The Benefits and Costs of Periodic Technical Inspection of Motorcycles in Finland

Suomen Motoristit ry

Contents

FOREWORD

In the first follow-up meeting of the proceeding of the EU's Roadworthiness Package COM(2012) 381 final (13.7.2012) the Ministry of Transport and Communications presented a request to interest groups for providing information to be used in determining the position of Finland and consideration of the proposal of the directive in meetings of the EC Council of Ministers. The Traffic and Communications Committee of the Parliament presented the same request to the representative of Suomen Motoristit ry (SMOTO) in the hearing of expert statements held on the same day.

SMOTO has for years argued clearly and with grounds that the benefits of the periodic technical inspection (PTI) of motorcycles are small, particularly in proportion to the costs arising from roadworthiness testing. The arguments have been accepted and taken into consideration by several parties, among others by the Parliament. On the other hand, the Finnish motor vehicle inspection testing sector states that the benefits of PTI of motorcycles are significant. By contrast, SMOTO states that PTI is cost-effective when it focuses on modifications to motorcycles through the use and development of the current modification inspection procedure. It can be supplemented with roadside inspections (RSI) by the police, if necessary.

SMOTO experts Teemu S. Lindfors LL.M. and Juha Tervonen M.Sc.econ have written this memorandum to promote the transparent presentation of the benefits and costs of the PTI of motorcycles. The memorandum is based on statistics and research data and conclusions drawn from them.

The authors would like to thank Liaison Officer Tapio Koisaari from the Damage Prevention Unit of the Finnish Motor Insurers Centre for valuable help in the analysis of the road safety statistics, Testmill Pentanova Oy for expert help and producing statistics for this study and Jussi Katajainen for discussions at all stages of the writing process.

Suomen Motoristit ry

1 INTRODUCTION

The European Commission presented on 13 July 2012 the so-called Roadworthiness Package [COM(2012) 381], which is a proposal for a directive amending the periodic roadworthiness testing regulations of vehicles. The proposal proposes periodic roadworthiness testing to be required of all two or three-wheel motor vehicles in the whole of the European Community. According to the proposal, the first PTI for class L motor vehicles would be performed after 4 years of use, the second after 6 years of use and after that annually.

The proposal is based on the impact assessment conducted by the European Commission, according to which the benefits for road safety and the environment would be significant on the level of the European Community. The contents of the impact assessment are inadequate at least regarding the following aspects:

- ***the assessment is not transparent, it is impossible to determine which alleged benefits impact which part of the Roadworthiness Package;***
- ***the assessment does not include a realistic estimate of the benefit potential of roadworthiness tests for improving road safety – only cursory references, most often to a report by DEKRA from 2010;***
- ***the assessment does not include an accurate estimate of the reduction of costs from damages that is supposedly achieved through the periodic roadworthiness testing of motorcycles; and***
- ***the claimed benefits of the Roadworthiness Package are presented as a total sum at the level of the whole community without considering the initial situations in different member states and the benefits that can be gained in proportion to the circumstances.***

The proposal does not conform to democratic decision-making. The parliaments and authorities of relevant sectors (in Finland, the Ministry of Traffic and Communications and the Trafi traffic safety authority) do not have accurate information to take a position on the proposal. The Ministry of Traffic and Communications has in its presentation of the proposal for the Parliament emphasised the importance of cost-effective control and consideration for the conditions in Finland. The Finnish vehicle inspection sector has claimed that the PTI of motorcycles has significant benefits.

Suomen Motoristit ry saw that it was necessary to conduct a study on the benefits, costs and cost-effectiveness of the PTI of motorcycles and mopeds in Finland.

The following aspects are assessed regarding the benefits of PTI:

- ***road safety***
- ***the environment, emissions and noise and***
- ***identity, tax, insurance and property crime monitoring.***

The following aspects are assessed regarding the costs of PTI:

- inspection fees and visit
- administrative costs and
- the effect on businesses and economy.

In addition, certain aspects related to the contents of the roadworthiness testing of motorcycles are observed. Other sections of the Roadworthiness Package – RSI and requirements for the inspection staff – are not discussed. The study focuses on issues pertaining to motorcycles but mopeds are also discussed in places.

2 THE BENEFITS OF PERIODIC TECHNICAL INSPECTION

2.1 Road Safety

2.1.1 The Technical Risk Factors of Motorcycles According to Road Safety Studies

Personal injuries caused by road traffic accidents have a significant negative socioeconomic effect, which should be reduced with road safety norms and other road safety work. Now, it is being proposed that the PTI of motorcycles and mopeds should be compulsory because it is assumed that this would enhance road safety. In order to motivate the proposal properly, the incidence of risk factors that could be prevented with PTI in traffic accidents involving motorcycles and mopeds should be determined.

Numerous reports from Finland, other countries of Europe and for example from Australia and North America on the road safety of motorcycles have been reviewed for this study. The reports have one common factor: in each study, the proportion of vehicle technology-related risks of all risk factors affecting motorcycle accidents is very small. In several studies, technical defects have even been excluded from the analysis, since they are so rare. In studies carried out in Europe, the presence of a technical defect in a vehicle involved in an accident that might have been controlled by roadworthiness testing has been found in no more than a few percent of accidents leading to death or other bodily injury.

The causality between defects related to vehicle technology and accidents is often difficult to prove. Several studies merely state that a technical defect was discovered and that it might have been the cause or one of the causes for the accident. In addition, the research methods and the accuracy at which the relation of defects to accidents has been analysed vary. The study results are therefore not entirely comparable with each other.

The most comprehensive study on the road safety and technical aspects of motorcycles carried out in Europe is the Motorcycle Accident In-Depth Study (MAIDS), which investigated a total of 921 motorcycle accident cases in France, Germany, the Netherlands, Spain and Italy in 1999–2000 (ACEM 2009). The study indicated that the technical condition of the motorcycle affected the accidents or their consequences in some way in 5.1 percent of the cases (47 cases). Technical condition refers to a component of the motorcycle functioning inadequately or not functioning at all.

The distribution of problems related to the technical condition of the vehicle reported in MAIDS is the following:

- ***problems related to tyres (a worn-out or damaged tyre, incorrect tyre pressure) 3.7%***
- ***problems related to braking devices 1.2%***
- ***problems related to steering technology and suspension 0.2%.***

The Norwegian Public Roads Administration (Statens vegvesen 2011) has published a comprehensive study on the factors of motorcycle accidents that occurred in 2005–2009. The study report states that a problem related to the technology of the motorcycle was a factor in 3% of the cases. These comprised almost entirely of tyre-related problems, and in most cases the problem was incorrect tyre pressure. In one case, the problem was an engine failure.

The Commission proposal for extending the scope of vehicles to be tested to powered two or three-wheelers is based primarily on the Motorcycle Road Safety Report 2010 conducted by the vehicle inspection company DEKRA (DEKRA 2010). The research material comprises 700 motorcycle accidents. In 165 cases (approx. 23%), a technical risk factor was detected in the vehicle and, in 56 cases (8%), the technical risk factor was found to have been a cause for the accident. The most typical technical risk factors were related to the tyres, braking devices and engine or gearbox.

In order to indicate the potential benefits of PTI, it is essential to assess how many accidents could have been prevented if the technical risk factor could have been eliminated from the accident. A technical risk factor can be the primary cause of an accident or a latent risk factor that affects the occurrence of the accident to some extent as part of a heterogeneous group of other risk factors, for example, pertaining to infrastructure or human risk factors. The reports by the Norwegian Public Roads Administration and DEKRA do not specify how the technical risk factor affected the occurrence of the accident.

The frame of reference of MAIDS presented below is based on the classification of human, infrastructure-related and vehicle-related risk factors by the road accident investigation teams investigating the accidents:

- a risk factor present, no effect on the accident
- an event preceding the accident caused the chain of events of the accident
- a primary contributing factor in the accident
- a latent risk factor (among other risk factors)
- a risk factor not present.

In the study, a technical risk factor related to the vehicle was categorised as a primary contributing factor only in 3 cases, which is 0.3% of a total of 921 cases investigated. In other cases, there was a latent risk factor involved in the accident. The study does not define how the latent risk factors affected the occurrence of the accident.

