvement in risky situations. However, measuring the distance travelled and the potential risks is quite difficult (Chipman, 1982; Roess, 2004 & Huntchinson, 2009). The factors influencing exposure to traffic are socioeconomic, demographic, type of travel, travel route and length of trip (Al Haji, 2005).

## 2.3 Variables of VKT

Many VKT studies have covered the differential exposures through primarily demographic and socioeconomic groups. Essentially, the VKT variables that a researcher should be attentive to include the type of the goods vehicle, age of vehicle, and frequency of service of the vehicle.

### 2.3.1 Types of Goods Vehicles

The types of goods vehicles is an important variable in this study because the heavier the vehicle and the greater the distance it travels poses increased risk to smaller vehicles on the road.

Knight et al. in his report for the United Kingdom's (UK) Transport Research Laboratory recounted that the UK's domestic freight grew by 13% between 1995 to 2005 and that

the road was the dominant mode of transport, accounting for 63% of the total domestic freight. There were three (3) types og good vehicles namely, rigid, articulated and drawbars.

The Australian Bureau of Statistics designed a survey to provide a measure of total distance travelled and tone-kilometre for each state of registration by type of vehicle. The Survey of Motor Vehicle Use 2013 reported that 82.9% were light commercial vehicles, 14.2% rigid trucks and 2.8% were articulated trucks. The Bureau also reported that freight carrying vehicles accounted for 26% of the total number of travelling vehicles in 2012, specifically, light commercial vehicles (43,716 million kilometres travelled ), followed by rigid trucks (9,258 million kilometres travelled) and articulated trucks (7,382 million kilometres travelled)(ABS, 2013).

Vehicle types are defined according to classification; where is made to maximum mass. There a lot of type of goods vehicle in Malaysia by usage code. It is classified by the Road Transport Department Malaysia as the authority who coordinate all aspects of land transportation. However, the large number of registered goods vehicles in Malaysia are rigid Decon, rigid, prime mover and off road vehicle (JPJ, 2013).

The literature indicates that each country has various classifications of the type of goods vehicles. In the present study, vehicle type is classified by weight such as small lorry with goods laden weight (GVM) below than 2500 kilogrammes, rigid lorry with goods laden weight (GVM) above than 2500 kilogrammes, prime movers and others (PDRM, 2011).

### 2.3.2 Age of Vehicles

The National Highway Traffic Safety Adminitation of the United States reported in 2013 that the newer a vehicle,and the more recent the model year of a vehicle, both independently depict smaller percentages of drivers being fatally injured in crashes. Figure 3 shows, after adjusting for many other crash factors, that a driver in a vehicle model year of 1985 – 1992 was 1.6 times more likely to be fatality injured, compared to those where the vehicle model years were between 2008 – 2012.

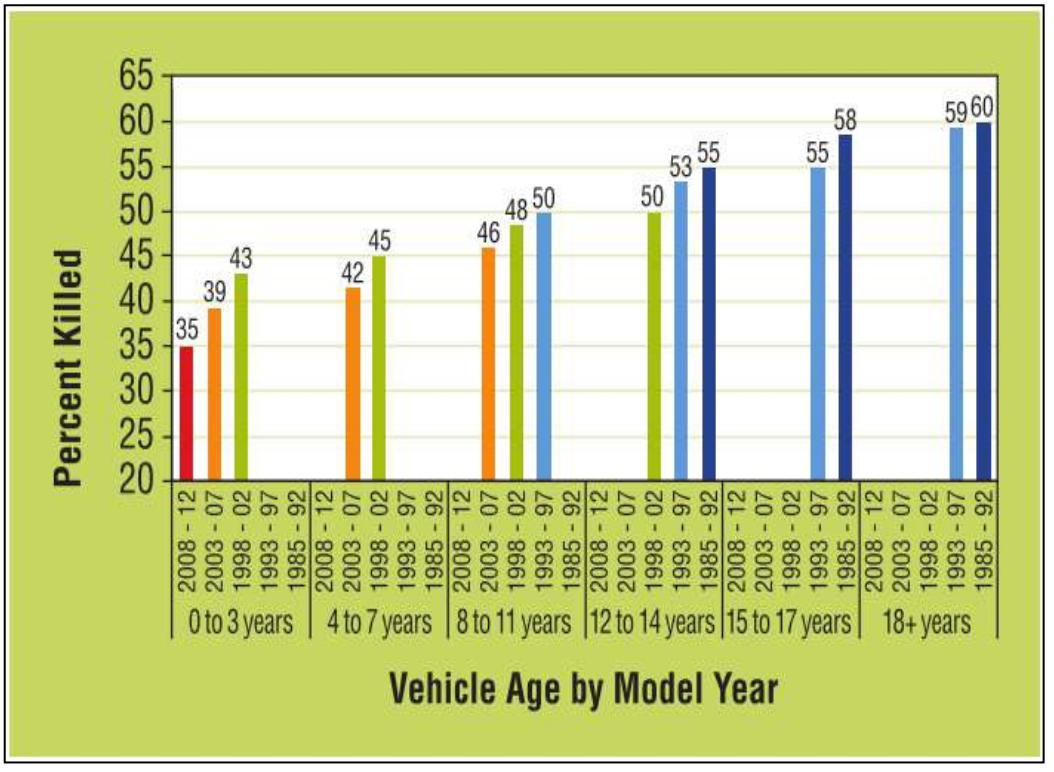



**Figure 3** Percentage killed by vehicle age and model year. (FARS 2005 – 2011) [Reproduced from the NHTSA (2013) report]

Keall et al. (2012) in a study in New Zealand and the Australian state of Victoria, examined the vehicle road worthiness inspection. That study indicated that periodic inspection regimes have used the increase in risk for older vehicles as a measure of increased crash risk due to mechanical defects. Moreover, Keall et al., showed that the higher risk for older vehicles occurs even for vehicles immediately after they are certified as roadworthy, which suggests that other factors, likely to be related to the way the vehicle is used and by whom, lead to the increased crash risk. This increase in risk with each added year of vehicle age was estimated to be 7.8% with a 95% confidence interval of 6% to 9.7%.

Fukuda et al. (2013) studied the estimation of VKT and fuel consumption in Khon Kaen city, Thailand. In his study, VKT by vehicle types were measured by applying the method based on odometer records and survey interviews survey. He found that the annual VKT for vans and pickup trucks had high negative relation with vehicle age.

Most of the research on vehicle travel do not include the age of the vehicle as the main variable. However, it is important to provide such information to traffic safety authorities to assist them when making new policies regarding goods vehicles.

### 2.3.3 Frequency of Service

Service of goods vehicles refers to routine maintenance, usually determined in scope and frequency by the vehicle's usage (VOSA, 2009). In Malaysia, periodic inspection is carried out on items covered by the PUSPAKOM for the mandatory annual test that may affect roadworthiness.

Usually, the requirement for service of a vehicle depands on the distance that the vehicle has travelled. The greater the distance (measured in kilometres), the more frequent should the service be. As such, this study used the frequency of service as a variable to calculate the VKT of the vehicles studied kilometres.

# 3. Methodology

The method of study is designed based on the objectives of the study. Face to face interview survey was conducted among the goods vehicle driver to obtain the VKT and the characteristic of vehicle.

Figure 4 shows the flow chart of study approach on the Vehicle Kilometer Travelled for goods vehicle. The location was permitted by the PUSPAKOM and the interview survey was collected for three (3) days each location from 8.00 am to 5.00 pm.

