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Periodical Technical Inspection on Taxi Roadworthiness

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Abstract – *The objectives of this study are to analyse the taxi roadworthiness resulting from the mandatory Periodic Technical Inspection (PTI). The data was obtained from a local vehicle inspection company, PUSPAKOM and the dataset only involved taxis which had been sent to PUSPAKOM for roadworthiness inspection which includes initial inspection and periodic inspection. Majority of the taxis are EA type (Perkhidmatan Awam Teksi) with about 60% of the overall of the taxi population. Using logistic regression analysis, the probability of failure of PTI by the taxi was developed. The results indicate that with the existing periodic technical inspection for roadworthiness, the probability of an EA type taxi to have failed the periodic inspection (PTI) reaches 50% after Year-2. Moreover, for a well-maintained EA type taxi that had never failed before, the probability of it to fail in the coming inspection would reach 50% in Year-5.*

Keywords: Roadworthiness, taxi, car inspection, periodical inspection

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1.0 INTRODUCTION

Periodic Technical Inspection (PTI) is an important tool to ensure that the designed safety level of a vehicle is kept through-out its life-cycle. A number of studies have reported on the effectiveness of PTI in preventing accidents. A time-series analysis covering the years 1955-1981 in Sweden concluded that the number of cars involved in police-reported accidents declined by 14% following the introduction of annual inspections (Berg et al., 1984). In New Jersey, USA, Loeb and Gildad (1984) found an average reduction of 304 fatalities associated with the introduction of PTI in 1983. They also reported that these vehicles had at least a 5.3% reduction in accident involvement in the period after the diagnostic inspection compared to the period before the inspection.

In addition, various data recorded a reduction in defective vehicle involvement in accidents. In Texas, data show a decline from 12% in 1951 to 4% in 1971 in defective vehicle involvement in accidents (DOT, 1976). In a recent study, it was found that vehicle defects contributed approximately over 6% of accident (Rechnitzer et al., 2000). In terms of type of

defects as the cause of accident, DEKRA (2005) found that 6% of the defects are mainly from braking systems, lighting system and tire. Rompe and Seul (1985) noted that inspection programs influence and reduce accidents by increasing drivers' understanding of the need for regular maintenance, of safety issues and of the condition of their own car.

In Malaysia, periodic inspection falls under the rule of *Motor Vehicle Rules (Periodical Inspection, Equipment & Inspection Standard) 1995* which compels the category of goods vehicles, public service vehicles and driving school vehicles to undergo periodic inspection at vehicle inspection centre (Solah et al., 2017). Throughout this periodic inspection, the motor vehicles will first undergo a process to check the registration number, engine number and chassis number. If necessary, the vehicles are measured and weighed according to the approved Vehicle Technical Plan. Furthermore, they need to be further inspected through several tests such as physical inspection, side slip test, brake test, speedometer test, lighting system test, exhaust emission test and noise emission test (Solah et al., 2017).

The frequency of PTI can vary according to the age of the vehicle. Some governments exempt from inspection new vehicles up to three years of age. In Malaysia, the government mandated that the commercial vehicle including taxis to undergo PTI once every six months after once annually for its first two years since the manufactured vehicle. Age has been the main factor to determine the frequency of inspection because as vehicles getting older, their technical condition deteriorates. Elvik et al., (1989) also shown old cars have higher accident rates per unit of driving distance than new cars. In terms of vehicle inspection, Dutch and German reports show a strong increase in rejection percentages as cars get older. Dutch study based on 10,322 inspected vehicles, shows rejection percentages of 21% for three-year-old cars and 28% for five-year-old cars; this figure increases to almost 65% for fifteen-year-old cars (Bovag et al., 2006). DEKRA (2005) shows slightly higher percentages for Germany, 28%, 36%, and 75% respectively.

Although vehicle age is critical little consideration has been given to whether the benefits are sufficient to justify the frequency PTI as it involved considerable cost. Researchers in New Zealand, study the effects of doubling the inspection frequency, from annual to biannual, when the vehicle reaches six years of age (Keall & Newstead, 2013). They found that even at an optimistically high level of safety benefits, the estimated costs to the motorist of the six-monthly inspections over and above the annual inspections still exceed these benefits. So, it was concluded that the 6-monthly inspections compared to annual inspections cannot be considered cost-effective.