Determining the primary contributing factor and the relative importance of other latent contributing risk factors in an accident is in most cases somewhat subjective. In any case, it is clear that a realistic assessment of how many accidents could have been avoided if a technical risk factor had not contributed to an accident cannot be made merely by observing the number of occurrences of technical risk factors alone. In other words, ***the benefit that is the object of PTI according to the data used in MAIDS is substantially smaller than the proportion of the technical risk factor frequency of 5.1%.***

2.1.2 The Technical Risk Factors of Motorcycles in Traffic Accidents in Finland

In 2003–2012 in Finland, 25 people died and 600 people were injured on average annually in traffic accidents involving motorcycles (see table 1). There are no comprehensive statistics available on the distribution of severity of the injuries; an injury can be anything from a minor injury to a serious paralysis.

Table 1. The number of fatalities and injured in traffic accidents in 2003–2012 (Statistics Finland)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*	Mean
Fatalities	23	20	30	24	30	33	27	16	28	17	24.8
Injured	493	496	641	692	657	654	649	638	626	434	598

* Preliminary figures; end-of-the-year data may change the figures.

The most comprehensive data of risk factors in motorcycle accidents is in the accident investigational material of the Traffic Safety Committee of Insurance Companies (VALT). The investigation of fatal road and off-road traffic accidents is regulated by law and carried out by road accident investigation teams. VALT summaries research results from road accident investigation teams and maintains a register of the results.

In 2009 in a letter to the Parliament (E 72/2009 vp, Amending Directive 96/96/EC on Periodic Technical Inspection of New Vehicle Classes) the Ministry of Traffic and Communications stated that the proportion of technical defects is 3.1%. The figure is based on the frequency of fatalities in the VALT material during 2002–2007 and includes all cases in which a technical defect was mentioned. The significance of the defects in relation to the causes of the accidents was not investigated.

In the VALT material, vehicle technology-related risks are categorised as “immediate risk factors” or “latent risk factors”. Immediate vehicle-related risk factors include for example a flat tyre or steering malfunction. In the descriptions by road accident investigation teams, an immediate risk factor is defined as the primary cause of the accident. Latent vehicle-related risk factors are, for instance, wrong tyre pressure or defective shock absorption. Latent risk factors do not cause the accident directly but contribute to the occurrence of the immediate risk factor. For example, a worn-out tyre may lead to loss of grip, which, consequently leads to the loss of control of the vehicle.

For this study, the VALT research material from 2001–2011 was requested. The material consists of 207 fatal accidents including all cases that the Ministry of Traffic and Communications referred to in the aforementioned letter to the Parliament. The material includes a total of 20 cases in which road accident investigation teams have detected a technical risk factor pertaining to the vehicle. A technical risk factor occurs in the material 26 times in total (see table 2).

Table 2. The technical risk factors in motorcycles and light motorcycles in fatal accidents in 2001–2011 (the Finnish Motor Insurer' Centre/VALT 2012)

Immediate technical risk factor	Freq.
"Other sudden event related to the vehicle"	2
Latent technical risk factor	
Steering system	1
Braking devices	4
Shock absorption	1
Speed limiter bypass	1
Vehicle's function requiring observation	1
Lamps and reflectors	1
Tyres	15
Detected risk factors in total	26
Investigated accidents in total	207

Immediate Vehicle-Related Technical Risk Factors

The VALT accident data show that a technical defect in the vehicle was the immediate risk factor of the accident only in two cases during the period of the sample. Descriptions of the cases are available.

Case 1. Other sudden event related to the vehicle: "The vehicle was a 47-year old motorcycle that was driven at highway speed. Apparently due to a defective steering damper (or a technical malfunction, this was not verified), the front wheel began to wobble, causing the driver to lose control of the vehicle."

Case 2. Other sudden event related to the vehicle: "A motorcyclist pulled away from traffic lights and soon after this performed a wheelie. At a driving speed of 170 km/h, the rotation of the front wheel and its angular momentum had decreased to the point in which the wheel started to tilt. The driver was unable to lay down the front wheel back on the road neatly and the motorcycle swerved off the road."

The data indicate that ***a vehicle-related technical defect has not been shown to be the main contributing risk factor in a single accident in 2001–2011.*** In case 1, this is possible but the road accident investigation team was unable to prove this. In case 2, the main contributing factor in the accident was evidently not a technical defect related to the vehicle but the high speed and the wheelie.

Latent Technical Risk Factors

Latent vehicle-related technical risk factors occur in 19 cases in the VALT data. The figure includes the aforementioned case, in which an immediate risk factor was present, and there is no need to discuss it in further detail here.

There were always more than one detected latent risks that were defined by road accident investigation teams. The driver was under the influence of alcohol in 9 cases, blood alcohol content being 0.91–2.58‰. Speeding by more than 30 km/h over the limit occurred in 10 cases. It is impossible to verify the contribution of each risk factor to the accident reliably. For example, the immediate risk factor in case 14 in Appendix 1 was "erroneous assessment of driving possibilities". The blood alcohol content of the driver was 1.8‰, the vehicle was speeding by 70 km/h over the limit and the tyres were worn. How did the worn tyres contribute to the accident? Was the accident caused by speeding or intoxication?

Causality is studied by asking whether event X would have occurred without the presence of Y. The causality between latent vehicle-related technical risk factors and accidents can be investigated by reconstructing the conditions of the accident without the latent technical risk factor and asking whether the accident would have occurred. At least in 14 cases of the 18 presented in Appendix 1, the accident would probably have occurred regardless of the existence of the latent technical risk factor. If it is presumed in the remaining cases that the weighted value of a technical risk factor is 25% and the aforementioned case 1, which includes an immediate risk factor, is taken into account, ***it can be stated that the potential benefit in proportion to the cases in total is 2/207, which is less than 1%.***

Another way to assess the impact of latent technical risk factors on the occurrence of an accident is to assess their weighted value among other risk factors present in the accident. By observing the distribution and type of immediate risk factors and those of risk factors other than technical risk factors (see Appendix 1), it can be claimed that the weighted value of latent technical risk factors among other risk factors is small. In order to determine the weighted values of latent technical risk factors for the purposes of this study, the following simple assumptions were made: the weighted value of an immediate risk factor is 50% and the weighted value of latent risk factors is 50%. The weighted value of latent vehicle-related technical risk factors is their proportion of the number of latent risk factors detected in each case divided by two. Thus, all involved risk factors total 100%.

The authors emphasise that the assumed weighted values are the authors' own and that there are other ways of calculating them. The statistical sample in proportion to all motorcycle and light motorcycle accidents is also small, which may decrease the reliability of the results. The purpose of the analysis is above all to present as realistic a view as possible of what the potential benefit of the PTI of motorcycles for enhancing road safety could be.

With the aforementioned assumptions, the following observations can be made:

- there were a total of 18 cases in which at least one latent technical risk was detected
- the proportion of the said cases of all accidents in the data was 8.5%
- ***the weighted value of technical risk factors in proportion to the occurrence of the accident or the severity of its consequences was 0.7%.***

2.1.3 The Statistical Effectiveness of Roadworthiness Testing in Preventing Accidents

No systematic study reports of the effectiveness of roadworthiness tests for motorcycles are available. However, contrastive methods can be used to assess the effectiveness. When the proportion of vehicle-related technical risk factors detected in accidents involving motorcycles and light motorcycles is compared to cars that were tested for roadworthiness in the same period (initiated by drivers: 2,092 cars, 114 vans, 70 lorries, 18 buses and 7 special cars) an immediate technical risk factor occurs in 0.6% and a latent risk factor in 9% of cases.

Based on the abovementioned, ***the frequency of technical risk factors in motorcycles and light motorcycles that are not tested for roadworthiness and that were involved in accidents in the data is virtually the same as in cars that were tested for roadworthiness.***

In Sweden, the PTI of motorcycles is obligatory (the inspection frequency has been reduced to every second year). A study conducted by the Swedish Transport Administration investigated 341 fatal motorcycle accidents in 2005–2011 (Trafikverket 2012). A technical defect was detected in a total of 9 cases. This constitutes around 2.6% of the total number of accidents. It is noteworthy that, statistical uncertainty taken into account, the frequency of technical defects in accidents is virtually the same in Sweden as in Norway where the PTI of motorcycles is not carried out.

