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RESPONSIBLE CHANGE OF VEHICLE DRIVER'S DRIVING BEHAVIOURS

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Abstract. The mobility of society is an essential condition for the development of the regions. Transportation provides access to the labour market, satisfying people's daily needs, encouraging consumption and making a positive impact on the economic development of the regions. An efficient, economical and safe transport infrastructure is an essential precondition for sustainable mobility. Society can be considered as being part of the transport infrastructure, because society's everyday routine directly affects the use of infrastructure and related processes. Driver's behaviour in road traffic is an essential factor for a safe transport infrastructure. Road traffic accident statistics in each country is a significant indicator of transport infrastructure quality and its efficient usage.

The problem of the study is the negative influence of drivers driving behaviours to road safety and the necessity to propose the discussion of solutions to change these behaviours. For a solution to the defined problem, the authors put the article's objective: with the aim of determining the essential benefits from a change in driving habits, to identify preventive actions applied in practice, to improve road safety and to reduce the number of road traffic accidents.

National economic indicators affect society's behaviour and there is a direct observable correlation to road traffic accident's statistics. Serious accidents are associated with driving a car or being in a car that was involved in a road traffic accident. The issue of traffic safety needs to be addressed at a national level, however, entrepreneurs must engage in solving this problem, whereas road accidents directly affect the profitability of companies.

Key words: responsibility, society, sustainable transport, training, business.

JEL code: L62, L91, M14, M21

Introduction

Eco-driving means smarter and more fuel-efficient driving. Eco-driving represents a new driving culture that makes best use of advanced vehicle technologies, while improving road

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safety. An important component of sustainable mobility, eco-driving considerably contributes to climate protection and pollution reduction (ECOWILL, 2011).

The objective of eco-driving is to reduce average speed levels and minimise acceleration and deceleration, thereby, reducing fuel consumption, polluting emissions, noise and costs — not only of fuel but also in terms of reduced maintenance and fewer accidents. On the environmental side, eco-driving training was found to be effective in reducing fuel consumption in the short term, although longer-term analyses indicate that the impact is reduced over time. Fuel saving and speed reduction are the two targets achieved by these measures, with accident numbers and noise levels decreasing as a consequence. In both cases, cost-benefit analyses show that the measure is effective, both socioeconomically and financially (EU Sustainable Mobility Concepts, 2013).

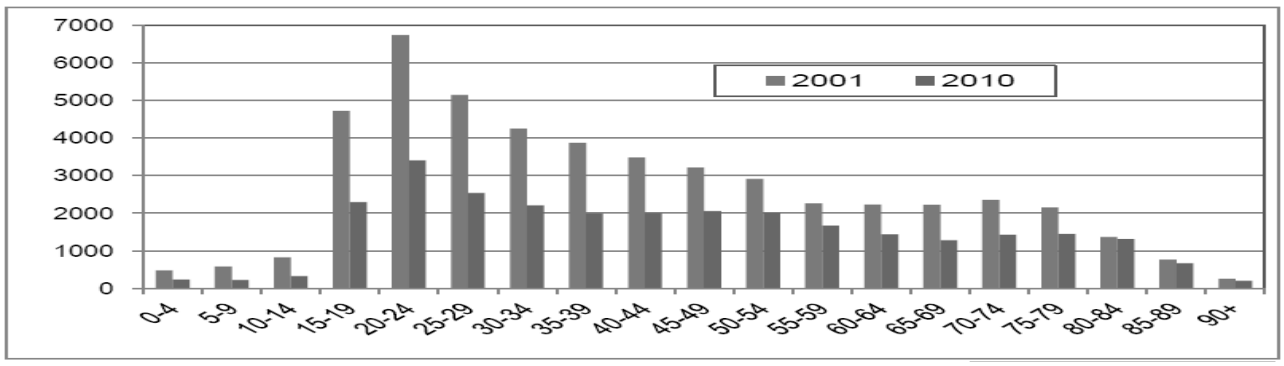
Given the worldwide popularity of eco-driving instructions, it is of the utmost importance to not only assess the real changes in terms of fuel consumption and travel time but also on emissions and safety. The joint consideration of optimal benefits for road safety and vehicle emissions is an area that merits further research because benefits to both issues are highly desirable (Carslaw et al., 2010).