Recently, in Malaysia, such cost-benefit issues were raised when the taxi driver community wanted to reduce the PTI from six-month period to annual inspection.as taxi had to go for PTI every six months as early as year three after the vehicle was manufactured. Statistics in 2013 (Figure 1) show that taxi Budget (taxi cab) forms a majority in the industry with 64% and approximately 40,000 registered vehicles follow by hire cab with 26%. The smallest percentage of licensed taxi in Malaysia is premier taxi – less than 1%. Thus, this study aims to study and explore the possibility of reducing the frequencies of PTI for taxi based on the probability of inspection rejection or failure by inspection company.

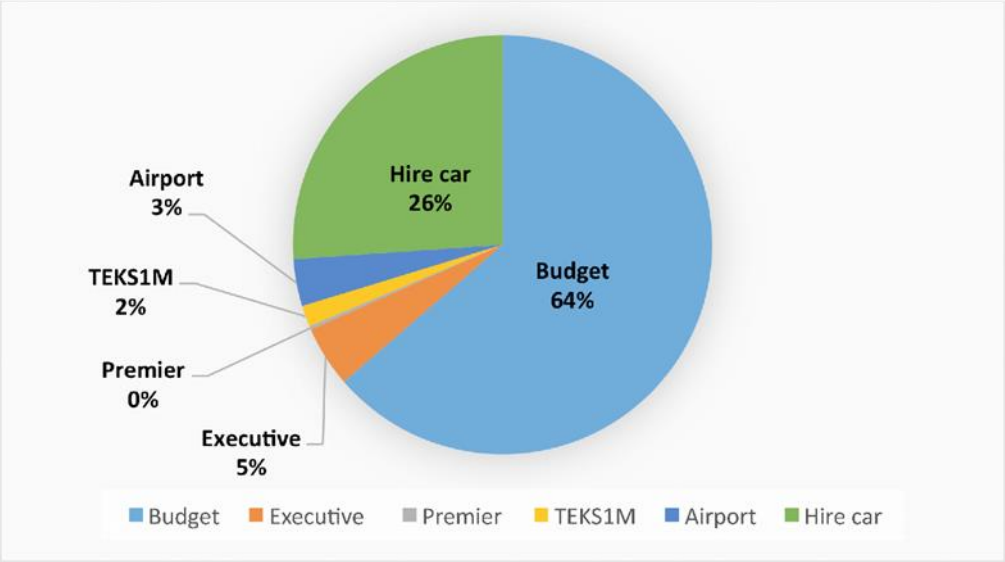

Figure 1: SPAD 2013 statistics

2.0 METHODOLOGY

The roadworthiness data was acquired from the country's PTI service known as PUSPAKOM (*Pusat Peperiksaan Kenderaan Berkomputer*). The dataset involved taxis that had been sent to PUSPAKOM for roadworthiness inspection which includes initial inspection and periodic inspection. As the majority of taxis are categorized as EA type Taxi (*Perkhidmatan Awam – Teksi*) the data sets obtained from PUSPAKOM mainly consisted of EA type taxi. There were two sets of data obtained from PUSPAKOM namely overall data for number of inspections for vehicles manufactured in 2009-2015 and individual data for number of inspections of failures for vehicles manufactured in year 2004-2015.

Descriptive analysis was conducted for the overall data set to identify the trends for vehicle inspections. Next, using the individual data probability model for inspection failure with respect to vehicle age was developed using logistic regression. In estimating the parameters of the logistic regression, the method of maximum likelihood is used (Kutner et al., 2005). This method suits the data well since the outcome of the inspection will always be categorical, namely "Pass" or "Fail". Logistic regression analysis was conducted using the IBM SPSS Statistics software.

Vehicle age is defined as the age of the vehicle starting from when the vehicle was manufactured. As most of the taxis are usually used up to age nine years from their manufactured year, only vehicles manufactured from the year 2008 until 2015 were used in the analysis. In addition, the analysis only considered new vehicle which was sent to PUSPAKOM for initial inspection within two years from when it was manufactured.

3.0 RESULTS AND DISCUSSION

Figure 2 shows the number of initial and routine inspections undergone by all types of taxis at PUSPAKOM from 2009-2015. The routine inspection increased every year as a result of the introduction of the new taxi each year. As shown in Table 1, the majority of the taxi are EA type (*Perkhidmatan Awam Teksi*) with about 60% of the overall taxi population.