Therefore, it can be asked to what extent PTI would reduce technical risk factors in motorcycle accidents. A comparison with the effectiveness of the roadworthiness testing of cars and foreign accident statistics indicates that statistically the effectiveness of roadworthiness testing is not very high.

2.1.4 The Benefits of Roadworthiness Testing of Motorcycles for Road Safety

From the data available, it is difficult to accurately estimate the proportion of accidents that could be prevented through PTI. However, rough estimates can be made about the effectiveness of PTI.

The frequency of technical risk factors in proportion to the total number of cases in data – 3.1% often referred to in Finland and 5.1% in MAIDS – do not take into account the impact or weighted value of various risk factor types on the occurrence of an accident. As stated above, from the point of view of the impact assessment of roadworthiness testing both figures are clearly too high. The impact of latent risk factors on the occurrence or severity of an accident is of a completely different magnitude than that of immediate risk factors.

The Finnish data refers to a risk figure of less than 1%. By applying the weighted values of latent technical risk factors defined above to the data of MAIDS a risk factor for cases excluding those involving immediate risks is 0.4% (44/921*8.5%). If in order to consider statistical uncertainty factors and the possibility of mistakes pertaining to weighted values of risk factors it is assumed that the weighted value of technical risk factors is threefold, the weighted risk factor in the data of MAIDS is 1.2%. If the cases of immediate risk are included, the aggregate risk factor in the data of MAIDS is 0.7–1.5%. In other studies referred to above, the impact of technical risk factors is not defined, hence they cannot be used to specify the estimate.

In proportion to the annual mean of personal injuries in Finland, a risk factor of 0.7% translates to a potential reduction of 0.17 fatalities and 4.19 injuries through roadworthiness testing. Using the unit values of the Finnish Transport Agency for accident costs, these fatalities cause financial losses of 326,230 euros. Injuries cause financial losses of 1,009,790 euros when the average injury unit value is used. These costs total 1.34 million euros annually.

Applying a risk factor of 1.5% would mean 0.37 fatalities and 8.97 injuries in proportion to the average annual personal casualties. This number of fatalities would cause financial losses of 710,030 euros and the number of injuries would cause financial losses of 2,161,770 euros. These costs total 2.87 million euros annually.

Eliminating technical defects in motorcycles and accidents caused by them could reduce accident costs pertaining to personal injuries by 1.34–2.87 million euros annually. The benefits can be achieved only if PTI is 100% effective, which is unrealistic. Comparison to risk factors abroad and technical defects of cars that undergo PTI detected in accident investigations does not support the assumption that the effectiveness of PTI is perfect or even close to perfect.

From this, it can be concluded that the possibilities of PTI to reduce motorcycle accident costs in Finland are very limited. The cost-effectiveness of PTI can be questioned when compared to other road safety measures (such as driver training and general traffic control).

Moped accident risk factors and the impact of roadworthiness testing on moped accidents have not been studied here. It is possible that more benefits could be achieved through roadworthiness tests for mopeds.

2.2 **Emissions**

Total road traffic exhaust emissions in Finland and the proportion of motorcycles and mopeds of the emissions for 2011 from LIPASTO calculation system developed by the VTT Technical Research Centre of Finland are presented for the compounds whose emission amounts and adverse effects have scientifically calculable significance for the quality of the environment (see table 3). The data include street and highway traffic.

The proportion of motorcycles and mopeds of total traffic particulate matter (PM) emissions was less than 1%. This was also the case for nitrogen oxides (NOx). The proportion of motorcycles and mopeds constituted less than 10% of carbon monoxide (CO) emissions and 17% of hydrocarbon (HC) emissions. The proportion of motorcycles and mopeds of carbon dioxide (CO_2) emissions was approximately 1%.

The socioeconomic significance of the emissions should be observed as losses and costs caused by the emissions, instead of the amount of emissions. The total costs caused by emissions indicate to which compounds and emission sources measures should be targeted so they are cost-effective.

Table 3. Total road traffic emissions in Finland and the proportion of motorcycles and mopeds of the emissions in 2011 (VTT LIPASTO)

	PM	NO_x	CO	HC	CO_2
Total road traffic, tonnes	2 304	40 925	165 840	18 617	11 389 152
Motorcycles, tonnes	14	258	13 006	1 577	89 210
Mopeds, tonnes	6	8	2 512	1 588	19 322
Motorcycles and mopeds tonnes in total	20	266	15 518	3 165	108 532
Proportion of motorcycles and mopeds of road traffic exhaust emissions%	0,87%	0,65%	9,36%	17,0%	0,95%

The costs arising from the emissions of the Finnish transport system have been calculated using up-to-date methods in a study by the Finnish Transport Agency (Gynther et al 2012). The calculation method for emission costs is based on a methodology that has been developed in the research projects of the European Commission and applied in the impact assessments of the Commission.

Using the unit values of the Finnish Transport Agency for emission costs it can be calculated that the proportion of motorcycles and mopeds of the emission costs from road traffic in Finland in 2011 (572 million euros) was just over 5 million euros, which is roughly 1% (see table 4).

Costs due to carbon dioxide emissions caused by road traffic as a whole (421 million euros) and by motorcycles and mopeds (4 million euros) are socioeconomically the most significant. The second most significant are particulate matter emissions, which cause nearly all adverse health effects from traffic emissions. Costs due to the PM emissions of motorcycles and mopeds were 1.1 million euros, which is less than 1% of the total road traffic PM emissions. Nitrogen oxides and hydrocarbons affect health (and the environment) mainly through the formation of ozone. Motorcycles and mopeds cause a very small proportion of the costs arising from these compounds. Carbon monoxide emissions were excluded from the calculation of costs in the study of the Finnish Transport Agency due to the low number of epidemiologically determinable adverse effects.

Table 4. Costs due to road traffic emissions in Finland and the proportion of the costs arising from motorcycles and mopeds in 2011 (in 2010 prices)

	PM	NO_x	CO	HC	CO_2	Total
Unit cost per compound, euros per tonne	55 680*	533	-	30	37	-
Road traffic total, million euros	128.29	21.8	-	0.56	421.4	572.05
– Motorcycles, million euros	0.78	0.14	-	0.047	3.3	4.27
– Mopeds, million euros	0.33	0.004	-	0.048	0.7	1.08
Motorcycles and mopeds in total, million euros	1.11	0.144	-	0.095	4.0	5.35

*Costs on average for various exposure levels.

In order to reduce emission costs effectively through the PTI of motorcycles and mopeds, an assessment needs to be made on which compounds can be reduced with roadworthiness testing and how large the reduction could be. Carbon dioxide emissions, which have the greatest relative socioeconomic value, cannot be reduced by PTI because it does not affect the specific consumption of a motorcycle or moped.

Considering the total costs (1.35 million euros per year) arising from unhealthy compounds (PM, NOx and HC), roadworthiness testing should reduce the emissions from the entire two-wheeled vehicle fleet drastically (with emphasis on PM emissions) in order to affect the amount of emissions and emission costs. This is impossible in practice. Emissions from motorcycles will be reduced in any case over time as the motorcycle fleet is renewed and emissions-reducing technology becomes more common.

The conclusion is obvious: PTI cannot reduce emissions or emission costs caused by motorcycles and mopeds in Finland to an extent that would have a substantial socioeconomic impact. PTI is not a cost-effective measure for reducing motorcycle and moped exhaust emissions.

2.3 Noise

According to studies by the Finnish Transport Agency and cities, around 330,000 people are exposed to highway traffic noise of over 55 dB (L_{den}) and around 175,000 people are exposed to traffic noise of 50 dB ($L_{yö}$) at night. The Finnish Transport Agency has defined cost values for noise exposure levels, varying from 35 euros per person for 50–55 dB (A) to 1,600 euros per person for over 75 dB (A). Thus, traffic noise is a significant cause of harm. A few years ago, the annual total value of highway and street traffic noise in Finland was estimated to be 19–31 million euros (see Ministry of the Environment 2006, for example). These estimates are based on the costs due to continuous exposure, not temporary noise peaks.