Research results and discussion

Road traffic accident statistics

The authors conducted a road traffic accident analysis with the aim of identifying the main groups of drivers, which by the EU statistic data are most involved in road traffic accidents with serious consequences.

An analysis of age and gender was performed, identifying driver groups with the highest risk of being involved in road traffic accidents with fatalities. Top priority should be given to these groups in organizing educational activities related to traffic safety. Figure 1 compares the number of fatalities between the years 2001 and 2010 in groups with ranges of five years. The distribution remained broadly the same, with the highest fatality numbers between the ages of 15 and 29 years (Brandstaetter, C., et al., 2012).



Source: Brandstaetter, C., et al., 2012

Fig. 1. **Fatalities by age group, the EU-19, 2001 and 2010**

Table 1 shows the distribution of fatalities by age groups in Latvia compared with EU-24. In Latvia, as in other EU countries, the average proportion of accidents with fatalities is in working ability range between 25-59 years. This fact is an important indicator for employers of the need to educate employees about road safety.

Table 1

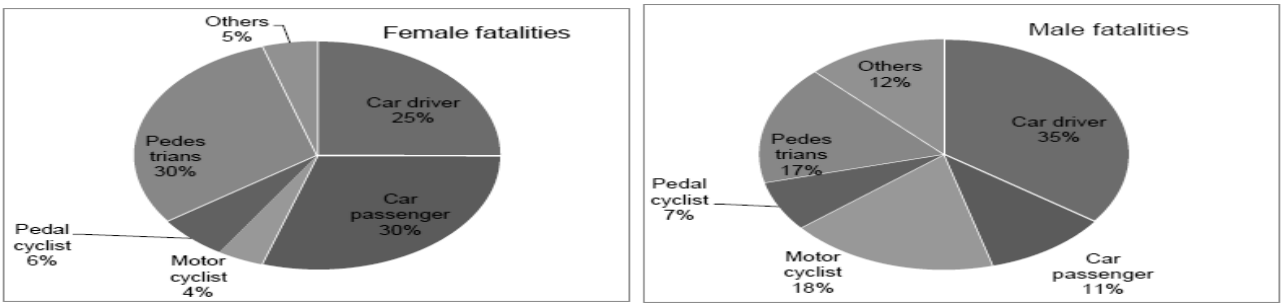
Distribution of fatalities by age group in Latvia compared with the EU-24, 2010

Age group / country	0-14	15-24	25-59	60-99	Median age
LV	4%	17%	54%	25%	45
EU-24	3%	20%	51%	27%	40

Source: Source: Brandstaetter, C., et al., 2012

An analysis by mode of transport and road user type identifies the target audience with a higher possibility of risk to be involved in road traffic accidents with fatalities. An individual educational methodology for each of these groups can be applied, according to the group's main interests and habits.

Figure 2 shows the male and female distributions of fatalities in the EU-24 by road user type, and these differ considerably. Nearly two thirds of female fatalities were car passengers (30%) or pedestrians (30%) while only 11% of male fatalities were car passengers and 17% pedestrians: 18% were motorcyclists (Broughton J. et al., 2012).