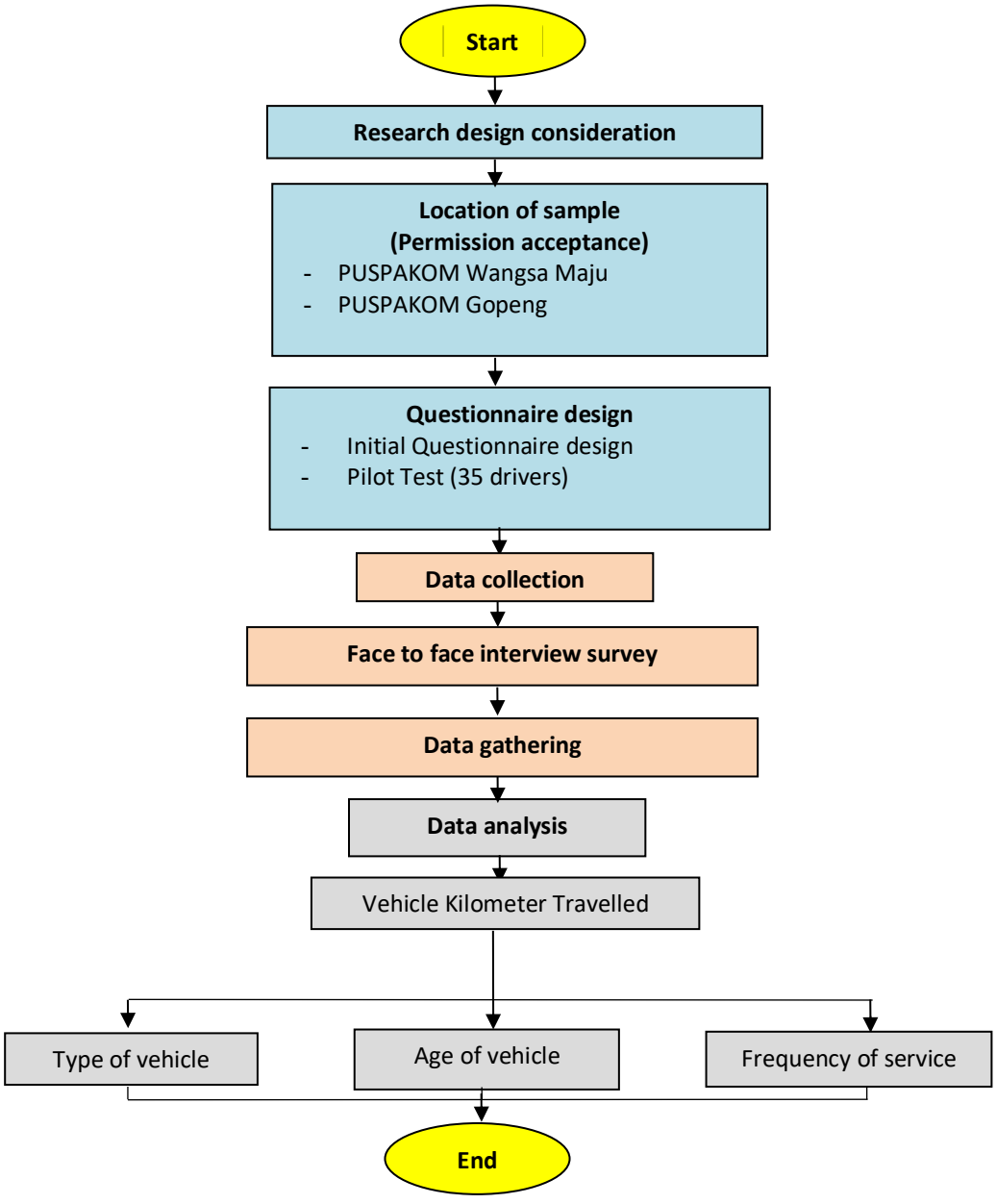



**Figure 4** Flow chart of study approach on Vehicle Kilometer Travelled for goods vehicle

## 3.1 Research Design Consideration

There are two-stage process is required to produce a good questionnaire; initial questionnaire design, pilot test and simplified postcard design. Postcard design should be able to deliver clear and simple questions for respondents to complete. The information obtained from the secondary data can reduce the number of question incorporated into the questionnaire survey.

### 3.1.1 Location of Samples

As mentioned, PUSPAKOM is a one stop inspection center for all vehicles on the road. Through its network of 71 branches nationwide and mobile units, it performs more than 3 million inspections with more than 1.5 million customers annually. Every 6 months, goods vehicles must to go to PUSPAKOM for inspection as required by Rule 4 (b) of the the Motor Vehicles (Periodic Inspection, Equipment and Inspection Standard) Rules 1995 enacted pursuant to the Road Transport Act 1987. Given this mandatory inspection requirement for all commercial vehicles, PUSPAKOM was the ideal location to obtain samples for this study as it provided easy access to all categories of goods vehicles in Malaysia.

The PUSPAKOM branch in the suburb of Wangsa Maju in Kuala Lumpur and the PUSPAKOM branch at Gopeng in the state of Perak were chosen for this pilot study. The basis of selection was that both branches hadhigher rates of goods vehicle inspections and each branch was the main inspection centers for the Central and Northern areas respectively. PUSPAKOM Wangsa Maju has 70 staff and undertook inspection of 800 vehicles per day. PUSPAKOM Gopeng has 38 staff and inspected 450 vehicles per day.


**Figure 5** PUSPAKOM Wangsa Maju


**Figure 6** PUSPAKOM Gopeng

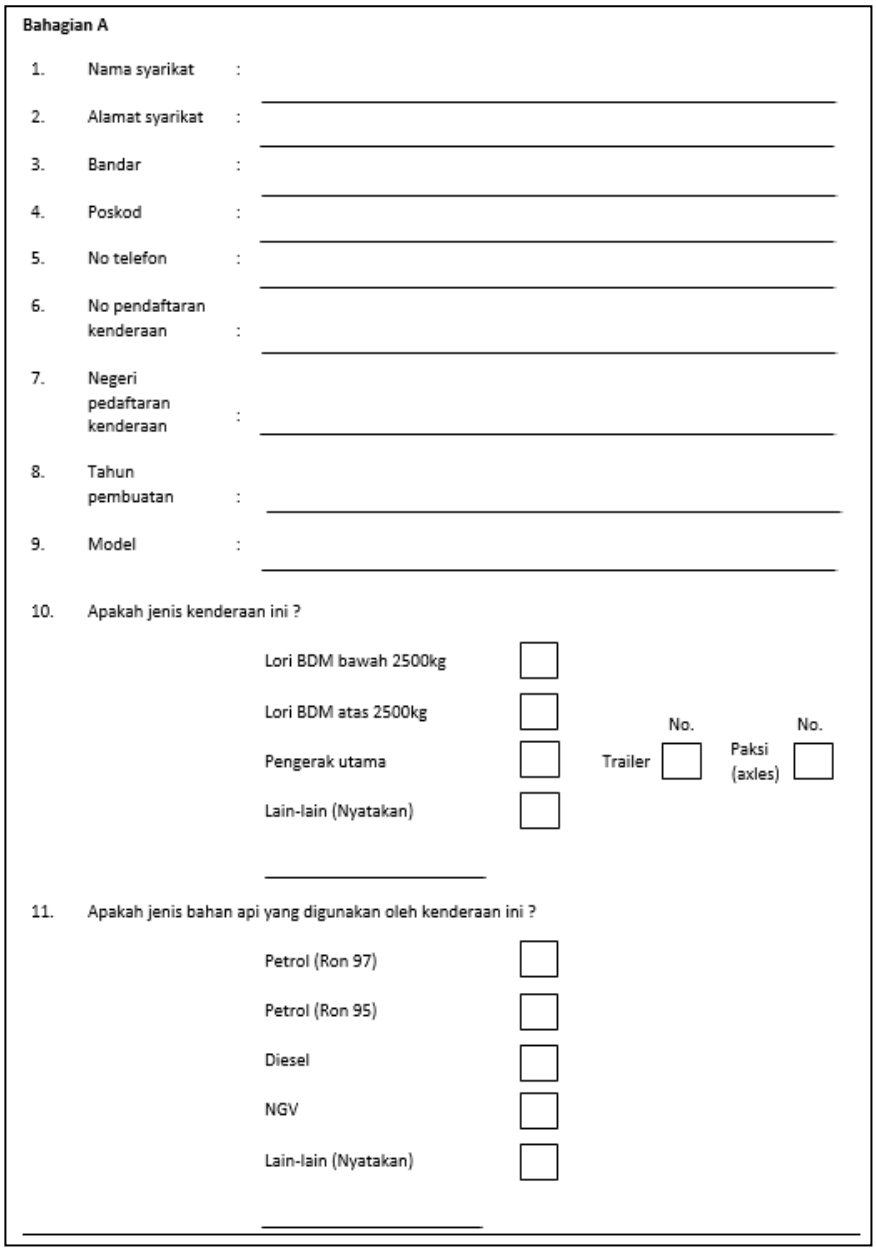
### 3.1.2 Questionnaire Design

The questionnaire design stage should be done because a questionnaire is an important tool in carrying out interviews. The questionnaire design should be able to deliver clear and simple questions for respondents to complete. This questionnaire (in Bahasa Melayu) is divided into the four sections.