Obviously, most traffic noise pollution is caused by cars, buses, lorries and heavy equipment. The proportion of motorcycles and mopeds of highway and street traffic is not as regular as that of the said vehicle types. The proportion of motorcycles and mopeds of the vehicle fleet and of the total mileage is considerably smaller and their use in traffic is seasonal. Thus, only a fraction of the estimated costs due to traffic noise can be associated with powered two-wheelers. Nevertheless, the number of disturbingly noisy vehicles in traffic should be reduced regardless of the vehicle type.

There are no systematic research data available regarding the increase of traffic noise pollution by motorcycles. The noise pollution caused by motorcycles must be assessed in comparison to general studies and theories on traffic noise.

The thresholds and measurement methods for motorcycle drive-by noise set by a directive vary from 80–86 dB(A) depending on the year of first registration. In practice, measured values are often 1–5 dB(A) higher than this. In motorcycles with customised exhaust pipes, the measured values are typically 85–95 dB(A) (Testmill Pentanova Oy 2012, an expert authorised by the Finnish Transport Agency HA-0002).

Due to the statutory measurement method, the noise caused by a motorcycle in an authentic traffic situation cannot be concluded directly from the thresholds as the measurement is carried out using a small gear (2nd gear or an average of 2nd and 3rd gear) considering the measurement start speed of 50 km/h and as it includes acceleration with full throttle.

In reality, small gears are not used at a speed of 50 km/h and a motorcycle is not accelerated with full throttle in areas where the speed limit is 50 km/h. Thus, the actual motorcycle traffic noise level is significantly lower than the thresholds defined in vehicle legislation. It can be stated that motorcycle noise level does not differ from the traffic noise level *on average* (measured *at the side of the road*, traffic noise ranges 70–85 dB(A)).

During the motorcycling season, motorcycle traffic supposedly increases on certain roads. However, in many cases motorcycle traffic causes car traffic to decrease. If the doubling of traffic increases the noise level by 3 dB on average and if motorcycles increase traffic in certain parts of the road network as much as by 20%, the traffic noise level increases in those parts by less than 1 dB. Therefore, it is unlikely that the proportion of powered two-wheelers increases the traffic noise load during the summer months to the extent that in certain parts of the road or street network the traffic noise level rises to the lowest noise pollution category (50 $L_{yö}$ /55 L_{den}) or from low categories to higher categories.

What is generally experienced as disturbing motorcycle noise is above all related to the driving styles of drivers. The capacity of a motorcycle to produce noise can be quite high without any illegal modifications to the technical functions of the motorcycle. The control values measured in the type-approval and applied in the static measurement of motorcycles in original condition vary considerably for different brands and models. The loudest type-approved motorcycles have a control value of 106 dB(A). Making changes to the exhaust manifold is allowed in Finland but requires passing a modification inspection after the change. Noise values applied in a modification inspection vary according to the first registration of the motorcycle. The general control values applied in a static measurement are 103 or 106 dB(A) depending on the time of first registration or the control value marked on the manufacturer’s shield + 5 dB(A). Obviously, if the driver wants he/she can produce disturbing noise with the motorcycle even if it meets the requirements. Also, it is apparent that the PTI of such motorcycles cannot affect drivers’ attitudes.

There are also motorcycles with modified exhaust pipes in traffic that have not been to a modification inspection. For the general road traffic noise level and the social costs due to noise, however, these constitute a quite marginal proportion of the entire motorcycle fleet. Testmill Pentanova Oy has performed static noise measurements in 2012 for 150 motorcycles that have a modified exhaust manifold. The results for less than 10% of these motorcycles were higher than the highest control value 106 dB(A) (Testmill Pentanova Oy 2012). Considering the small number of illegally noisy motorcycles and their random and seasonal use in traffic, it is clear that the costs that their noise cause to society is small.

In addition, the motorcycle traffic noise due to drivers’ attitudes can be affected by other means than PTI. According to section 86 of the Road Traffic Act, a power-driven vehicle must be operated so that its engine and other devices do not cause unreasonable noise. Pertaining to section 4 of the regulation on the use of vehicles on a road, unnecessary and disturbing driving in an urban area is prohibited. The penalty for breaking the said regulations is a fixed fine.

It can be concluded that PTI cannot significantly reduce the social costs arising from motorcycle traffic noise. Unlike continuous noise load, unit cost values due to individual noise peaks have not been determined and therefore it is impossible to assess the economic benefit of removing individual noisy vehicles from traffic.

2.4 Tax Monitoring and Vehicle Identity

Vehicles used in road traffic in Finland are taxed in two tax systems. A car tax is levied when a car or a motorcycle is registered. Cars and certain other vehicle types are subject to a vehicle tax (base tax and the tax on driving power).

Since the vehicle tax is not levied on motorcycles in Finland, benefits cannot be achieved through PTI. Paying the car tax is the requirement for the registration of a motorcycle; a motorcycle cannot be registered until the car tax has been paid and the payment has been entered into the vehicle information system.

The potential tax benefits of the PTI of motorcycles relate to the re-taxation of vehicles in certain cases. According to the section 3 of the Car Tax Act (1482/1994), a vehicle that has been taxed previously is taxed again as a vehicle taken into use for the first time if over 50% or more of the parts of the vehicle are replaced. The regulation does not distinguish between original spare parts, fitment parts or parts differing from the original but includes all replacement of parts.

In 2004–2012, section 3 of the Car Tax Act has been applied to a motorcycle once (Trafi 2012). Precise information on the number of registered vehicles of any type on which the car tax should have been levied by virtue of section 3 of the Car Tax Act but on which it has not been levied is unavailable. The identity and re-taxation of vehicles is already controlled by modification inspections and roadside monitoring by the police. Furthermore, the classification of the percentages of vehicle parts were changed by a legislative amendment that came into effect in 2007. As the new classification puts greater emphasis on larger part and component entities, the scope of application of section 3 of the Car Tax Act is probably very narrow in proportion to the motorcycle fleet. On the other hand, it focuses on old motorcycles that require replacement of parts due to the maintenance need caused by aging.

As more specific information is lacking, a fiscally over-optimistic estimate based on assumptions is presented as an example of the possible fiscal impact of applying section 3 of the Car Tax Act on PTI of motorcycles. Let us assume that the regulation would be applied to 20–30 motorcycles annually and that their taxable value would be 10,000–15,000 euros. Furthermore, let us assume that all these motorcycles have a cylinder capacity of over 756 cm^3 and consequently their tax rate according to section 7 of the Car Tax Rate is 24.4% of the taxable value. Given these assumptions, the annual tax accrual would be 48,800–109,800 euros.

The cost-effectiveness of performing roadworthiness tests to 200,000 motorcycles in order to monitor taxation is obviously questionable.

2.5 The Monitoring of Property Crime

Approximately 500–700 motorcycles are stolen annually in Finland. Some of them are found abandoned after the theft, some are found concealed and some are permanently lost possibly because they are smuggled abroad in pieces or as a whole. Roughly a half of all stolen motorcycles remain missing permanently.

PTI cannot prevent vehicle theft nor can it contribute to returning stolen motorcycles that have been smuggled abroad to their owners. It is also highly unlikely that a stolen motorcycle would be brought to a PTI without the right of ownership to it.

The current registration system is an efficient method for preventing theft as a vehicle that has been reported stolen cannot be transferred to a new owner in the vehicle register nor can a new identity be created for the vehicle in the vehicle register. The benefits of PTI to solving property crime are in practice limited to identification of stolen motorcycle parts that have been sold after disassembly and there are practical limitations due to which the benefit gained is merely theoretical.

2.6 Insurance Monitoring

The Finnish Motor Insurers Centre processes annually on average less than 30 accidents involving uninsured motorcycles. Driving an uninsured vehicle is usually intentional illegal activity. In the event of an accident, this leads to collecting claims from the initiator of the accident. Bringing uninsured vehicles to roadworthiness tests is very improbable. Thus, the benefits of PTI are clearly marginal from the point of view of insurance monitoring.