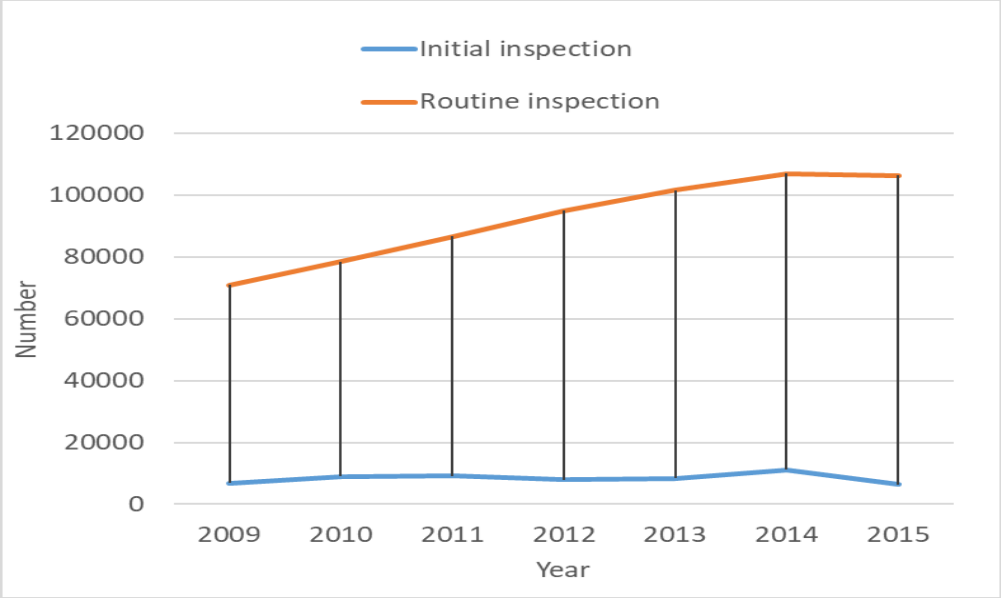

Figure 2: Taxi inspections from 2009 until 2015 by PUSPAKOM

Table 1: Total number of initial and routine inspections for each type of taxi from 2009 – 2015

Inspection	Type of taxi	2009	2010	2011	2012	2013	2014	2015
Initial	*Perkhidmatan Awam*	2,035	2,070	2,000	1,441	1,685	1,707	1,414
Routine	*– Kereta Sewa*	24,138	26,183	27,375	28,290	28,578	28,955	26,565
Initial	*Perkhidmatan Awam*	880	1,172	950	1,228	1,744	2,884	2,172
Routine	*– Kereta Sewa Pandu*	3,407	3,502	3,786	4,251	5,816	8,196	11,073
Initial	***Perkhidmatan***	**3,693**	**5,497**	**5,899**	**4,951**	**4,646**	**5,798**	**2,415**
Routine	***Awam – Teksi***	**40,428**	**45,489**	**51,662**	**58,408**	**62,998**	**65,469**	**64,309**
Initial	*Perkhidmatan Awam*	70	82	97	150	121	131	122
Routine	*– Teksi Limosin*	2,000	1,940	1,875	1,770	1,749	1,709	1,491
Initial	*Perkhidmatan Awam*	141	207	220	83	97	550	313
Routine	*– Teksi Lapangan Terbang*	881	1,365	1,873	2,262	2,460	2,597	2,844
Initial	*Total Inspected*	**6,819**	**9,028**	**9,166**	**7,853**	**8,293**	**11,070**	**6,436**
Routine	*Vehicle*	**70,854**	**78,479**	**86,571**	**94,981**	**101,601**	**106,926**	**106,282**

Figure 3 illustrates the probability of failure for EA taxi undergone PTI from age one to nine years. There are two lines on the figure, indicating two types of probability function estimated using the Logistic Regression Model. The blue line is the probability of "Failed Before" and the red line is probability of "First Fail".

The "Failed-Before" was defined as the probability of the taxi to fail the PTI at any time. This included all taxi that had failed the PTI regardless of the number of failures, number of re-inspection or when did the vehicle fail the inspection. On the other hand, the "First Fail"

was defined as the probability of the taxi to fail the PTI for the first time in 2015. This included taxis that have never failed the PTI before until 2015.