On the first page, the title of the survey was at the top of the questionnaire. Immediately below it was an explanation of the purpose of the survey. The respondent's contact details such as name, mobile phone number, office phone number and date of this questionnaire were filled in by the respondent.

Section A of the questionnaire requests information on the vehicle's specifications and about the company that owns the vehicle to enable more analysis of the company future research. From this section, the researcher would also be able to identify the location of the origin of the vehicle's travel to its destination.

The vehicle's information such as vehicle registration number, state registration, year of manufacture, model and type of goods vehicle are the basic data to enable researchers to understand the circumstances of the goods vehicle driven by the respondent. Figure 7 shows the example of the question for the section A.



**Bahagian A**

1. Nama syarikat :
2. Alamat syarikat :
3. Bandar :
4. Poskod :
5. No telefon :
6. No pendaftaran kenderaan :
7. Negeri pedaftaran kenderaan :
8. Tahun pembuatan :
9. Model :
10. Apakah jenis kenderaan ini ?

- Lori BDM bawah 2500kg ☐
- Lori BDM atas 2500kg ☐
- Pengerak utama ☐
- Lain-lain (Nyatakan) ☐

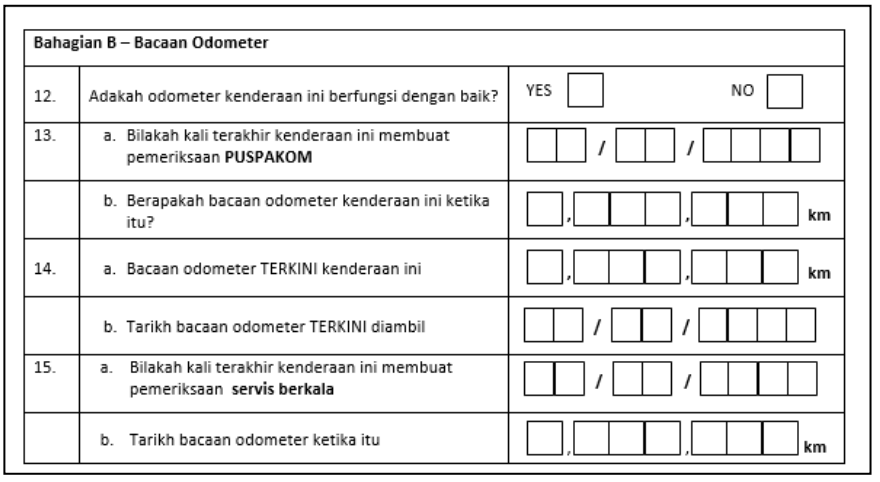
Trailer ☐ No. ☐ Paksi (axles) ☐ No. ☐

11. Apakah jenis bahan api yang digunakan oleh kenderaan ini ?

- Petrol (Ron 97) ☐
- Petrol (Ron 95) ☐
- Diesel ☐
- NGV ☐
- Lain-lain (Nyatakan) ☐

**Figure 7** Example of Section A

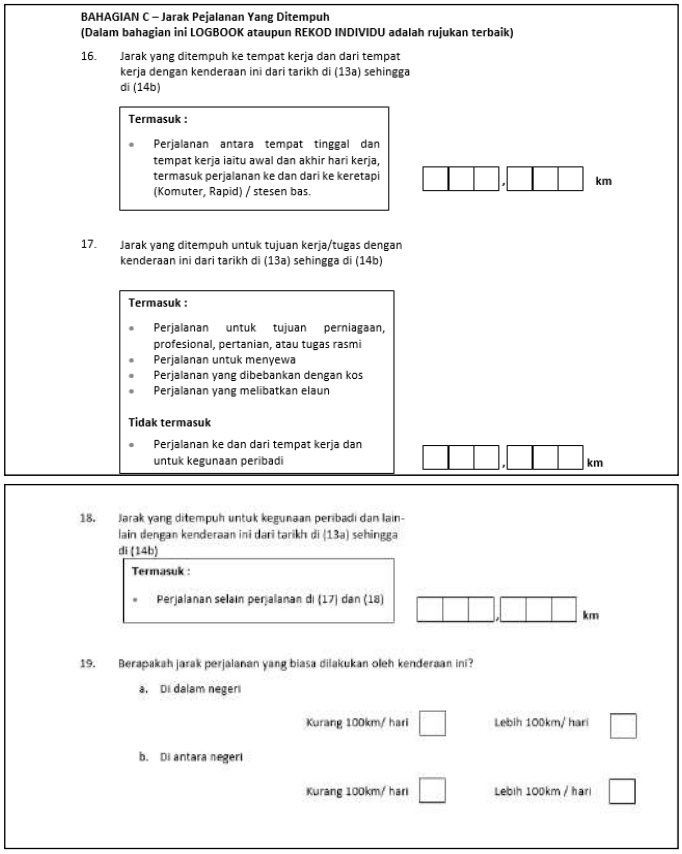
The aim of Section B was to elicit information about the vehicles' odometer readings in various situations. The odometer reading would be used to determine the distance the vehicle would have travelled by a specific time in order to analyse the vehicle's exposure The question about the servicing of vehicles was to identify the frequency of vehicle maintenance, which is related to vehicle safety. Figure 8 shows the example of the question for the section B.



| Bahagian B – Bacaan Odometer | | |
|---|---|---|
| 12. | Adakah odometer kenderaan ini berfungsi dengan baik? | YES ☐ NO ☐ |
| 13. | a. Bilakah kali terakhir kenderaan ini membuat pemeriksaan **PUSPAKOM** | ☐☐ / ☐☐ / ☐☐☐☐ |
| | b. Berapakah bacaan odometer kenderaan ini ketika itu? | ☐,☐☐☐,☐☐☐ **km** |
| 14. | a. Bacaan odometer TERKINI kenderaan ini | ☐,☐☐☐,☐☐☐ **km** |
| | b. Tarikh bacaan odometer TERKINI diambil | ☐☐ / ☐☐ / ☐☐☐☐ |
| 15. | a. Bilakah kali terakhir kenderaan ini membuat pemeriksaan **servis berkala** | ☐☐ / ☐☐ / ☐☐☐☐ |
| | b. Tarikh bacaan odometer ketika itu | ☐,☐☐☐,☐☐☐ **km** |

**Figure 8** Example of Section B

The questions in Section C sought information on the distance travelled by a vehicle for work and personal use between its last and its present inspections by PUSPAKOM in order to facilitate analysisof the distances travelled by purpose of trips. The reason for requesting respondents' estimations of whether the distance that they travelled within a state and between states was more or was less than 100 kilometres per day wasto cross check and verify the respondents' answers to Section B about their odometer readings. Analysis of data from Section C, would also reveal findings on the details of distances travelled by vehicles in Malaysia. Figure 9 shows the example of the question for the section C.



**BAHAGIAN C – Jarak Pejalanan Yang Ditempuh**
**(Dalam bahagian ini LOGBOOK ataupun REKOD INDIVIDU adalah rujukan terbaik)**

16. Jarak yang ditempuh ke tempat kerja dan dari tempat kerja dengan kenderaan ini dari tarikh di (13a) sehingga di (14b)

**Termasuk :**
- Perjalanan antara tempat tinggal dan tempat kerja iaitu awal dan akhir hari kerja, termasuk perjalanan ke dan dari ke keretapi (Komuter, Rapid) / stesen bas.

km

17. Jarak yang ditempuh untuk tujuan kerja/tugas dengan kenderaan ini dari tarikh di (13a) sehingga di (14b)

**Termasuk :**
- Perjalanan untuk tujuan perniagaan, profesional, pertanian, atau tugas rasmi
- Perjalanan untuk menyewa
- Perjalanan yang dibebankan dengan kos
- Perjalanan yang melibatkan elaun

**Tidak termasuk**
- Perjalanan ke dan dari tempat kerja dan untuk kegunaan peribadi

km

18. Jarak yang ditempuh untuk kegunaan peribadi dan lain-lain dengan kenderaan ini dari tarikh di (13a) sehingga di (14b)