2.7 Summary of Benefits

The greatest potential benefit of roadworthiness testing is preventing personal injuries due to accidents. Accident costs amount to several millions with certain assumptions. However, roadworthiness testing could presumably prevent only a proportion of accidents caused by the bad condition of brakes or tyres. Reducing exhaust emissions is also important but the possibilities of PTI to contribute to it are limited, particularly with respect to costs due to emissions, not the amount of emissions in tonnes.

On the basis of the assumed effects of PTI that are presented in table 5, the estimated benefits for road safety and the environment could be annually no more than 0.8–1.6 million euros. The table shows that the impact of roadworthiness testing affects the scope of benefits substantially. However, there are numerous restrictions to the impact.

Accident costs exclude moped accidents, which would presumably increase the benefits to some extent. The overall benefits cannot exceed those of motorcycles.

Due to the lack of required information, the benefits for preventing noise pollution cannot be evaluated. As regards tax, identity, property crime and insurance monitoring, the effectiveness was assessed to be very small.

Table 5. The assessment of the potential benefits of PTI of motorcycles and mopeds (emphasis on motorcycles)

Benefit	Costs to be reduced, million euros per year	Estimated maximum impact potential	Amount of impact, million euros per year
Road safety (motorcycles)	1.34-2.87	50%	0.67-1.44
Unhealthy emissions (motorcycles and mopeds)	1.35	10%	0.135
Total	2.69-4.22	-	0.805-1.575

3 THE COSTS OF PERIODIC TECHNICAL INSPECTION

3.1 Periodic Technical Inspection Fees and Visit

The PTI of motorcycles and mopeds would cause costs to vehicle owners, of which the most apparent is the inspection fee. Due to the substantial growth of the motorcycle and moped fleet in the 2000s, the cost potential from inspection fees is high. At the same time, expanding the technical inspection business has become more lucrative.

The motorcycle fleet in Finland at the end of 2011 was roughly 237,000 vehicles and the moped fleet around 279,000 vehicles (figure 1). In 2001–2010, the motorcycle fleet grew annually by approximately 8.7% and the moped fleet by 10.5%, respectively. There are no signs of the growth slowing down, unless for example economic growth or PTI causes it. It is possible that as a result of the PTI obligation a proportion of the powered two-wheeler fleet is removed from the vehicle register, thus reducing the number of vehicles to be inspected annually smaller than the entire fleet of powered two-wheelers.

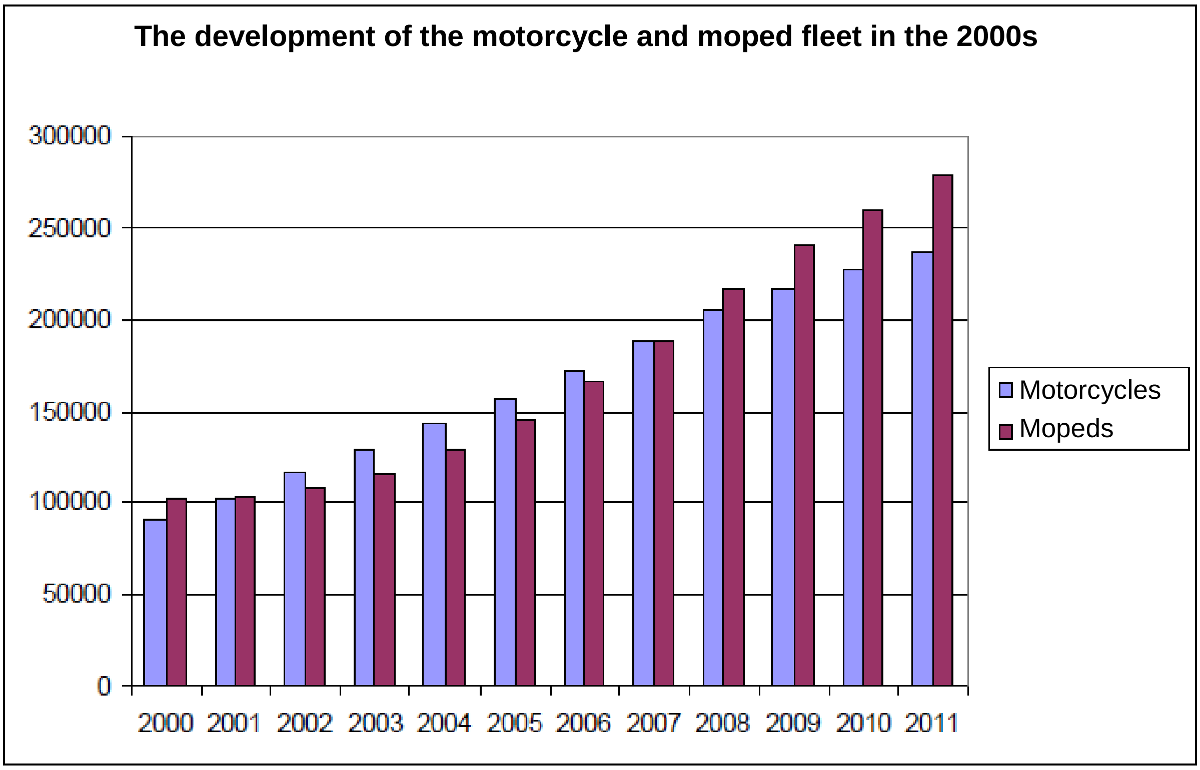

Figure 1. The development of the motorcycle and moped fleet in Finland in 2000–2011 (Statistics Finland)

Costs paid as inspection fees can be assessed on the basis of the vehicle fleet size and the level of the estimated inspection fee. Here, the size of the powered two-wheeler fleet is assumed to be the same as in the statistics for 2011. No assumptions are made regarding the number of vehicles removed from the fleet or the increase of the fleet through sales of new vehicles. Also it is not considered that with respect to the newer vehicles, PTI would probably begin, for example, only on the fourth usage year of the vehicle, which would reduce the size of the inspected fleet.

The assumptions regarding the amount of the inspection fee are based on the inspection fees charged in certain European countries (for example Sweden and the UK).

Estimates on the inspection fees for motorcycles and mopeds in Finland have not been presented. The inspection fee level would be affected by the scope of the inspection and competition on the vehicle inspection sector. The more testing at the PTI centre is involved in the inspection, the more equipment needs to be procured and the more time is spent per inspection. The need for additional training of the inspection staff would also affect the fees.

The estimated costs due to inspection fees and the transfer of income to the vehicle inspection business would be approximately 15.5–30.9 million euros annually (see table 6).

Table 6. The estimate of costs due to inspection fees

		Estimated inspection fee, euros			Total costs, million euros		
	Fleet, number of vehicles	Low	Average	High	Low	Average	High
Motorcycles	236,661	30	45	60	7.1	10.6	14.2
Mopeds	278, 856	30	45	60	8.4	12.5	16.7
Total	515,517	-	-	-	15.5	23.1	30.9

There are also other costs involved in vehicle inspection visits. There are vehicle operating costs arising from travelling to a PTI and the inspection takes time. Where services are near, operating costs and the time spent are smaller whereas in rural areas services may be tens of kilometres away or further.

The costs of PTI are higher if driving costs and the value of time are taken into account. Fuel costs depend on the distance, the specific fuel consumption of the vehicle and the fuel price. For the shortest distances, vehicle running costs are (for example, if calculated using the kilometre allowance principle of the tax administration: motorcycle 34 c/km and moped 18 c/km) from a few euros to tens of euros per PTI, depending on the location of the inspection services. If it is assumed that journeys to the inspection and back were approximately 10 kilometres (the inspection site is therefore very close to everything), the PTI of half million vehicles (half of which are motorcycles, half of which are mopeds) would cost 1.3 million euros. In reality, the costs are definitely higher.

The value of the lost time is more significant than the fuel costs. In the impact assessment by the traffic sector, the value of the lost time was 8–22 euros/hour depending on whether the time lost was free time or working time. If it is assumed that PTI takes one hour including the journeys to the inspection and back (very fast) and the lost time is free time, PTI of 500,000 vehicles would cost four million euros annually. In fact, the costs are higher as a PTI surely takes more time.

