Operational Research in Engineering Sciences: Theory and Applications
Vol. 2, Issue 1, 2019, pp. 15-26
ISSN: 2620-1607
eISSN: 2620-1747
DOI: https://doi.org/10.31181/oresta1901001s

EVALUATION OF THE ECO-DRIVING TRAINING OF PROFESSIONAL TRUCK DRIVERS

Tatjana Savković [a]*, Milica Miličić [a], Pavle Pitka [a], Ivana Milenković [a], Dejan Koleška [b]

[a] Faculty of Technical Sciences, Trg Dositeja Obradovića 6, Novi Sad
[b] Scania BH D.o.o., Sarajevo, Bosnia & Herzegovina

Received: 23 November 2018
Accepted: 16 February 2019
First online: 04 March 2019

Original scientific paper

Abstract. *The paper presents the evaluation of the Eco-driving program impact (classroom with on-road instructions) on truck drivers' operation parameters. A total of 8 professional truck drivers were tested in the real driving conditions. Evaluation of the training impact on the drivers' behavior was done in three periods: intervention period (P1), one month after training (P2) and four months after training (P3). Data was collected with the assistance of the Scania Fleet Management System™. Fuel economy and CO_2 emission, idling time and coasting were significantly improved in the periods P2 and P3 compared to period P1 while speeding significantly increased. Statistically, the use of the brake did not significantly change in the first and fourth month after the completed training in comparison to the intervention period. The drivers' adoption of the eco-driving tips showed that statistically significant differences in fuel consumption and brake usage were obtained. This study shows that the use of the eco-driving techniques has got a potential for significant short-term reduction of fuel consumption and CO_2 emission in road transport; hence in the future the research studies will deal with the effects of training and potential downtrend in the long run (> 6 months). Also, future research projects should analyze the impact of the drivers' socio-economic characteristics on the application of the eco-driving instructions.*

Key Words*: Eco-driving, Truck Drivers, Effect Evaluation, Operation Parameters*

1. Introduction

Road transport produces over 80% of emissions of harmful substances within the European Union transport sector. The road transport (passenger and freight) will especially continue to dominate in the total fuel consumption, with the demand for energy in the road transport considered to be reaching 80% of total demand in the transport sector by the year of 2050 (Kojima & Ryan, 2010). Given these facts, the

* Corresponding author.
savkovic.t@uns.ac.rs (T. Savković), mmilica@uns.ac.rs (M. Miličić), pitka@uns.ac.rs (P. Pitka), milenkovic@uns.ac.rs (I. Milenković), dejan.koleska@scania.ba (D. Koleška)

fuel economy and, subsequently, greenhouse gas emissions in this section are of the highest priorities of all the countries. The manner in which the vehicle is operated has an important impact on fuel consumption so that the driver training leads to reduction of fuel consumption (Barkenbus, 2010; ECMT, 2005) and, subsequently, emission reduction.

Eco-driving involves a series of simple rules for maximizing fuel economy of the existing cars while minimizing CO_2 emission. It is a modified way of driving that is the most suitable for modern engine technology.

Studies (Decicco & Ross, 1996; El-Shawarby, Kyoungho, & Hesham, 2005) confirm a technical aspect of the eco-driving program, namely, its operations affecting fuel consumption upmost in driving (for example, in acceleration, deceleration, maintaining constant speed and idle vehicle operation). Eco-driving in Europe, in accordance with the programs and studies (CIECA, 2007; Zarkadoula, 2007) includes the following technical regulations which are of relevance for inducing changes in the driving behavior: maintaining a steady driving speed, turning off engine at the traffic lights (while parked, when loading and unloading, etc.), an appropriate level of transmission in comparison to the type of transmission and an efficient use of brakes.