**Termasuk :**
- Perjalanan selain perjalanan di (17) dan (18)

km

19. Berapakah jarak perjalanan yang biasa dilakukan oleh kenderaan ini?

a. Di dalam negeri

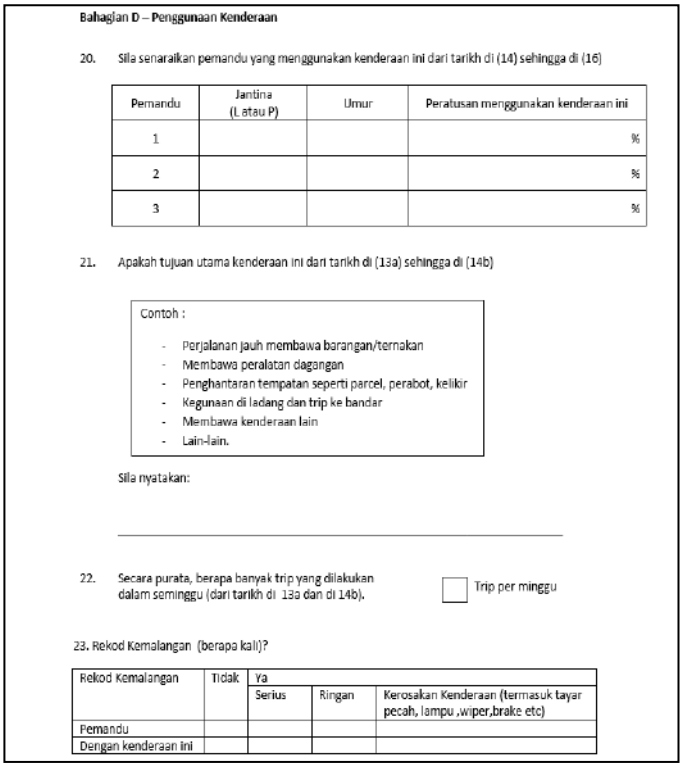
Kurang 100km/ hari ☐ Lebih 100km/ hari ☐

b. Di antara negeri

Kurang 100km/ hari ☐ Lebih 100km / hari ☐

**Figure 9** Example of Section C

Section D was designed to get information on the usage of the vehicles such as the number of drivers and passengers who used the vehicles during specific periods, the purpose for which the vehicles were used and the vehicles' crash histories (if any). Goods carried by these vehicles should be connected with the purpose of trip and destination. The history of crashes by drivers or the vehicles were recorded to analyse the risk of exposure. Figure 10 shows the example of the question for the section D. Figure 10 shows the example of the question for the section C.



**Bahagian D – Penggunaan Kenderaan**

20. Sila senaraikan pemandu yang menggunakan kenderaan ini dari tarikh di (14) sehingga di (16)

| Pemandu | Jantina (L atau P) | Umur | Peratusan menggunakan kenderaan ini |
|---|---|---|---|
| 1 | | | % |
| 2 | | | % |
| 3 | | | % |

21. Apakah tujuan utama kenderaan ini dari tarikh di (13a) sehingga di (14b)

Contoh :

- Perjalanan jauh membawa barangan/ternakan
- Membawa peralatan dagangan
- Penghantaran tempatan seperti parcel, perabot, kelikir
- Kegunaan di ladang dan trip ke bandar
- Membawa kenderaan lain
- Lain-lain.

Sila nyatakan:

22. Secara purata, berapa banyak trip yang dilakukan dalam seminggu (dari tarikh di 13a dan di 14b). ☐ Trip per minggu

23. Rekod Kemalangan (berapa kali)?

| Rekod Kemalangan | Tidak | Ya | | |
|---|---|---|---|---|
| | | Serius | Ringan | Kerosakan Kenderaan (termasuk tayar pecah, lampu ,wiper,brake etc) |
| Pemandu | | | | |
| Dengan kenderaan ini | | | | |

**Figure 10** Example of Section D

The questions in the questionnaire were pilot tested with a thirty five of lorry drivers to access the drivers' understanding of the questions that has been formed. The pilot test results revealed that no major changes to the questionnaire were necessary.

## 3.2 Data Collection

This section describes the face to face interview data collection of the questionnaire which were compiled and analysed using SPSS (Statistical Package for Social Sciences). The calculation of the VKT and the crash risk for goods vehicles were reviewed.

### 3.2.1 Face to Face Interviews

Data was collected by structured face to face interviews using a questionnaire designed by MIROS.

Pursuant to permissions granted by PUSPAKOM and consents of the respondents, data was collected from PUSPAKOM at Gopeng from 27 August 2013 through 29 August 2013, and from PUSPAKOM at Wangsa Maju from 22 October 2013 through 24 October 2013 from 9.00 am to 5.00 pm daily.


**Figure 11** Research staff interviewing drivers of goods vehicles

### 3.2.2 Data Gathering

After the collection the data from the location (PUSPAKOM), were stored (keyed in) in the Statistical Package for Social Sciences Software (SPSS) for further analysis.

## 3.3 Data Analysis

The data was collected and cleaned it was analysed by using SPSSS. The objective of the data analysis was to obtain calculation of VKT, develop a fatality index and further explore the evidence.

### 3.3.1 Calculation of VKT for Goods Vehicles

VKT for the sample vehicles was determined by taking the difference between two odometer readings, which spanned a period of time. The difference between the odometer readings was then multiplied by 365, then divided by the number of days that elapsed between the two odometer readings (Harrison, 2005).

The value of Kilometres Travelled (KT) can be calculated by Equation 1

$$KT = \frac{(A - B) \times (365)}{\text{days elapsed}} \qquad \text{(Equation 1)}$$

A = First odometer reading
B = Second odometer reading

VKT as an indicator can be used in the calculation of an accident index. The accident index per billion vehicle kilometres travelled for a particular year was calculated based on Equation 2.

$$I_f = \frac{As_y}{VKT}$$ (Equation 2)

$I_f$ = Accident Index
$As_y$ = Accident self record in particular year.
$VKT_y$= Vehicle Kilometres Travelled in a particular year.

"Accident self record" in the equation refers to the number of accidents which drivers and their vehicle (goods vehicle) were involved in, in a particular year, while the number of registered vehicles used is obtained for the same year.

# 4. Results and Discussion

This section discusses the results and findings of the study. This section is divided into two subsections; descriptive analysis and analysis of VKT. Through the discussion on the results of this study, insights on the significance of VKT for goods vehicles and potential data from PUSPAKOM inspection useful for extensive exposure data.

## 4.1 Descriptive Analysis

The descriptive analysis were based on respondents responses and their vehicle characteristics. The descriptive analysis was to describe the results accurately by presenting all values and relative frequencies.

### 4.1.1 Face to Face Interview Responses

Table 2 shows the number of respondents involved in this survey. The total sample size from both branches was 463. However, only 350 respondents completed the questionnaire, especially parts B and C.

**Table 2** Number of respondents involved in this survey

| Location | Wangsa Maju | Gopeng |
|---|---|---|
| Sample | 308 | 155 |
| Valid sample | 224 | 126 |
| % of valid sample | 72.7% | 81.3% |

Of the 350 respondents, 7% had been involved in an accident which appeared consistent with the PDRM's 2012 data, and 6.84% of goods vehicles were involved in a crash. It was approximately about 70, 378 goods vehicles (PDRM, 2012).

### 4.1.2 Types of Vehicles

As shown in Figure 12, the vast majority (84%) of goods vehicles at Puspakom Wangsa Maju were lorries whose GVM exceeded 2500 kilogrammes followed by 105 being lorries of GVM of less than 2500 kilogrammes. Prime movers accounted for only 2% and others were at 4%.

Similarly at PUSPAKOM Gopeng, 57% were lorries of GVM of more than 2500 kilogrammes and 22% were lorries with GVM of less than 2500 kilogrammes (Figure 13). This descriptive data was consistent with Road Transport Department data (2011), which indicated that most type of goods vehicles were rigid decon vehicles, followed by rigid vehicles and prime movers.