PTI costs can accrue to certain people and households. Many motorcycle hobbyists have several vehicles. Households may have both mopeds and motorcycles. In these cases, the accruing PTI costs can be several hundred euros per hobbyist or household annually.

3.2 The Administrative Costs of PTI

The national implementation of the expansion of the PTI directive requires legislative work. Furthermore, the definition, instruction, education and monitoring pertaining to the standards of inspection activity cause administrative costs. All internal costs of the vehicle inspection business would be paid by the customers. In a system run by authorities, costs would increase the need to collect more taxes if the Trafi proportion included in inspection fees does not cover the costs.

The PTI of motorcycles and mopeds would increase surveillance duties for the police. The PTI status of vehicles would be monitored in traffic monitoring. Presumably, traffic control would not be decreased even if the PTI of motorcycles and mopeds was commenced to monitor their condition. In practice, there would be two types of costs: inspection fees and traffic control costs funded with tax revenue.

3.3 The Impact on Businesses

Business related to motorcycling and mopeds has grown as the vehicle fleet has grown and thus the business has employed more people (table 7). It is noteworthy that the sector-specific statistics only cover a part of the turnover of the sector. A significant part of the sales is registered under other technical retail.

Table 7. Business information – The sales, service and repair of motorcycles and their parts and equipment (Statistics Finland)

	No. of businesses	Staff	Turnover in total, million euros	Salaries paid, million euros
2002	235	587	235	12
2007	296	944	458	31
2009	320	939	408	29

It is possible that PTI reduces the popularity of motorcycling as a hobby and the turnover and jobs of the businesses of the sector. The fear of constantly increasing regulation causes uncertainty and impacts businesses as their customers ponder the possibilities of continuing their hobby and the financial risks involved.

The PTI of motorcycles and mopeds would, however, bring new jobs to the vehicle inspection business. No estimates have been made on the number of new jobs. Demand arising from needs of customers would most likely create jobs more effectively than jobs created on the basis of inadequately motivated administrative regulations. The inspection fees also reduce the consumption of other goods and therefore jobs created by consumer demand.

From the point of view of the competitiveness of the national economy, Finland and the EC should consider carefully when to increase regulation that decreases the competitiveness of their economy and the purchasing power of their citizens. This is an important matter for an economic union plagued with economic crises.

3.4 The Impacts on the National Economy

If motorcycle sales and other sales in the business are reduced due to PTI, the state will lose tax revenue i.a. from the car tax levied on motorcycles, value added tax from equipment sales and income tax from the employees of the business.

The loss of car tax revenue would be the most significant of these. According to Trafi, 5,763 new motorcycles were registered in 2011. For example, in 2006 and 2007 the number was two-fold. The car tax revenue for these years was tens of millions euros. The losses for the state can therefore be counted in millions. It can be claimed that the growing vehicle inspection business cannot cover these losses of tax revenue.

3.5 The Summary of Costs

The most significant PTI costs for motorcycles and mopeds are related to the actual inspection: the inspection fee and the cost of driving and time. Annually, they total approximately 20.8–36.2 million euros.

There are no estimates on the amount of additional administrative costs due to monitoring by the vehicle inspection business and monitoring by the police. Also, there are no estimates on the possible reduction of sales of businesses in the sector, the reduction of consumer demand caused by inspection fees and the loss of tax revenue for the state. However, each of these consequences impact the national economy.

Table 8. The assessment of the costs of the PTI of motorcycles and mopeds

Immediate cost effect of PTI	Million euros annually	Notes
Inspection fees (motorcycles and mopeds)	15.5–30.9	Depends on the level of the fee
Driving costs to PTI (motorcycles and mopeds)	1.3	Minimum estimate; varies depending on the length of the journey and specific consumption
The value of the time spent on PTI (motorcycles and mopeds)	4.0	Minimum estimate; varies depending on the length of the journey and the functionality of the service
Total	20.8–36.2	-

4 THE CHALLENGES OF PERIODIC TECHNICAL INSPECTION

4.1 The Content-Related Efficiency of PTI

4.1.1 Inspection Items and Inspection Methods

The suggested content of PTI is presented in Annex II to the Commission proposal for a Regulation of the European Parliament and of the Council on periodic roadworthiness tests for motor vehicles and their trailers and repealing Directive 2009/40/EC. According to the presentation, the following items are to be tested compulsorily:

- Vehicle identification
- Braking devices
- Steering
- Visibility
- Lamps, reflectors and electrical equipment
- Axles, wheels, tyres, suspension
- Cab and bodywork
- Other equipment
- Environmental nuisance
- Additional tests for class M2 and M3 vehicles for transporting passengers.

Regarding inspection methods, the Commission proposal is not specific enough. Only some of the methods can be applied as such to powered two-wheelers. Referring to the accident statistics presented in chapter 2, the most relevant items to be tested for motorcycles from the point of view of road safety are braking devices and tyres. Other items are either entirely irrelevant inspection items or their significance in accident investigations on technical defects is so small that their socioeconomic cost-benefit assessment is irrelevant here.

The following assesses the contents of PTI in detail with respect to braking devices, tyres, noise, exhaust emissions and vehicle identification.

4.1.2 Braking Devices

The inspection of braking devices has two components: the overall inspection of the condition of braking devices and service brake performance and efficiency. The visual inspection of braking devices includes inspecting brake linkage, inspecting brake fluid tank and hoses for leaks and inspecting brake drums or brake pads and discs. No standard values are given for these types of inspections. Service brake performance and efficiency is inspected either using a static brake testing device or a test drive.

Typically, all or nearly all motorcycle brake components can be inspected easily without the need to disassemble or lift the vehicle for the inspection. In addition, unlike with cars, all factors affecting the drivability of a motorcycle including the condition of the brakes can be detected immediately by the driver. Due to these properties of motorcycles, their drivers detect for example defects in the braking devices considerably more likely than car drivers detect defects in the braking devices of cars. For example, detecting a fluid leakage does not require going under the vehicle or even opening a bonnet or a corresponding casing.

The inefficiency of a brake can be felt immediately when braking, since typically front and rear brakes are separate circuits, affecting only one tyre at a time and functioning of both brakes affects the controllability of the motorcycle essentially. Thus, PTI can detect a significantly smaller number of defective brakes from motorcycles than from cars. The replacement frequency of wear and tear brake components varies greatly and matches the time of PTI only occasionally.

In Finland, PTI centres do not currently have static brake testing devices for testing motorcycles. Therefore, brake performance could be tested only with a test drive if additional investments are not made.

Testmill Pentanova oy performs among other things motorcycle brake testing as an authorised expert in Finland. The company has performed nearly 300 tests, the majority of which are motorcycles whose structure has been modified. Out of the brake tests performed by Testmill Pentanova oy, only one, over 50-year old vehicle with incorrectly installed drum brakes has failed the test due to inadequate brake performance (efficiency). This suggests that inadequate brake performance would lead to rejection of a motorcycle in a PTI very seldom.

There are also practical issues in testing brake performance through a test drive at a PTI centre. For the test to be reliable, it must be carried out at a sufficiently high speed. PTI centres do not normally have the necessary facilities for this type of testing. In the aforementioned case of the rejected vehicle, the statutory limit values were met from a speed of 60 km/h but not from a speed of 100 km/h.

Another practical issue in brake performance testing is related to the braking ability and skill of the vehicle inspection staff. Controlled and efficient braking with a motorcycle is a matter of technique that requires practice. For brake testing, the education received at a driving school is not enough. Brake testing with a test drive would therefore require training the vehicle inspectors.

4.1.3 Tyres

A visual inspection is also carried out for tyres. The most essential causes for rejection applied to motorcycles are the damaged structure of a tyre and substandard groove depth. Visual inspection of tyres for the said defects can be performed at all PTI centres.

However, there are problems related to the inspection of tyres that reduce the efficiency of PTI. Firstly, the appropriate frequency for changing tyres varies according to the motorcycle type, driving style and mileage. Sporty motorcycles typically can use up (regardless of mileage) several tyre pairs in a season, whereas in another type of motorcycle the condition and the groove depth of the same tyre pair can be sufficient even for 10 years. The tyre changing frequency and PTI frequency thus match only occasionally.