Apart from the technical recommendations, eco-driving tips also require practical advices that refer more to the restraining of driving habits and drivers' behaviors which are in accordance with the driving patterns. Studies (Wilbers, 1999; Fujikawa & Taniguchi, 2002; Ukita & Shirota, 2003; Matsuki, 2006; Barth & Boriboonsomsin, 2009; IEE, 2008) have prompted eco-driving tips which included: improvement of vehicle maintenance and that of aerodynamics, prediction of traffic conditions, avoidance of excessive vehicle weight, choice of appropriate fuel or motor oil, control of unnecessary use of equipment in the vehicle and the use of on-board computer and navigation systems (for example, simulators, driving systems, cruise control, GPS, engine speedometer, etc.)

Numerous studies have proved a feasible fuel economy of between 5% and 10%, and even in some cases, over 20% (FIAT, 2010; Wilbers, 1999; Onoda, 2009). Reduced fuel consumption also affects reduction of CO_2 emission ranging from 5-25% (Barkenbus, 2010; Mensing, Bideaux, Trigui, & Tattegrain, 2013; Onoda, 2009). The eco-driving benefits are not only limited to the reduction of CO_2 emission, and to fuel economy but are far more extensive as indicated in the given studies (CIECA, 2007; Intelligent Energy Europe, n.d.; Lauper, Moser, Fisher, Matthies, & Kaufmann-Hayoz, 2015):

- Noise reduction,
- Advancement of traffic safety,
- Minimizing of drivers' stress (that occurs when overtaking and speeding),
- Improvement of driving comfort,
- Positive influence on vehicle parts wear and tear or maintenance (for example, brakes, pneumatics), and,
- Improvement of travel time.

In this study, the evaluation of the eco-driving training efficiency was done (classroom with on-road instruction training) through operation parameters (Fuel consumption, CO_2 emission, idling time, braking events, speeding, coasting) of 8 professional truck drivers over a short-term period, and in the first month after the P2 training and the fourth month after the P3 training in comparison to the P1 training period. Besides, there is an approach which analyzes the differences in the adopted instructions among the drivers trained for eco-driving.

2. Methodology

2.1 Participants

The drivers received in-vehicle feedback (advices) and classroom training. They all volunteered to participate in the research and they did not have previous experience with the eco-driving. The drivers' average age was 32 years with SD=3.46 and their average driving experience was 7 years (SD=2.42).

2.2 Testing vehicle

When testing the drivers and measuring the operation parameters, the SCANIA model S500A4*2LA™ tractor truck composition was used, with the semitrailer Schmitz™ that was fully loaded in order to create more realistic driving conditions.

2.3 Testing route

The length of the tested route is 26,2 km in the urban and rural area of Derventa (Fig. 1). Both driving tests (before and after the training) were completed on the same route in order to avoid deviations in fuel consumption because of different distances whereas the parameters that affect fuel consumption remained identical (pressure in the pneumatics, load, etc.). In relation to the decline characteristics of the observed route, 8 sections with different lengths were formed. The biggest incline of 4.38% along the testing route was recorded in the section 4, 2.1 km long, whereas the biggest decline of 2.80% was recorded in the section 5 which is 0.5 km long (Fig. 2). These characteristics of the slope provide an opportunity for the drivers to apply the advices they received during the training on uphill-downhill driving and thus reduce fuel consumption.