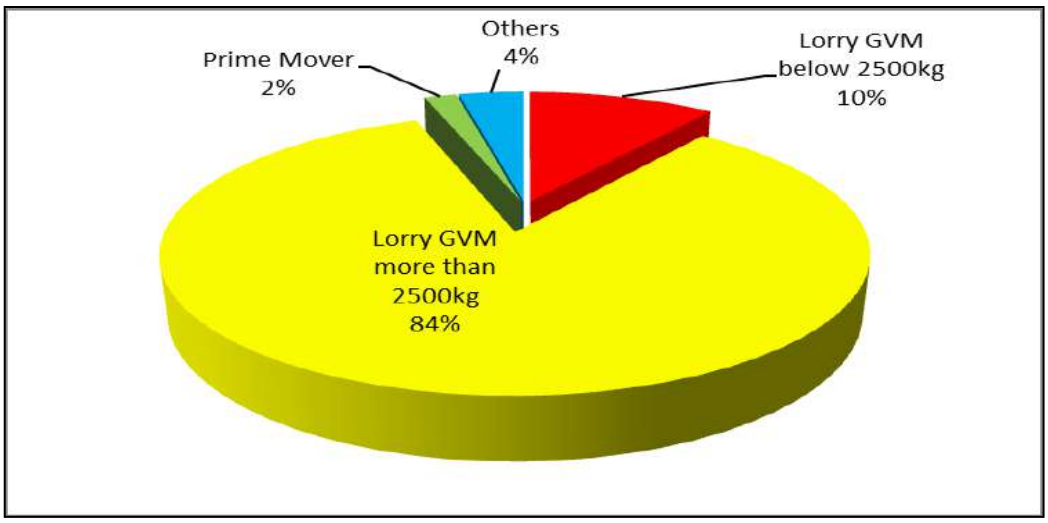



**Figure 12** Percentage of the goods vehicles of respondents in PUSPAKOM Wangsa Maju

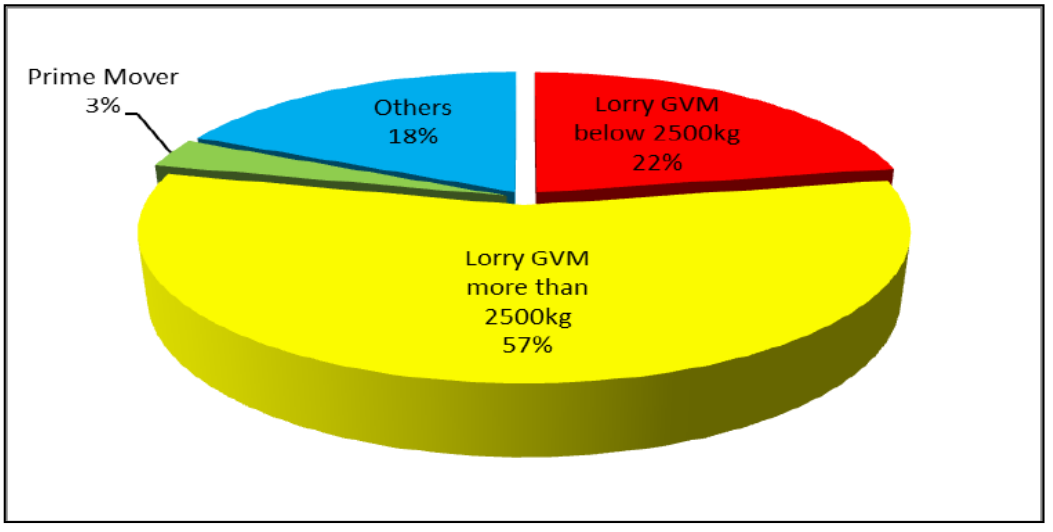



**Figure 13** Percentage of the goods vehicles of respondents in PUSPAKOM Gopeng

### 4.1.3 Age of Vehicles

Although the results show that there were more vehicles older than20 years at PUSPAKOM Gopeng compared withPUSPAKOM Wangsa, however, both branches had the same trend. As illustrated by Figures 14 and 15, there were far more vehicles aged between0-10 years old followed by vehicles 11-20 years old and then by vehicles which are aged more than 20 years old.

This finding is consistent with a report from the Road Transport Department (RTD) that there was an increase in the number of new registrations of goods vehicles from the year 1998 to 2013 (RTD, 2013). Economic growth also influences the turnover of goods vehicles. In 2009, Malaysia's Gross Development Product's annual growth rate decreased (Department of Statistics, 2009) and the RTD recorded that new registrations of goods vehicles had also decreasd that year.

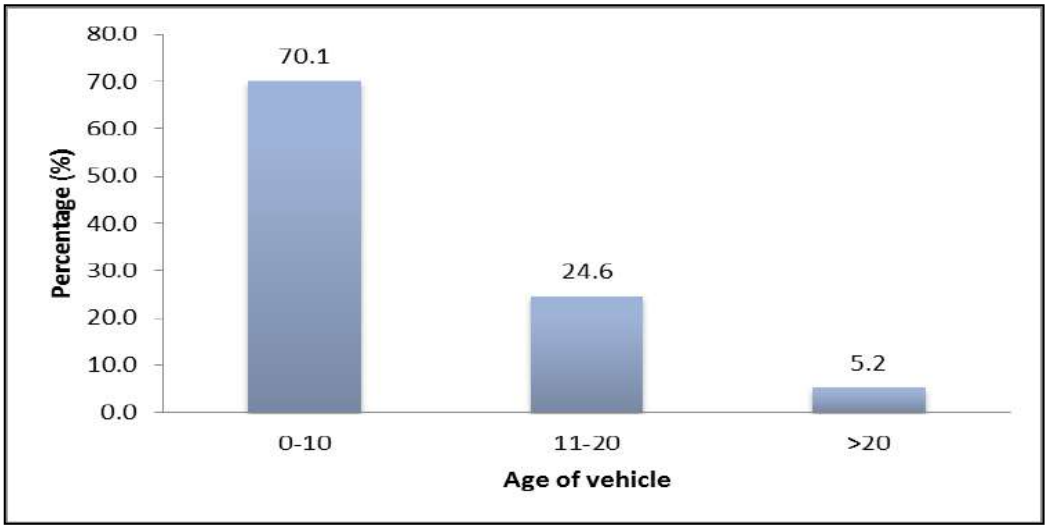



**Figure 14** Percentage of the age of goods vehicles in PUSPAKOM Wangsa Maju

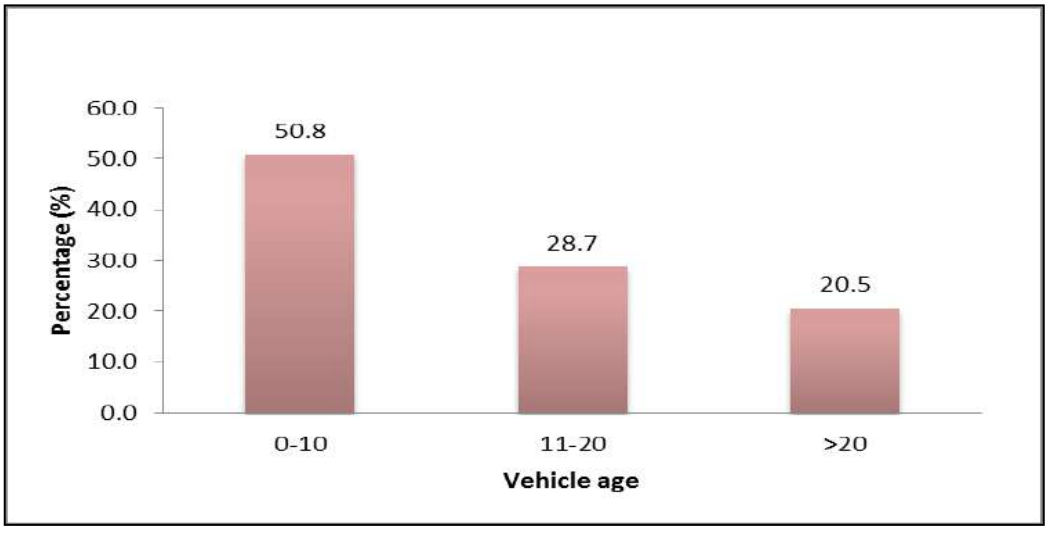



**Figure 15** Percentage of the age of goods vehicles in PUSPAKOM Gopeng

### 4.1.4 Frequency of Service

Figure 16 shows that 46.5% of respondents at PUSPAKOM Wangsa Maju, serviced their goods vehicles one to four times per year. About 31.2% serviced their goods vehicles from five to eight times per year followed by 22.3% servicing their goods vehicles more than eight times annually

The pattern of service of goods vehicles service between PUSPAKOM Wangsa Maju and PUSPAKOM Gopeng is similar. However, PUSPAKOM Wangsa Maju had a higher percentage of service of over 8 times per year (22.3%) than PUSPAKOM Gopeng (3%). It might be because most of the goods vehicles were from the Central Region and their mileage was higher than those from the Northern Region. Further disscussion about mileage has been included in VKT for goods vehicles (section 4.2).