The wet grip of tyres especially with hard tread mixtures deteriorates with aging but the consistency and groove depth meet the standards. This problem is difficult to address with PTI as no age restrictions are set for the use of tyres in traffic.

4.1.4 Emissions-Reducing Technology

The possibilities of reducing emissions depend on how well the use of emissions-reducing technology in motorcycles (and cars) increases. Certain limit values have been checked by measuring from cars that are equipped with catalytic converters. In principle, motorcycle exhaust emissions can be measured with the same equipment as car exhaust emissions if there is a sufficient number of adapters for various types of motorcycle exhaust pipes at the PTI centre. The possibility to control emissions is limited to motorcycles that the norm requirements for emissions-reducing technology are applied to.

4.1.5 Noise

Each PTI centre can measure the noise during the use of a motorcycle as required by law, given that there is a device for indicating the correct measurement speed of rotation. However, two factors decrease the efficiency of PTI regarding prevention of noise pollution.

Original exhaust silencers do not usually lose their ability to reduce the amount of noise to a significant extent. Especially in new motorcycles, noise is not reduced by a dampening material but the structure of the exhaust silencer. The structure of an exhaust silencer can nowadays be assumed to last for the entire life span of a motorcycle. Thus, it is probable that motorcycles equipped with original exhaust silencers would fail a PTI due to too high a noise level.

Another factor posing difficulties for noise control through PTI is that a failure in the test can be avoided very easily with measures carried out in advance. In most motorcycle models, the exhaust manifold can be changed with ordinary hand tools and without special technical skills. Thus, PTI would most likely not find a large number of vehicles that had not been to a required modification inspection. Efficient noise monitoring based on vehicle technology can be only performed through roadside inspections by the police, so that it is impossible to prepare for an inspection.

4.1.6 Monitoring Taxation and Property Crime

Means available at PTI facilities to detect that a tax should be paid for a vehicle again or that a vehicle includes stolen parts are visual inspection and identification. From the point of view of tax monitoring this is possible in principle for modified parts but requires the inspector to have a wide case-specific knowledge base in order to distinguish between original and modified parts of each vehicle. The identification of parts that are identical to original parts with the methods available at PTI centres is limited to parts that have identification numbers as it is impossible to determine for other parts such as fuel tanks, rims, lighting equipment and seats if they are original parts of the motorcycle or identical spare parts. The above is also applied to the identification of stolen parts. Thus, the content-related efficiency of PTI in tax and property crime monitoring is unlikely socioeconomically significant.

4.1.7 Summary

Certain braking system and tyre defects can be detected with the methods used in PTI. However, the content-related efficiency of PTI is limited from the point of view of improving road safety, which was also discovered in the statistical analysis of the effectiveness of PTI (chapter 2.1.3).

The reduction of emissions depends on the regulation of emission norms and the presence of corresponding technology and the monitoring of its functioning. Presently, this applies only to a proportion of the motorcycle fleet. With respect to noise monitoring, the possibility of preemptive action reduces the effectiveness of PTI substantially. It is unlikely that PTI could detect a significant number of motorcycles with an illegal exhaust manifold, as this type of illegal activity is intentional and replacing the exhaust manifold for a PTI is simple.

In tax and property crime monitoring, the effectiveness of PTI is simply reduced by the lack of methods at PTI centres for investigating the origins of parts.

4.2 The Time of Periodic Technical Inspection and the Availability of Services

The date of PTI should not be determined as with regards to cars: around the year according to the time of first registration and register number. Flexibility would be needed in determining PTI dates for motorcycles and mopeds. From the point of view of maintenance and safety, an appropriate time for the PTI of motorcycles and mopeds would be at the beginning of the driving season in spring. However, the starting time of the driving season varies. It is affected for example by road conditions and different factors pertaining to the vehicle and its owner. The driving season lasts from March–April to October–November at the longest.

The PTI of over half a million motorcycles and mopeds from March to May would jam the services and make choosing an appropriate PTI date difficult. The congestion becomes worse if PTI services are not available at all facilities. PTI in mid or late summer or autumn would not be effective for enhancing road safety and preserving the environment, although it would spread out the timing of the demand. PTI in winter would require transporting a motorcycle or a moped to a PTI by car, which would not be reasonable, as the purpose is to inspect the functioning and condition of a vehicle that is used in road traffic. In addition, car transport would increase PTI costs.

It is also characteristic for the motorcycle hobby that the vehicle may be “under construction” at the time of a PTI for various reasons: service is delayed due to the unavailability of services or spare parts or the vehicle is still being built. These situations would also require flexibility from PTI.

Another cause of concern regarding the availability of services is the distance to the nearest PTI centre that also inspects motorcycles and mopeds. The freeing of the competition in the vehicle inspection business has increased the number of PTI centres and expanded the regional service network, but despite this in rural areas, for example in northern and eastern Finland the distance to a PTI service is often long. If the availability of PTI services for motorcycles and mopeds at all or nearly all PTI centres throughout the country is not ensured, the effort and costs involved in PTI will increase.

5 SUMMARY AND CONCLUSIONS

The impact assessment of the PTI of motorcycles and mopeds requires substantially more detailed observation of the effects of PTI on road safety and the environment than the Commission impact assessment has done or has been discussed in Finland. The potential benefits of PTI can be assessed by reviewing the classification of technical risk factors detected in accident investigations and their significance in proportion to the occurrence of accidents and by assessing the significance and controllability of motorcycle exhaust emissions as part of the total traffic emissions.

In the creation of this memorandum, it was noticed that the risk figures pertaining to technical defects observed in motorcycle accident investigations presented in the public discussion depict the number of risk factors in proportion to the total number of investigated accidents. They do not depict the detected risk factors as causes for accidents and, therefore, they do not form the appropriate basis for assessing the potential benefits of PTI. From the available Finnish and international data, the risk factor depicting the causal relation of technical defects to accidents was defined as 0.7–1.5%. The figure is clearly smaller than those presented in the Commission proposals and the public debate in Finland (3–8%).

The reduction of emission costs should focus above all on the reduction of particulate matter emissions. The possibilities to do this depend on to what extent emissions-reducing technology is taken into use in motorcycles. PTI cannot do much here. Only a general assessment of the effectiveness of PTI to curb emissions was possible to be performed in this memorandum.

The potential benefits of PTI of motorcycles for road safety were estimated to be 0.7–1.4 million euros annually (excluding mopeds) and for environmental effects around 0.14 million euros annually (both motorcycles and mopeds). Thus, annual benefits would total 0.84–1.54 euros. If it were possible to reduce personal injuries due to moped accidents in the same proportion as motorcycle accidents, the benefits would be slightly higher. Considering this, the potential savings are no more than 1–2 million euros annually.

The costs due to inspection fees were estimated to be 15.5–30.9 million euros annually. In addition, annual costs of at least 4.3 million euros would arise from PTI visits (driving costs and time spent).

Thus, it is obvious that the benefit–cost ratio of the PTI of motorcycles and mopeds would be very low in the conditions in Finland. Comparing the potential benefits only to the costs due to inspection fees gives a benefit–cost ratio of 0.06. Taking other costs to account decreases the figure even more.

The critical profitability threshold of the benefits and costs (benefit–cost ratio of 1) cannot be met in the conditions in Finland even if all accident costs pertaining to technical defects and a significant proportion of emissions and noise were eliminated with the PTI of motorcycles and mopeds. Therefore, the PTI of motorcycles is not a cost-effective method for enhancing road safety for motorcycling and mopeds or reducing their environmental load. The focus must be on other measures.

6 REFERENCES

ACEM (2009). MAIDS 2.0. In-depth investigations of accidents involving powered two wheelers.

DEKRA (2010). Motorcycle Road Safety Report 2010. Dekra Automobil GmbH.

Gynther, L. ym. (2012). Liikenteen päästökustannukset. Liikenneviraston tutkimuksia ja selvityksiä 23/2012.

Liikennevakuutuskeskus/VALT (2012) - onnettomuustutkintatietokannat.

Liikennevakuutuskeskus/VALT (2010). VALT Moporaportti 2010.