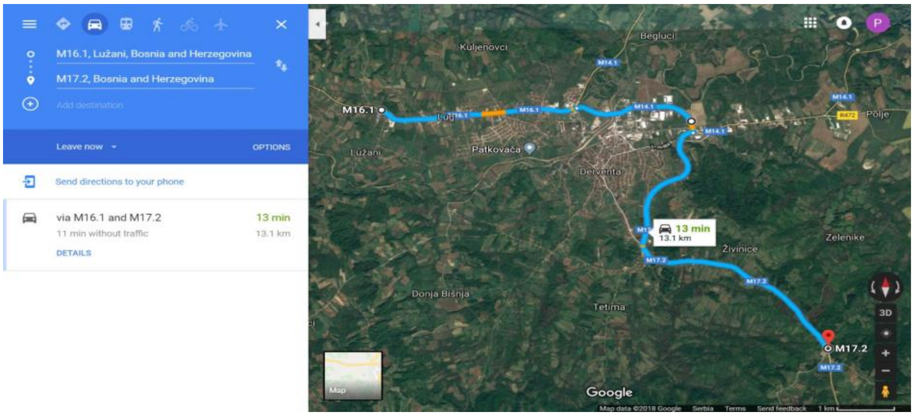

Figure 1 Testing route

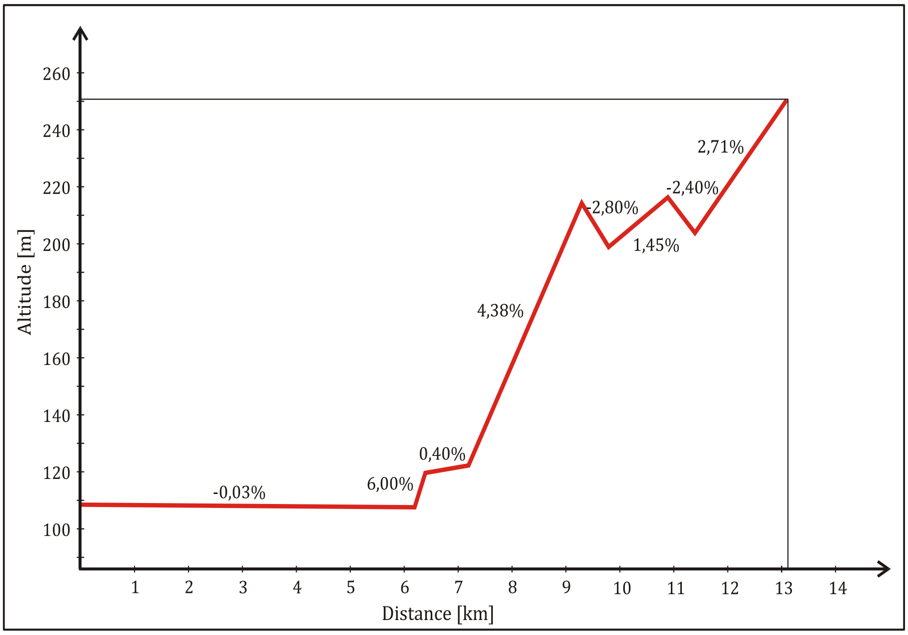

Figure 2 Slope characteristics on testing route

2.4 Measurement results

Results of the measured parameters show their monthly average values. Results comparison of the tested driving parameters (fuel consumption and other parameters) intervention period (P1), one month after training (P2) and four months after training (P3) are presented in Table 1.

2.5 Chronological phases

Phase 1: Intervention Period: March 1 to 31 March, 2018: eco-driving training was conducted for all the drivers and in-vehicle advices were given to the drivers.

Phase 2: Off Period: April 1 to 31 July, 2018: no in-vehicle advices, no eco-driving training – the driving after eco-driving interventions.

Table 1 Training diagnostic data (intervention period, one month after training and four months after training)