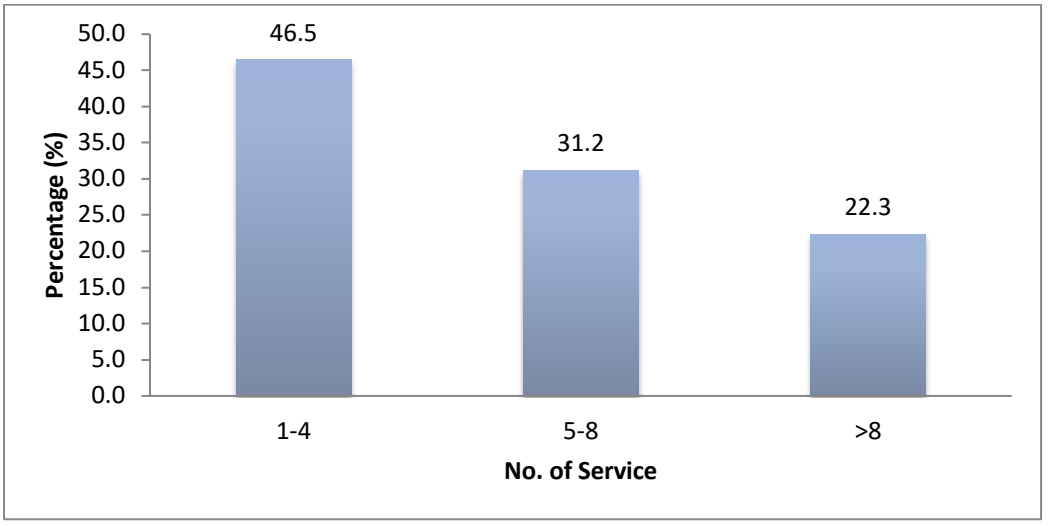



**Figure 16** Percentage of the goods vehicles ensures the service in PUSPAKOM Wangsa Maju

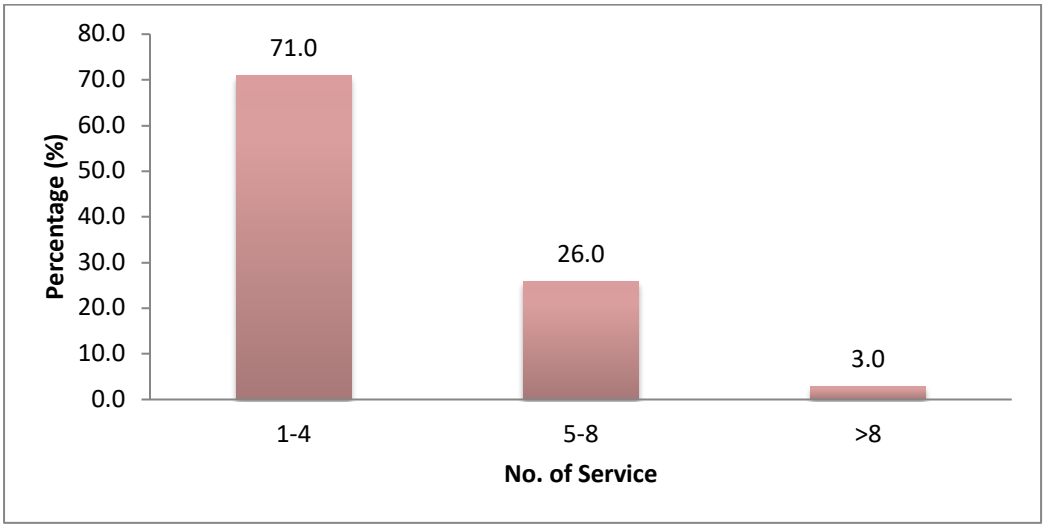



**Figure 17** Percentage of the goods vehicles ensures the service in PUSPAKOM Gopeng

## 4.2 VKT for Goods Vehicles

### 4.2.1 Types of Vehicles

As shown in Figure 18, at Puspakom Wangsa Maju prime movershad an average annual kilometres travelled (AAKT) of 78,140 kilometers, which is the highest compared to other vehicles. This was followed by lorries with GVM's of more than 2500 kilogrammes whose annual average was 62,380 kilometres traveled. As expected, most of the lorries which were less than 2500 kilogrammes were used for local trading purpose, and had fewer kilometres travelled with an annual average of 52,700 kilometres traveled. Others consisted of vans, which had an average of 32,890 kilometres.

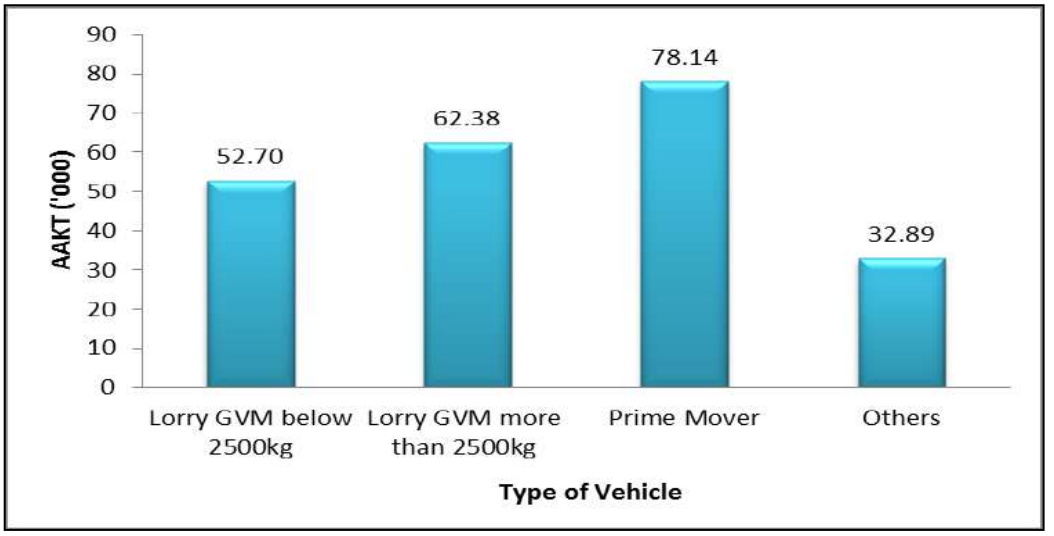



**Figure 18** Average annual VKT vs types of vehicles in PUSPAKOM Wangsa Maju

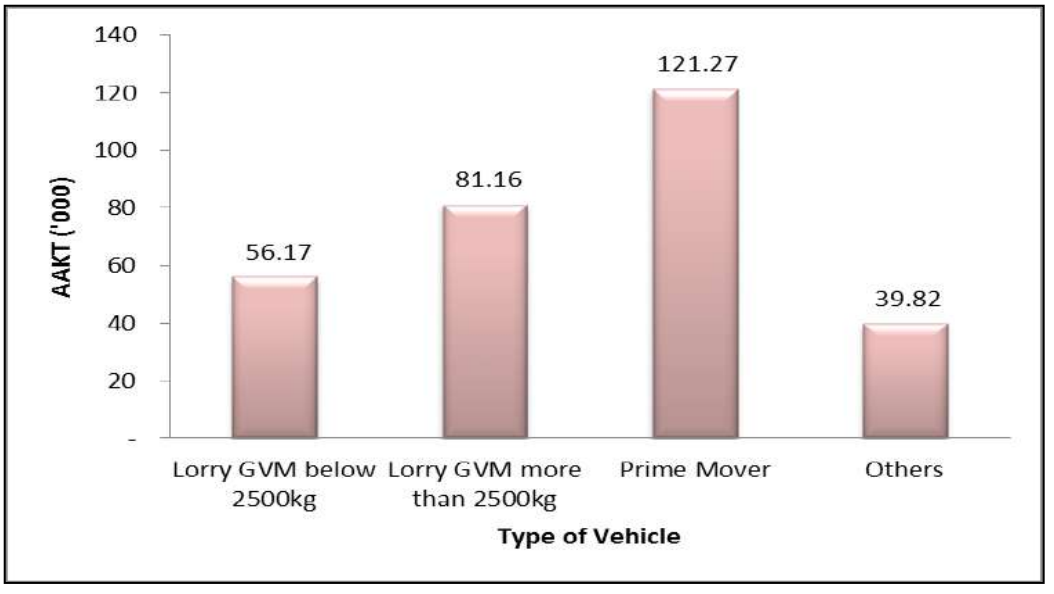



**Figure 19** Average annual VKT vs types of vehicles in PUSPAKOM Gopeng

As compared to PUSPAKOM Wangsa Maju the respondents at PUSPAKOM Gopeng (see Figure 19), reported more kilometres travelled. The prime movers at Gopeng had 55% more annual average kilometres travelled compared with prime movers at Wangsa Maju. Lorries exceeding GVM 2500 kilogrammes in Gopeng travelled a yearly average of 18,780 kilometres more when compared to their counterparts in Wangsa Maju, while slight differences (about 3470 kilometres) was noted between drivers with lorries of GVM of less than 2500 kilogrammes between Gopeng and Wangsa Maju.