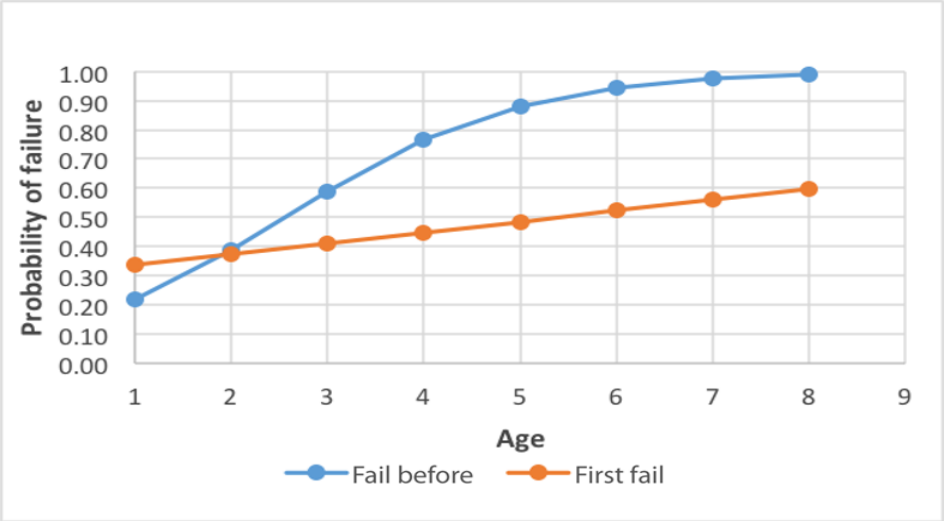

Figure 3: Age of EA taxi and its probability of failure

As shown in Figure 3, the models show that at age one (counted from the year in which the taxi had gone to the initial inspection), the probability of the taxi to fail is 22% while the probability of the all passing vehicles to fail first time at 2015 was 34%. The value for the "Failed-Before" rate further increases by vehicle age and reaches 59% in Year-3 while the probability to fail at the first time reached 41% for the same year.

Furthermore, at Year-5, the table shows that the "First Fail" rate reaches approximately 50% (48% to be precise), as for the "Failed-Before" rate, the model predicted a prominent 88% failure for the said year. Based on the probability model, it was found that a failure during periodic roadworthiness inspection can be considered definite for eight-year-old vehicles, with a significant value of 0.99.

The finding of this study is comparable to the previous done to the private vehicle by UPM which showed that vehicles with age five and above the probability of failure is about 50% or more (Wong et al., 2005). However, the previous study did not consider the effect of failure between the group of vehicles that had failed before or just failed only failed recently. Compared to a study by Wong et al. (2005), this study only includes the EA type taxis with the same year of manufactured and year for annual inspection that were taken as the test samples.

Based on the two logistic models the poor-maintained (failed before) EA typed taxi are more likely to fail the periodical inspection compared to the well-maintained taxi (first failed). Thus, this is justified to propose a new requirement for periodical technical inspection (PTI) for taxi based on the inspection performance records of the taxi which should reflect how well the roadworthiness condition of the vehicle.

However, by current regulation, all taxis are required for taximeter inspection every six months. Thus, changes in the current PTI scheme may not possess a holistic effect on the taxi operators as taximeter inspections are not affected by the proposed changes. Furthermore, it is important to note that such implementation of the revised schedule for the annual PTI may influence other potential consequences. A similar request may arise from other categories of

commercial vehicles including e-hailing services such as Uber or Grab and a similar evaluation method needs to be carried out before deciding on any alterations to the existing PTI schedule.

Based on the analysis result and from the developed statistical probability model, the following recommendations are proposed:

- To maintain the existing practice for the first two years with annual periodic technical inspection:
  - subsequent PTI depends on how well the roadworthiness condition of the vehicle with a possibility of extending the annual PTI up to five years.
  - PTI for after Year-5 will be twice a year (every six months).
  - If a vehicle has failed in any of the first two years or subsequent annual inspections, then the subsequent PTI after Year-2 will be every six months.

4.0 CONCLUSION

Based on the two logistic models the poor-maintained taxi is more likely to fail the PTI compared to the well-maintained taxi. Thus, this is justified to propose a new requirement for PTI for taxi based on the inspection performance records of the taxi which should reflect how well the roadworthiness condition of the vehicle.

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