Training data	Periods	Driver								
		D1	D2	D3	D4	D5	D6	D7	D8	Avg.
Distance (km*10^3)	P1	22.97	24.61	21.68	22.55	22.49	23.28	22.21	26.26	23.26
	P2	35.13	37.96	31.09	33.72	30.89	35.99	32.77	38.42	34.50
	P3	72.92	82.25	72.20	75.27	63.04	77.15	73.89	81.86	74.82
	Avg.P2/P1 (%)	52.95	54.25	43.46	49.52	56.49	54.57	47.51	46.31	50.63
	Avg.P3/P1 (%)	>100	>100	>100	>100	>100	>100	>100	>100	>100
Fuel consumption (l/100km)	P1	26.3	29	26.1	26.1	26.5	26.2	24.6	27.2	26.50
	P2	23.9	26.6	25.8	25.0	24.8	24.7	22.8	26.6	25.03
	P3	24.2	26.5	25.4	23.2	24.2	25.1	23.7	26.1	24.80
	Avg.P2/P1 (%)	9.12	-8.27	-1.15	-4.21	-6.41	-5.72	-7.32	-2.21	-3.27
	Avg.P3/P1 (%)	-7.98	-8.62	-2.68	-11.11	-8.68	-4.19	-3.66	-4.04	-6.37
CO_2 emission (kg/km)	P1	0.28	0.44	0.32	0.33	0.31	0.32	0.33	0.41	0.34
	P2	0.22	0.25	0.21	0.22	0.18	0.23	0.19	0.22	0.22
	P3	0.11	0.13	0.13	0.12	0.11	0.13	0.12	0.13	0.12
	Avg.P2/P1 (%)	-21.42	-43.18	-34.38	-33.33	-41.94	-28.13	-42.42	-46.34	-36.39
	Avg.P3/P1 (%)	-60.71	-70.45	-59.38	-63.63	-64.51	-59.38	-63.63	-68.29	-63.75
Idling time (min/10^3 km)	P1	41.40	41.89	41.71	46.70	45.54	38.48	34.80	46.91	42.27
	P2	21.95	25.08	42.88	26.90	20.49	18.71	22.03	27.10	25.48
	P3	14.84	12.86	11.74	21.18	13.75	19.27	12.20	18.53	15.63
	Avg.P2/P1 (%)	-46.99	-40.11	2.82	-42.39	-55.00	-51.39	-36.70	-42.24	-39.71
	Avg.P3/P1 (%)	-64.17	-69.30	-71.85	-54.64	-69.80	-49.92	-64.92	-60.50	-63.03
Brake applications (#/100km)	P1	25.8	24.4	32.9	23.9	30.9	25.2	24.9	20.4	26.05
	P2	23.1	24.9	41.1	25.8	26.7	27.0	20.3	21.8	26.34
	P3	23.1	31.3	42.8	27.3	29.9	30.6	19.8	19.5	28.04
	Avg.P2/P1 (%)	-10.46	2.05	24.92	7.95	-13.59	7.14	-18.47	6.86	0.80
	Avg.P3/P1 (%)	-10.46	28.27	30.09	14.22	-3.24	21.43	-20.48	-4.41	6.93
Speeding (% of engine running time)	P1	11.5	1.4	2.1	20.6	0.4	11.5	0.8	0.8	6.14
	P2	40.9	1.5	27.1	35.3	9.9	31.1	23.9	38.5	26.03
	P3	38.7	5.4	14.6	40.0	8.7	37.1	28.6	40.1	26.65
	Avg.P2/P1 (%)	>100	7.14	>100	71.35	>100	>100	>100	>100	>100
	Avg.P3/P1 (%)	>100	>100	>100	>100	>100	>100	>100	>100	>100
Coasting (% of distance driven)	P1	15	16	11	19	13	17	16	17	15.50
	P2	17	18	12	20	14	19	17	18	16.88
	P3	18	18	19	18	16	19	18	19	18.13
	Avg.P2/P1 (%)	13.33	12.5	9.09	5.26	7.69	11.76	6.25	5.88	8.97
	Avg.P3/P1 (%)	20.00	12.5	72.72	-5.26	23.07	11.71	12.5	11.76	19.88

2.6 Training

This study combined classroom training with on-road instructions by the instructor. The typical eco-driving training course consists of a test drive before the classroom training where the drivers learn the eco-driving principles. After the classroom training, the second test drive is conducted during which the instructor is advising the drivers. After the second test, the results are analyzed and compared. Characteristics of the training are as follows: they are relatively expensive; a small number of people can be trained simultaneously because of the limited capacity, and the training has a great impact on the change of the driving behavior over a short period of time (Basarić, et al., 2017; Barać, Zovak, & Periša, 2013; Husnjak, Forenbacher, & Bucak, 2015). A short resume of the training can be found below.

All the participants completed the test drive held by the instructor in Derventa, before completing the classroom training on 13th March 2018 (driver 1 – driver 4) and 14th March 2018 (driver 5 – driver 8) between 9 a.m. and 11:30 a.m. which served as the base point in comparison to the test drive after the training. After that, a 90-minute-long classroom training session (from 12 a.m. to 13:30 p.m.), was held for the same group of drivers during the above periods of time. The purpose of this classroom training is to encourage the drivers to apply techniques of eco-driving after their training (for example, smooth acceleration and deceleration, turning off the engine when the vehicle is idle, predicting traffic conditions, maintaining constant speed, using engine braking, etc.). After the classroom training, the second test drive was conducted from 14 p.m. to 16:30 p.m. combining the techniques learnt from the classroom training with instructions from the instructor during the same drive. In order to assess the effects of the training, the results obtained after the second drive were discussed with the drivers.