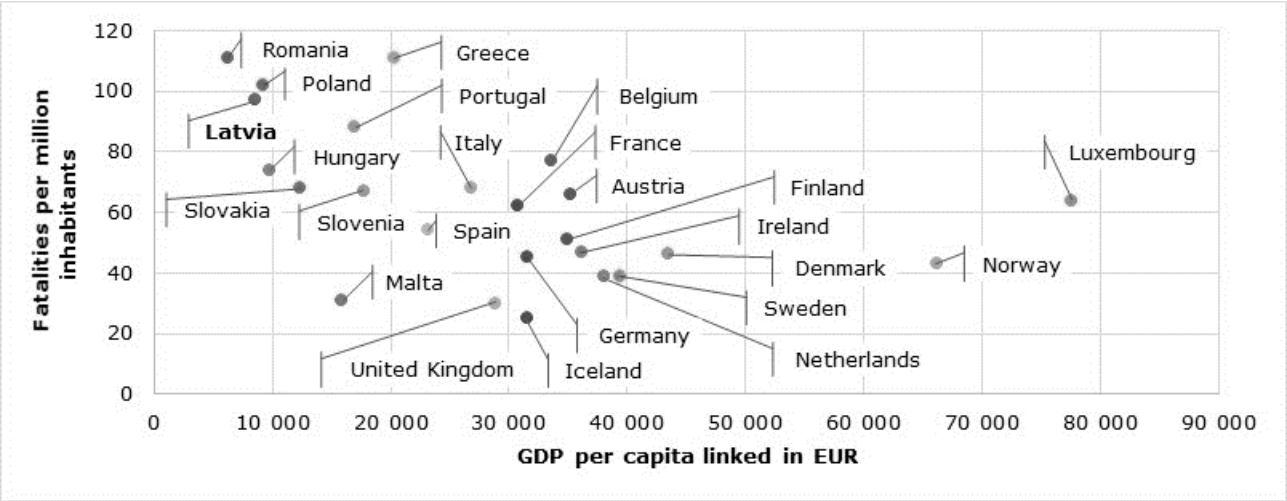


Source: Brandstaetter, C., et al., 2012

Fig. 2. **Distribution of male and female fatalities by mode of transport, the EU-24, 2010**

The authors compared **Gross Domestic Product (GDP) and geographical tendencies** indicators in Latvia with average indicators in the EU countries with the aim of making an in-depth research on improvements in traffic activities.

Figure 3 shows the distribution of fatalities per countries by GDP per capita in 2010. Countries with a lower GDP experienced tendencies with the highest rate of fatalities.



Source: Eurostat and CARE (authors' design)

Fig. 3. **Distribution of fatalities per GDP per capita, the EU-24, 2010**

The geographical representation of fatality rates in Figure 3 shows a tendency for rates to be lower in the North than in the South and lower in the West than in the East, which is probably the result of different historical backgrounds and policies for traffic safety (Brandstaetter, C., et al., 2012). Hungary and Slovakia have a similar GDP as in Latvia but with slightly more positive traffic accident statistic. The national traffic safety departments of these countries should conduct exchanges of experience on improvement activities, and community groups with similar financial capabilities could also take part in such activities. Similarly, the authors propose a further in-depth study of Iceland, the United Kingdom, Malta, the Netherlands and Sweden regarding traffic safety experience and activity since the statistical rates of fatalities in these countries are the best in the EU.

From the data in this section the authors conclude that national economic indicators affect society's behaviour and there is a direct observable correlation to road traffic accident statistics. Accidents with serious consequences resulting from common causes are shown in the South-Eastern countries (including Latvia) and they are associated with driving the car or being in a car that was involved in a road traffic accident.

Road traffic accident consequences impact on society

Road traffic accidents reduce or permanently change the quality of life for the victims and for their families, negatively affect the economic situation of the drivers who caused the accidents as well as negatively affecting health care capacity, performance of public health statistics, insurance and legal institutional capacities.

A road crash can have far-reaching and long-term consequences, not only physically but also psychologically and socially, and not only for the victim but also for his/her relatives and friends. Sometimes, longer-lasting support may be needed, either by professionals or by volunteers. In medical terms, the psycho-social support has to be understood as a preventive measure, since traumatic events like road crashes can create post-traumatic stress disorder

which result in further health risks and damage (European Commission. Best practices in road safety, 2010).

The health benefits of improving fuel consumption, and the resulting lower emissions, are harder to determine, there is a growing consensus that they do exist. Improving safety also has financial and health benefits. Road trauma results in high economic and social costs, both in lost productivity and demands on the health system (Rakotonirainy et al., 2011).

In economic terms, the cost of road crash injuries is estimated at roughly 1% of gross national product (GNP) in low-income regions such as Africa, Asia, Latin America and Caribbean; 1.5% in middle-income regions such as Middle East, Central and Eastern Europe; and 2% in high-income and highly motorized countries such as Australia, Japan, New Zealand, North America and the Western European countries (Peden, M, 2004).

Regardless of the costs of health care and rehabilitation, injured people bear additional costs. Eighty-five percent of the families of disabled road traffic survivors reported a significant decline in their quality of life. In all countries, the loss of income earners and the costs of funerals and prolonged care for disabled people can push families into poverty. A recent study in Bangladesh found that 21% of road traffic deaths occurred to household heads among non-poor people versus 32% among poor people. Three quarters of all poor families who had lost a member to road traffic death reported a decrease in their standard of living, and 61% reported that they had had to borrow money to cover expenses following their loss. Families who are deprived of the earning capacity of members disabled by road traffic injuries and who are burdened with the added cost of caring for these members may end up selling most of their assets and getting trapped in long-term indebtedness (Peden M. et al., 2004).