Liikennevirasto (2010). Tieliikenteen ajokustannusten yksikköarvot 2010. Liikenneviraston ohjeita 21/2010.

Statens vegvesen (2011). Special Analysis. Fatal Motorcycle Accidents 2005-2009. Report nr. 45.

Tilastokeskus - liikenneturvallisuustietokannat.

Tilastokeskus - Suomen yritykset 2002, 2007, 2009 -julkaisut.

Trafikverket (2012). Trafikverkets djupstudier av dödolyckor.

Ympäristöministeriö (2006). Meluntorjunnan valtakunnallisten linjausten hyödyt ja kustannukset. Suomen ympäristö 821/2006.

Appendix 1. Analysis of Risk Factors in Accident Investigation Data (Finnish Motor Insurers Centre/VALT 2012)

Case No	Alcohol	Overspeed (km/h)	Immediate risk (weighted value 50%)	Latent risks (weighted value 50%, mutual weighted value in relation to frequency)	Weighted value of the latent technical risk
1			Incorrect steering manoeuvre (sudden, slow, etc.)	Short driving experience	12,5%
				Unfamiliar vehicle and its devices	
				Worn tyres	
				Defective shock absorbers	
				Other risk related to a safety helmet	
				Missing traffic signs	
				Gravel surface	
				Ramps/embankments/ditches, culverts or other structure of the junction	
2	0,91	60	Did not recognise a danger in road traffic	Influence of alcohol; state after heavy drinking, cramps, spasms	8,3%
				Fatigue; decreased alertness	
				Urgent driving task/schedule	
				Too high situational speed (for the situation, conditions)	
				Defective steering device	
				Inflexible rail and other covers of the side barrier	
3	1,4	25	Incorrect assessment of own driving possibilities	Influence of alcohol; state after heavy drinking, cramps, spasms	9,1%
				Fatigue; decreased alertness	
				Driving speed greater than the limited value (speeding)	
				Too high situational speed (for the situation, conditions)	
				Worn tyres	
				Other risk related to tyres	
				Ruts	
				Trees, bushes	
				Wet, watery road; splashing water	
				Rain	
				Darkness	

4		Incorrect assessment of driving possibilities	No driver’s licence, Short driving experience	5,0%
			Need to exhibit driving skill (to others)	
			Overestimation of driving skill	
			Too high situational speed (for the situation, conditions)	
			Worn tyres	
			Powerful engine (e.g. turbo)	
			Narrow road	
			Other risk related to the road	
			Crossroads: Trees, bushes	
5	1,4	Inadequate or incorrect observation of surroundings	Influence of alcohol; state after heavy drinking, cramps, spasms	10,0%
			Too high situational speed (for the situation, conditions)	
			Other risk related to drive or gear, Technical defect in brakes	
			No lighting device	
			Lack of personal maintenance responsibility	
			Safety helmet was not used	
			Trees, bushes	
			Other collision objects	
			Dusk	
6	1,18	Incorrect steering manoeuvre (sudden, slow, etc.)	Influence of alcohol; state after heavy drinking, cramps, spasms	6,3%
			Influence of medicines/influence of lack of medicines; medicine addiction; influence of hormones	
			Other risk related to driving attitudes	
			Drunken passengers	
			Too high situational speed (for the situation, conditions)	

				Too low tyre pressure Worn tyres, Technical defect in brakes Effect of the load on driving characteristics Other risk related to passengers Unusual geometry e.g. a sudden curve Road surface damage Field stones, cobble deposit Trees, forest Wet, watery road; splashing water Dusk	
7		20	Incorrect driving line (approach to a curve, etc.)	Fatigue; decreased alertness Short driving experience; also bicycle and pedestrian traffic, for example little experience in rollerblading Spontaneous competition, racing Driving speed greater than the limited value (speeding) Speed limiter bypass Mismatch of limitation and surroundings Unusual geometry, e.g. a sudden curve Other risk related to the geometry of the road Trees, bushes Poles	5,0%
8	1,4	170	Incorrect assessment of driving possibilities	Influence of alcohol; state after heavy drinking, cramps, spasms Fatigue; decrease of alertness Other risk related to the purpose of the journey Driving speed greater than the limited value (speeding) Worn tyres Incorrect visor for the conditions Inflexible rail and other covers of the side barrier	7,1%

9	2,58	30	Incorrect observation of the other party/situation	Influence of alcohol; state after heavy drinking, cramps, spasms Fatigue; decreased alertness Other ignorance (driving history) Driving speed greater than the limited value (speeding) Technical defect in brakes Safety helmet was not used Other factor affecting collision safety	7,1%
10		40	Previous combination errors (in vehicle handling)	Attitude of driving fast (speeding violations in the driving history) Unfamiliar vehicle and devices; also for example, little experience in rollerblading Previous overtakings Driving speed greater than the limited value (speeding) Too low tyre pressure, a technical defect in brakes A curvy road Trees, forest	12,5%
11		90	Incorrect driving line (approach to a curve, etc.)	Attitude of driving fast (speeding violations in the driving history) Short driving experience; also bicycle and pedestrian traffic, for example little experience in rollerblading Driving speed greater than the limited value (speeding) Worn tyres	12,5%
12		20	Braking mistake (unnecessary, inadequate, etc.)	Attitude of driving fast (speeding violations in the driving history) Short driving experience; also bicycle and pedestrian traffic, for example little experience in rollerblading Unfamiliar vehicle and devices; also, e.g. little experience in rollerblading Driving speed greater than the limited value (speeding) Other risk related to drive or gear Unsuitable tyres for the vehicle Other risk related to tyres Tuned/built vehicle	16,7%

				Other risk related to braking	
				Ignorant/inadequate/unskilled service	
				Vehicle unprotected by a body, e.g. a motorcycle	
				Inflexible rail and other covers of the side barrier	
13	1,8		Incorrect steering manoeuvre (sudden, slow, etc.)	Influence of alcohol; state after heavy drinking, cramps, spasms	8,3%
				Fatigue; decreased alertness	
				Driving speed greater than the limited value (speeding)	
				Worn tyres	
				Powerful engine (e.g. turbo)	
				Inadequate driving suit (shoes, driving suit, floating suit, etc.)	
14	1,8	70	Incorrect assessment of driving possibilities	Influence of alcohol; state after heavy drinking, cramps, spasms	7,1%
				Influence of narcotics	
				Attitude of driving fast (speeding violations in the driving history)	
				Other ignorance (driving history)	
				Too high driving speed (in proportion to skill and vehicle)	
				Worn tyres	
				Powerful engine (e.g. turbo)	
15	2,1		Incorrect driving line (approach to a curve, etc.)	Influence of alcohol; state after heavy drinking, cramps, spasms	3,8%
				Influence of narcotics	
				Self-centred driving style (the history of driving behaviour)	
				No driver’s licence	
				Other risk related to the purpose of the journey	
				Driving speed greater than the limited value (speeding)	
				Worn tyres	
				Other risk related to driving characteristics	
				Effect of the load on driving characteristics	
				Other risk related to passengers	

				No warning of dangers and dangerous places A surprising change in condition, e.g. depression, loose sand Inadequate vehicle inspection requirements or methods	
16		85	Incorrect assessment of driving possibilities	Rush Attitude of driving fast (speeding violations in the driving history) Trusting familiar surroundings Driving speed greater than the limited value (speeding) Worn tyres Powerful engine (e.g. turbo) No Traction Control System	7,1%
17			Acceleration mistake (too intensive, etc.)	Rush Unpredictability of traffic and road conditions or their changes Driving speed greater than the limited value (speeding) Worn tyres Wet, watery road; splashing water Rain	8,3%
18			Animal	Tuned/built vehicle Ineffective lights Poor condition of the visor Vehicle unprotected by a body, e.g. a motorcycle Trees, bushes Unused road lighting Elk, deer and reindeer Black asphalt Darkness	5,6%
18	9	10			
				Average weighted value of the latent technical risk	8,5%

Cases in total	207
Cases in which one or more latent vehicle-related technical risks are mentioned	18
Proportion of all cases	8,7%
Weighted proportion of all cases	0,7%