2.7 Data collection

Data were collected with the assistance of the Scania Fleet Management System™. The Scania Communicator C300™ is connected to the vehicle *via* CAN bus, and *via* GSM network on the Scania server. All the data related to the work of vehicles and drivers can be found by logging on to the portal.

3. Results and discussion

The focus of this research study was to determine the impact of eco-driving training on drivers' behavior. A special attention was given to the analyses of the vehicle operation indicators, i.e. how the driver operates the vehicle during the training period (P1), in the first month after the training (P2) and in the fourth month after the training (P3).

Table 1 and Figs. 3-4 compare the average measuring driving quality indicators (fuel consumption, CO_2 emission, idling time, brake usage, coasting, and speeding) between the intervention period (P1), one month after training (P2) and four months after training (P3).

The values are calculated as averages for all eight drivers. Although there was a significant increase in speeding (>100%) in the first month after the training (P2) in comparison to the intervention period (P1), until an increase in braking (1,1%), there was still a small reduction in fuel consumption by 3.27% and CO_2 emission by significant 36.39%. There was also an increase in coasting by 8,97% in P2 period, i.e. the drivers used more the vehicle's motion without pressing the accelerator, and a reduction of idling by 39.71%, i.e. the drivers were often turning off the idle vehicle. This shows how idling has a significant impact on fuel consumption and, consequently, CO_2 emission. Accordingly, Beusen et al., (2009) established that 1.5% reduction of engine idling reduces an average fuel consumption by 5%, four months after completing the eco-driving course. The findings show that idling fuel cost per truck per year with six hours of idling per day is $4,134 (Omnitracks, n.d.). In addition, the literature indicates a significant impact of coasting on fuel consumption which was also established in this study. If the vehicle is moving on the straight road, coasting could reduce fuel consumption by 7,9% (Shakouri, Ordys, Darnell, & Kavanagh, 2013) whereas the coasting downhill could reduce fuel consumption by 5% (Koch-Groeber, n.d.).

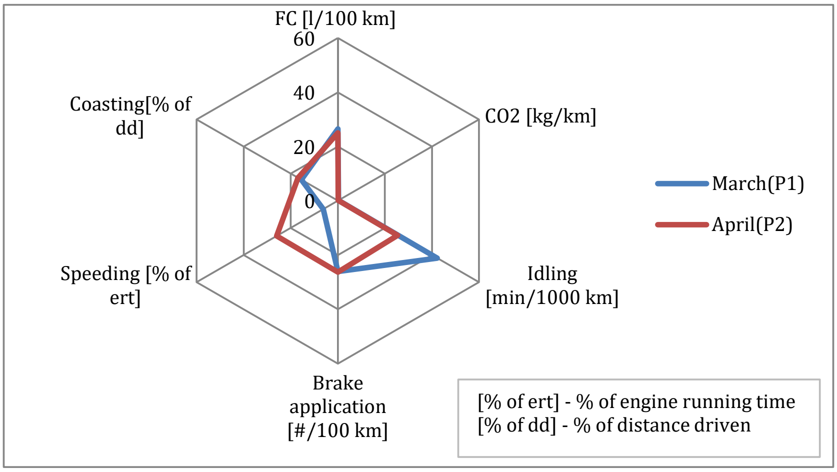

Figure 3 Radar chart with average results of eco-driving training - period P1 and period P2