The authors conclude that accidents have a negative impact on revenues of the economic and social sphere that would otherwise have been possible to deflect for improvement to the public's overall health and quality of life. The long-term rehabilitation of the working ability population brings losses to employers, who are forced to hire and train additional employees, and also reduces the effectiveness of the social system and the development in the long run.

Eco-driving training effect

In this chapter, the objective of the authors is to analyse and evaluate the effectiveness of eco-driving training of several target groups with different cultures and habits.

Driving behaviours can influence both fuel economy and safety. A positive correlation between crash rates and fuel consumption was found in a large corporate fleet (Haworth & Symmons, 2001). In contrast, another study demonstrated that the drivers who had the lowest fuel consumption were not necessarily the safest or those who complied with the eco-driving instructions (Saint Pierre et al., 2010).

A recent French study involving 1,200 passenger vehicles has shown that most of the drivers ignore the main Eco-driving instructions despite their strong motivation in reducing their fuel consumption (Delhomme, Paran & Nicolas, 2010).

Managing driver safety, for example, could not only reduce the number of accidents but also lead to lower insurance costs and result in less down time for staff members and their vehicles. Cars driven correctly can also result in savings in fuel costs and employees who have polished their skills through attending a driver training course, for example, are likely to feel less stressed when driving on business. The promotion of better health and safety driving practices could even spill over into an employee's private driving which, in turn, could reduce their risk of being injured in an accident outside of working hours (Centaur Media plc, 2006).

At the core of many eco-driving programmes, a variety of advice is provided to drivers to minimize fuel consumption while driving. Different eco-driving programmes in Europe have been found to yield fuel economy improvements on the order of 5 to 15% (Onoda, 2009). The study in Vietnam has ascertained the positive effect of the eco drive activities on vehicle fuel efficiency improvement. The findings have shown that the average fuel reduction is about 6.0% and 2.0% in suburban and inner city courses, respectively. Although the reduction results are not so high, it shows a potential for introducing eco-driving as a friendly environmental technique to road transport system towards GHG improvement (Hiep et al., 2013).

The safer driving behaviour results from: an anticipating driving style; maintaining a steady speed; less speeding; less overtaking; less stress/aggressiveness. Eleven months after eco-driving training, a German company HAMBURGER WASSERWERKE effected fuel consumption reductions of more than 6%, accidents and related costs could be diminished by more than 25%. Eco-driving programmes prove to be very cost-effective. The Dutch eco-driving programme results in a cost-effectiveness of about €5 per avoided ton of CO_2 emissions over a period of 10 years. CANON COMPANY in Switzerland trained the eco-driving style with 350 service car drivers in VSZ VELTHEIM. The drivers reduced fuel consumption by 6.1%, had 22% more km per accident and 35% less accidents in total (ECOWILL).

The drivers who had received training tended to decelerate earlier, using momentum. They drove more smoothly and in a much more proactive way and thereby saved a lot more fuel than before. In the driver group which had received training the fuel economy in the second and the third month after the training amounted to 6.8%. Six months after that, it was still at 3.7%. In the control group which had not received any training, no such reduction in fuel consumption occurred. During the test drives the speed of both groups was practically identical. The pre-post comparison showed that the journey time for the daily tour had not increased (ECOWILL).

The impact of technology use

One potential way to change drivers' behaviour on the road is to use feedback technologies. The purpose of this chapter is to identify the benefits of the use of technological solutions that can have a positive influence on road safety.

Vehicle's built-in eco-driving supported technologies

Numerous studies have been conducted in which car manufacturers such as Fiat, Ford, Toyota, and Nissan tested feedback technologies using on-board systems to enforce a sustainable driving behaviour. An obvious link between financial benefits and individual's motivation to reduce their fuel consumption was highlighted (Tulusan et al., 2012).

The study by Boriboonsomsin (2010) in the United States evaluated how an on-board eco-driving device that provides instantaneous fuel economy feedback affects driving behaviours, and consequently fuel economy, of gasoline-engine vehicle drivers in the United States under real-world driving conditions. The results show that on average the fuel economy on city streets improves by 6% while the fuel economy on highways improves by 1%.