This is consistent with the Australian Bureau of Statistics 2012 survey of motor vehicle use. The report was presented according to estimation of distance travelled by type of vehicle. It stated that in 2012, articulated trucks (prime movers) had the highest average kilometres travelled than rigid trucks and light commercial vehicles.

### 4.2.2 Age of Vehicles

Malaysia has no policy on the age of vehicles. Research has shown that the age of vehicles have significant impact on the economy and safety. As vehicles get older, higher operation cost and fuel consumption are incurred. The risk of crashes also increase linearly with the age of vehicles.

At PUSPAKOM Wangsa Maju, vehicles aged more than 20 years had reported an annual average of 63,550 kilometres travelled while vehicles aged between 11 – 20 years indicated a yearly average of 70,670 kilometres traveled as shown in Figure 20. New vehicles and vehicles aged up to 10 years had an annual average of 56,410 kilometres travelled.

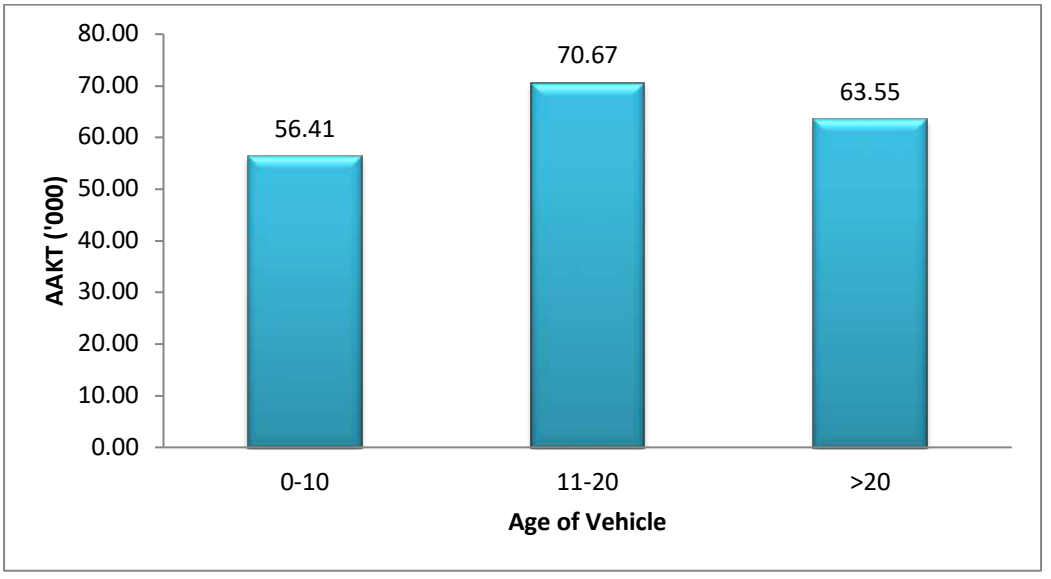



**Figure 20** Average annual VKT vs age of vehicles in PUSPAKOM Wangsa Maju

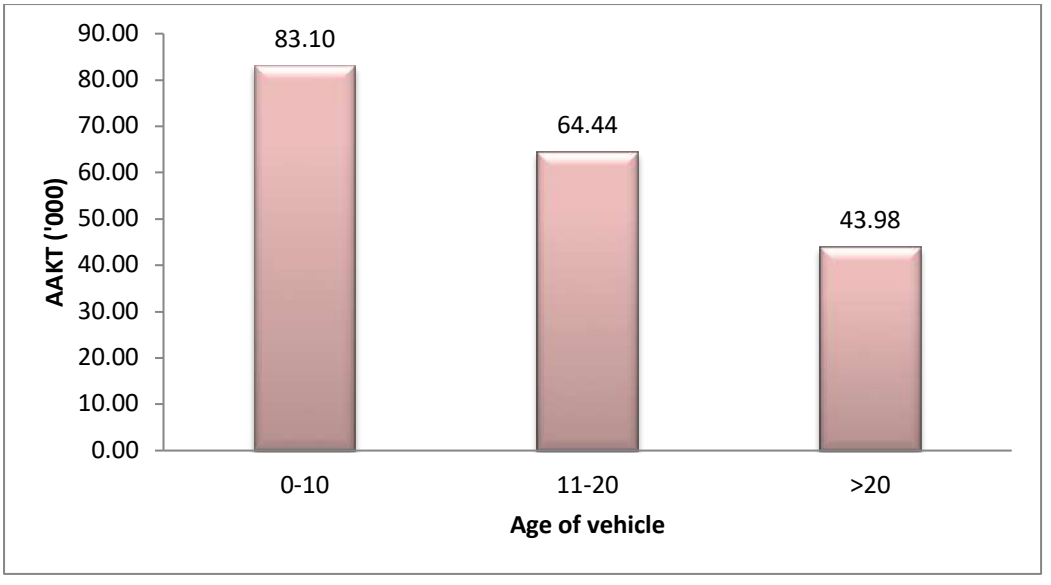



**Figure 21** Average annual VKT vs age of vehicles in PUSPAKOM Gopeng

The reverse was true of vehicles inspected at PUSPAKOM Gopeng where the trend of travelling vs age of vehicle decreased (See Figure 21). New vehicles and vehicles aged up to 10 years had the highest record of annual average kilometres travelled (83,100 kilometres) while vehicles aged between 11 – 20 years had an annual average of 64,440 kilometres travelled. For vehicles more than 20 years old, nearly 20000 less kilometres travelled were observed.

This was consistent with the Fukuda et al. (2013) study, which found that average annual VKT for truck had high negative relationship with vehicle age. A possible reason is that drivers, who have newer vehicles, tend to drive those newer vehicles more often and over longer distances, whilst older vehicles are driven less.

### 4.2.3 Frequency of Service

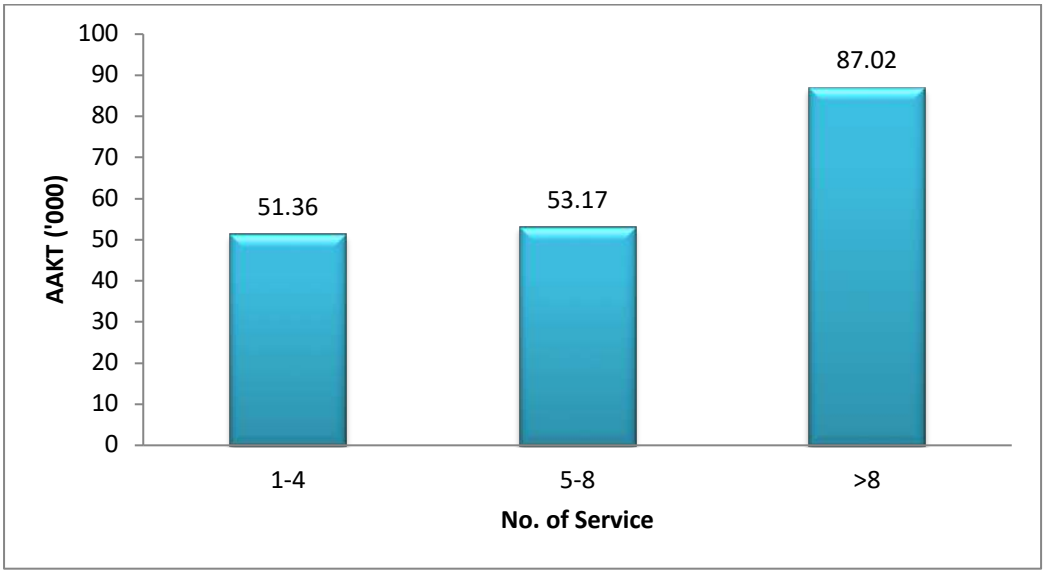



**Figure 22** Average annual VKT vs frequency of service in PUSPAKOM Wangsa Maju

For vehicles inspected at PUSPAKOM Wangsa Maju, it was found that vehicles that had an annual average of 51,360 kilometres had one to four times of maintenance services.