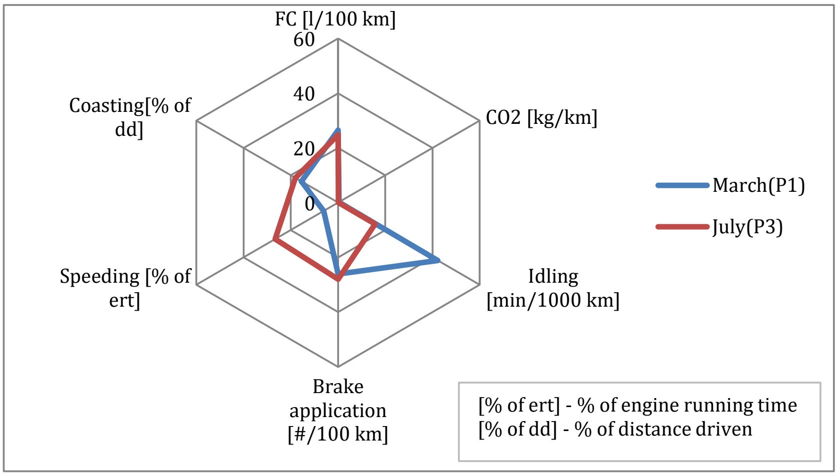

Figure 4 Radar chart with average results of eco-driving training - period P1 and period P3

There was a reduction in fuel consumption and CO_2 emission in period (P3) compared to intervention period (P1) by 6.37% and 63.75%, respectively, whereas the other observed parameters had the same tendency as in comparison to period P2 but significantly distinctive in P3 period. Accordingly, there was an increase in speeding by >100%, braking increased by 6.93% vehicle's engine running when the vehicle is not in motion decreased by 63.03%, and coasting increased by 19.88%. This case also shows that the increased vehicle motion without braking and when coasting, turning off the vehicle while idle, have a positive impact on fuel consumption and CO_2 emission.

The collected data were statistically analyzed in order to assess the effectiveness of the eco-driving training program in a short term period. The statistical evaluation of the driving parameters was conducted in the statistical program MINITAB 17 using ANOVA one-way (at 5% significance level) and Kruskal-Wallis test if there was no data correspondence with normal distribution. These tests were used to determine whether there was a statistically significant difference in the mentioned parameters by periods. Congruency with the Normal distribution was tested using Anderson-Darling Test, which showed that the fuel consumption and CO_2 emission values were susceptible to normal distribution unlike the values of idling time, brake applications, speeding and coasting. In 5 parameters (fuel consumption, CO_2 emission, idling, speeding and coasting) there is a statistically significant difference in values depending on the observation period (Table 2). In fuel consumption, CO_2 emission, idling time and coasting there was a significant improvement after the intervention period, while the speeding significantly increased in the periods after the training, which is negative.

Table 2 Summary statistics of variables by periods

Variable	Fuel consumption	CO_2 emission	Idling time	Brake application	Speeding	Coasting
AD test	0.481	0.071	0.011	0.023	0.010	0.007
P-value	0.025	0.000	0.000	0.851	0.009	0.050

Note: AD test - Anderson-Darling test

The Tukey comparison results are also used to formally test whether the difference between a pair of groups (P1-P2; P1-P3; P2-P3) is statistically significant in fuel consumption (FC) and CO_2 emission. The figures that include the Tukey simultaneous confidence intervals (Fig. 5, 6) show that the confidence interval for the difference between the means of four pairs these two parameters (P1 FC - P3 FC; P1 CO_2 – P2 CO_2; P1 CO_2 – P3 CO_2; P2 CO_2 – P3 CO_2) does not include zero which indicates that the difference is significant, i.e. the values of CO_2 emission were significantly improved in P2 and P3 periods compared to P1 period as well as period P3 compared to P1 period in terms of fuel consumption. The pairs P1 - P2 and P3 - P2 in fuel consumption have zero in the confidence interval which means that there is no statistically significant difference in fuel consumption between the periods P1 and P2 as well as P2 and P3.