The latest vehicles have technologies using on-board systems to enforce a sustainable driving behaviour such as gear change monitor and eco-driving mode. This equipment is available as standard and buyers' choice is not based on their willingness to improve driving safety. The traffic safety equipment selection, as for example City Safety System, Pre Crash System, Collision Avoidance System, Night Vision System, and Pedestrian Detection System i.e., are purchasing options and no separate research has been made indicating the main factors of consumer's motivation in choosing these options.

The smart phones

As smart phones are becoming increasingly available, several applications have been created to use the phone's internal technologies, such as GPS and accelerometer, to deliver context related feedback to drivers. Examples of these applications are: DriveGain, EcoDrive, GreenMeter, Fuel Saver, Green Driver, BlissTrek, iEcoMeter, Green Gas Saver. However, compared to other available eco-driving technologies (i.e. in-vehicle -, on-board -, or navigation systems), eco-efficient smart phone technologies seem, at present, underutilized. Feedback types identified to reduce fuel consumption were: correct gear changing during acceleration and smooth acceleration (Tulusan et al., 2012).

Global positioning systems (GPS)

Even though the technology has been out there for quite a while, only recently GPS fleet tracking solutions became available to small and medium size enterprises. Before that only the largest and wealthiest companies were able to afford GPS tracking, now the situation has changed. Not only are there a lot more enterprises that can afford these services, but there is also a big demand for them. GPS tracking solutions have proved to be an effective tool that helps companies reduce their costs, increase efficiency and have more control over their vehicles. GPS tracking combined with fuel monitoring devices can help analyse driven routes and fuel consumption data in order to optimize transportation services (Zarins, 2014).

A Research programme by Vonk (2007) proves that GPS solutions have a positive effect on traffic safety. Key findings: the use of car navigation improves the driver's behaviour when driving through an unknown area; heightens alertness and reduces the stress levels of the

driver; reduces the amount of miles driven by 16%; reduces travel time when driving through an unknown area to an unknown destination by 18%; reduces the workload (the amount of effort it takes the driver to drive) of the driver when travelling through an unknown area to an unknown destination. Drivers who do not have the use of a GPS solution have 12% more damage claims.

Conclusions, proposals, recommendations

1. National economic indicators affect society's behaviour and there is a direct observable correlation with the road traffic accident statistics.

2. Road traffic accidents with serious consequences are mostly in the working ability age range between 25 and 59 years and are associated with driving the car or being in a car that was involved in a road traffic accident.

3. Road traffic accidents have a negative impact on the economic and social sphere that would otherwise have been possible to deflect for improvement to the public's overall health and quality of life.

4. Driving behaviours of individuals can influence fuel economy and traffic safety. The promotion of better health and safety driving practices could even spill over into an employee's driving which, in turn, could reduce their risk of being injured in an accidents.

5. Eco-driving supported technologies for vehicles positively affect driving behaviours and consequently fuel economy. Technological solutions have proved to be an effective tool that helps companies reduce their costs, increase efficiency, improves the driver's behaviour and reduces the stress levels of the drivers.

To improve road safety and socio-economic prosperity in a long term, it is recommended to change the vehicle driver's driving behaviours at a national level. The authors propose to start discussions to incorporate eco-driving training programme elements as a mandatory in car driver's certification programmes; for the youngest drivers, who just received a driver's licence between the ages of 15 and 29 years, it is proposed to restrict ability to drive the vehicles (or other motorised transports) with high engine power and to incorporate the two level of re-examination programme with eco-driving principles as well as with training in different difficult road (wet, slippery, icy i.e.) conditions included.

For the preventive improving the company's efficiency and staff healthy, the authors recommends the following activities for entrepreneurs:

1. To introduce mandatory briefing on traffic safety and eco-driving principles for employees as well as introducing preventive educational activities that can mitigate potential traffic risks;

2. To include in transport fleet purchases a mandatory criteria, which would request that eco-driving and fuel consumption assistance features be installed in the vehicles;

3. To implement in transport fleets operation the technological and administrative solutions to control economic usage of the vehicles as well as to use the electronic devices (for example GPS systems) to support the driving mode and to control fuel consumption.

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