Vehicles with annual averages of 53,170 kilometres travel distance had an average of 5 – 8 times service (Figure 22). This may translate into an estimated of average of 6,000 kilometres to 12,000 kilometres distance traveled before they sent their vehicles in for maintenance service. It is because typcially,engines of vehiclesneed maintenance every 5,000 kilometres to 10,000 kilometres.

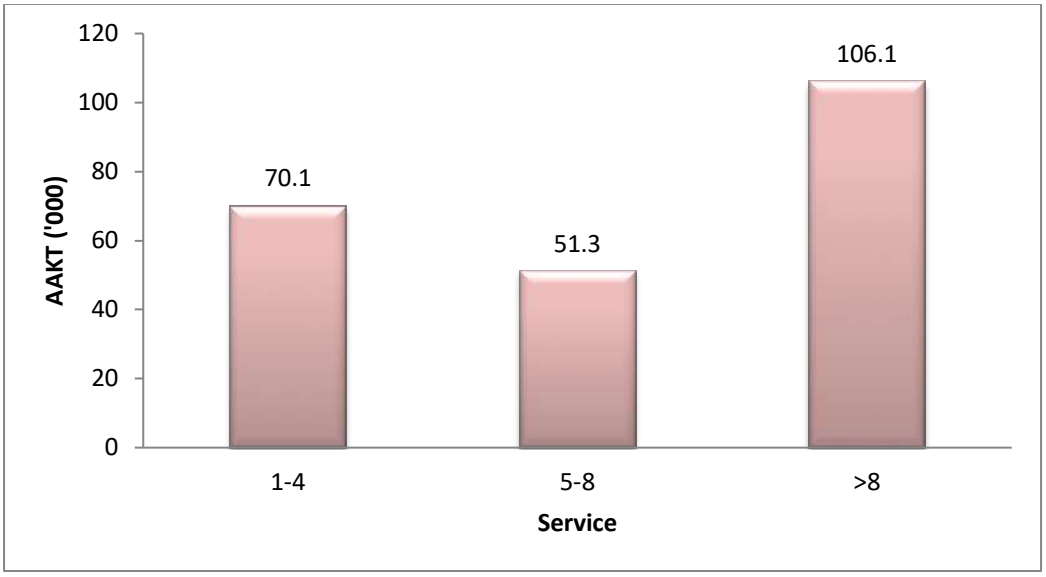



**Figure 23** Average annual VKT vs frequency of service in PUSPAKOM Gopeng

Figure 23 shows the annual average kilometres travelledof goods vehicles vs the fequency of service at PUSPAKOM Gopeng. It was found that drivers sent their vehicles in for maintenance between one to four times a year with an average distance of 70,100 kilometres. An average of 51,300 kilometres distance travelled was recorded for vehicles serviced between five to eight times a year, while those vehicles with more than 100,000 kilometres a year had more than eight times of maintenance services.

## 4.3 VKT and Risk between Branches

**Table 3** VKT between PUSPAKOM Wangsa Maju and PUSPAKOM Gopeng

| | Wangsa Maju | Gopeng |
|---|---|---|
| VKT (per day) | 166 | 190 |
| Average Annual VKT (km) | 60,618 | 69,332 |
| Total VKT (km) (from survey) | 13,578,248 | 8,735,910 |
| Crash record | 15 | 9 |
| Risk (crash per million travelled) | 1.10 | 1.03 |

From the analysis, the minimum work distance from origin to destination (e.g: from oil palm plantation to factory, from factory in Penang to distributor in Johor Baharu) of goods vehicles was two (2) kilometres per day and the maximum of the work distance was 1400 kilometres per day with a standard deviation of 204. Work distance depends on the goods carried and type of vehicle.

In the present survey, drivers were asked if they had been involved in any crashes in the past year. Table 3 shows that respondents at PUSPAKOM Wangsa Maju, had an average of 166 kilometres travelled which translated into an average of 60,618 kilometres annually. Compared to their peers at PUSPAKOM Wangsa Maju, drivers at PUSPAKOM Gopeng reported about 15% more distances travelled. But, from the survey, the total VKT from PUSPAKOM Wangsa Maju was higher than Gopeng Branch. Same as total VKT, the crash record of drivers from the Wangsa Maju Branch was higher i than those at the Gopeng Branch (Frequency at Wangsa Maju was 15 and at Gopeng branch). Thus, the theory when the more we travel the higher the probability of acrash occuring is relevant in this study.

Nevertheless, the risk of a crash for drivers at PUSPAKOM Wangsa Maju was slightly higher compared to drivers at the Gopeng branch (1.10 crash per million kilometres travelled compared with 1.03 crash per million kilometres travelled).

# 5. Conclusion and Recommendations

This study had two main objectives. The first objective was to collect vehicle kilometres travelled data for goods vehicles. Data collection would be by a survey of structured face to face interviews with MIROS designing the questionnaire. Results of this study suggested that face to face interviews were the appropriate method to collect the data given the low education level of respondents providing more accurate data collected more quickly. The history of the vehicle and driver such as the service and crash history could be assembled immediately. However, the cost of interviewing is high and would pose afinancial constraint for a nationwide survey.

The second objective was to define the effectiveness method to obtained exposure data for goods vehicles. MIROS's previous study, where data collection by postcards for commercial vehicles had a low response rate because the the vehicles were owned by companies.When the companies received the postcard, the driver did not know they need to send it the postcard back to MIROS. Some companies have many drivers who will do the rotation of the driving. The companies will record the Origin and destination ana fuel consumption also recorded. But some other problem is the container have registration number but it does not have odometer reading because it moves by using the prime mover. Usually the response will come from the prime mover types because it have odometer.

Therefore, in the present study approaching drivers led to more accurate information collected more quickly and effectively.

The present study found that the VKT per day for goods vehicles is nearly 200 kilometres and that the Average Annual VKT (AAKT) is approximately 65,000 kilometres. The total VKT of the sample from PUSPAKOM Wangsa Maju was higher than the total VKT from PUSPAKOM Gopeng, which were reflective ofthe crash records of the samples of the

respective PUSPAKOM samples. Thus, the results appear to support the theory that the more we travel the higher the probability of a crash.

Variables of VKT, which are the type of vehicle, age of vehicle and frequency of service were found to be affected by the amount of kilometres travelled by the vehicle. The heavier or larger the vehicle (i.e. with greater GMV) the more the kilometres travelled, whereas the amount of kilometres travelled reduced with the age of the vehicle and maintenance service of the vehicle became more frequent with an increase in the kilometres travelled. It can therefore be concluded that the exposure of goods vehicles have a high impact on their environment.

It would thus be prudent for goods vehicles to go for service for often as it will reduce damage to the vehicles and increase vehicle safety since they travel greater distances compared with private vehicles.

## 5.1 Recommendations for Further Study

This study has identified several issues which could enhance the understanding of exposure and risk for the goods vehicle drivers. Below are some recommendations for future research of VKT studies for goods vehicles:

i. Collaborate with PUSPAKOM Headquaters to obtain periodic odometer readings during every inspection. During the inspection, the Vehicle Examiner should record every vehicle inspected. The data sould be stored in a database.
ii. Develop systematic and reliable data collection approaches by using statistical sampling methods which cover other key exposure and risk factors such as time of day, environmental factors and vehicle kilometres travelled in relation to crashes.
iii. Driver regulatory compliance information, work and rest schedules, training and experience of the driver should be studied.
iv. Cross tabulate the crash data with the vehicle defect information.
v. Detailed investigation into crash factors and characteristics.

vi. Strengthen the use of the log book system in order to monitor compliance of the driver especially those with crash history.

In a nutshell, VKT is a vital and significant data for measuring road safety issues. The application of the VKT data for the various stakeholders is vital for various road safety initiatives in Malaysia. There fore, efforts to obtain exposure for all types of vehicles need to be intensified in order to reduce crashes.

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# Research Report

## Vehicle Kilometres Travelled (VKT) Study of Goods Vehicles: Pusat Pemeriksaan Kenderaan Berkomputer Sendirian Berhad (PUSPAKOM)

Designed by: MIROS

MIROS
MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH
ASEAN ROAD SAFETY CENTRE

**Malaysian Institute of Road Safety Research**
Lot 125-135, Jalan TKS 1, Taman Kajang Sentral
43000 Kajang, Selangor Darul Ehsan
**Tel:** +603 8924 9200 **Fax:** +603 8733 2005
**Website:** www.miros.gov.my **E-mail:** dg@miros.gov.my

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