To determine the difference between the pairs (levels), for parameters: idling time, speeding and coasting, the Mann-Whitney test was used. It helped establish the differences between all the pairs of the idling time parameter (P1-P2; P1-P3; P2-P3) with their p-values<0.05 as: 0.00009; 0.0009 and 0.0028, respectively. This indicates that the values of the vehicle's engine running, when the vehicle is not in motion, significantly improved in the first and the fourth month after the completed training. In addition, a significant improvement of the motion of the vehicle that is speeding without accelerating was confirmed in the period P3 compared to period P1 (p=0.0209). The differences were not detected in the pairs: P2-speeding and P3-speeding (p=0.7929); P1-coasting and P2-coasting (p=0.2076); P2-coasting and P3-coasting (p=0.3446), which indicates that there is no statistically significant difference in their medians (Table 3).

Table 3 Mann-Whitney test and Tukey comparison results

Variable	Fuel consumption	CO_2 emission	Idling time	Speeding	Coasting
Test	Tukey comparison - (interval)		Mann-Whitney test - (p-value)		
P1-P2	(-3.03489, 0.0848897)	(-0.170315, -0.0846847)	0.00009	0.0101	0.2076
P1-P3	(-3.25989, -0.140110)	(-0.262815, -0.177185)	0.0009	0.0101	0.0209
P2-P3	(-1.78489, 1.33489)	(-0.135315, -0.0496847)	0.0028	0.7929	0.3446

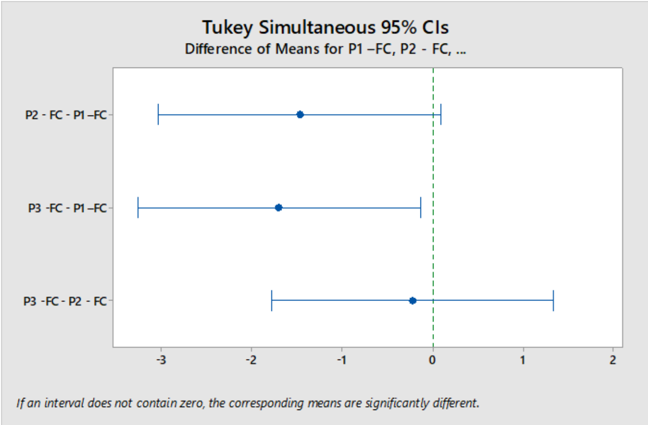

Figure 5 Tukey pairwise comparison of fuel consumption

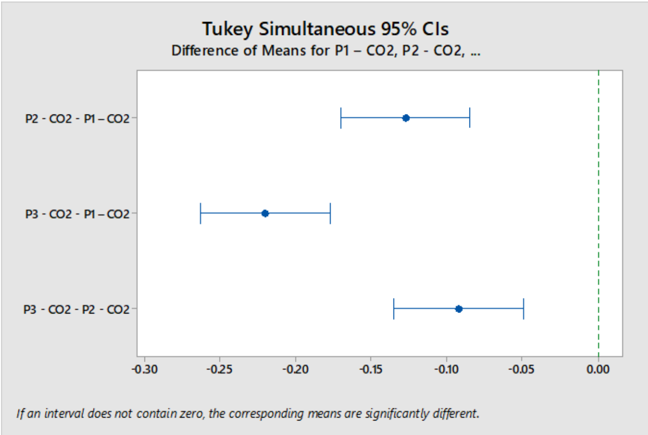

Figure 6 Tukey pairwise comparison of CO_2 emission

There is also an approach to the statistical analysis which serves to determine whether there is a difference in the adopted eco-driving instructions among the drivers. When analyzing the normality of the data set, the same p-values for the Anderson-Darling test and the eco-driving training analysis by periods, have been obtained. Accordingly, to check on whether there was a statistically significant difference in the mentioned parameters among the drivers, appropriate statistical tests have been applied in the analyses, namely, ANOVA one-way (at 5% significance level) and Kruskal-Wallis test subject to data compatibility with Normal distribution. In fuel consumption and brake usage there is a statistically significant difference in values among the drivers with $p<0.05$ (Table 4). In the other analyzed parameters no statistically significant difference has been found. Even though the drivers are of the same age and driving experience without major deviations, this points to the fact that the socio-economic characteristics of the drivers can be a significant factor for the way the eco-driving instructions are adopted and applied.

Table 4 Summary statistics of variables by drivers

Variable	Fuel consumption	CO_2 emission	Idling time	Brake application	Speeding	Coasting
AD test	0.481	0.071	0.011	0.023	0.010	0.007
P-value	0.019	0.992	0.971	0.012	0.155	0.127

Note: AD test - Anderson-Darling test

Economic benefit of eco-driving

Fuel consumption economy estimate enables calculation of the eco-driving economic benefits. If each truck spent around 32,000 liters of fuel annually, with the average fuel consumption savings of 3.27%, it could save 1,046.4 liters of fuel per truck per year. If an average cost of one liter of fuel was 1.18EUR, the annual savings per truck would be 1,235EUR. Economic gains could be even greater if we took into account a higher fuel consumption economy of 6.37% the drivers achieved 4 months after the training, on average. These savings are in accordance with the previous research results (Barać, Zovak, & Periša, 2013). They determined that the implementation of the eco-driving training could save around 1,505EUR per one commercial vehicle per year.

4. Conclusion

In this paper, the effects of the eco-driving program on the drivers' vehicle operation have been shown in a short-term period. Moreover, the effects of the driver eco-driving training were analyzed in the training period (P1) and in the first month (P2) and the fourth month (P3) after completing the training in relation to fuel consumption, CO_2 emission, idling time, brake usage, speeding and coasting. The obtained results are in accordance with the literature by showing how, with the implementation of the eco-driving, a reduction in fuel consumption and CO_2 emission in a short term period is attained. The results of the present study point to a statistically significant reduction in fuel consumption and CO_2 emission in the periods P2 and P3 compared to P1 period mostly due to a decrease of idling time parameter and increase of coasting parameter although there has been a significant increase of speeding, as proven statistically. This indicates that the targeted education about the change of drivers' behavior can be effective. Future research studies will focus on the effects of eco-driving in a long term period (> 6 months) and determine if the effects will downtrend over time. The facts obtained in this research show that the drivers' socio-economic characteristics had an impact on the eco-driving instructions adoption. Statistically significant differences in fuel consumption and brake usage among drivers were obtained. Because of these facts, future research projects should analyze this matter further.

References

Barać, D., Zovak, G., & Periša, M. (2013). Effects of Eco-Driving Education on the Reduction of Fuel Consumption and CO_2 Emissions. Promet-Traffic & Transportation, 25(3), 265-272.

Barkenbus J. N. (2010). Eco-driving: an overlooked climate change initiative. Energy Policy, 38, 762–769. doi: 10.1016/j.enpol.2009.10.021.

Barth, M., & Boriboonsomsin, K. (2009). Energy and Emissions Impact of a Freeway-Based dynamic Eco-driving System. Transpor Research Part D: Transport and Environment, 14(6), 400-410. https://doi.org/10.1016/j.trd.2009.01.004.

Basarić, V., Jambrović, M., Miličić, M., Savković, T., Basarić, Đ., & Bogdanović, V. (2017). Positive effects of eco-driving in public transport: a case study of Novi Sad. Thermal Science Journal, 21(1B): 683-692. doi: 10.2298/TSCI150219160B.

Beusen, B., Broekx, S., Denys, T., Beckx, C., Degraeuwe, B., Gijsbers, M., Scheepers, K., Govaerts, L., Torfs, R., & Panis, L.I. (2009). Using on-board logging devices tostudy the longer-term impact of an eco-driving course. Transportation Research Part D: Transport and Environment, 14, 514–520.

CIECA. Internal project on Eco-driving in category B driver training & the driving test. Final report 05-11-07. (2007). found at: http://www.transport-research.info/sites/default/files/project/documents/20091210_155535_71033_ECODRIVEN%20Final%20Report.pdf, Accessed 3 October 2018.

Decicco, J., & Ross, M. (1996). Recent advances in automotive technology and the cost-effectiveness of fuel economy improvement. Transportation Research D, 1(2), 79-96.

ECMT. (2005). Making cars more fuel efficient. Technology for real improvements on the road. Paris: International Energy Agency.

El-Shawarby, I., Kyoungho A., & Hesham R. (2005). Comparative field evaluation of vehicle cruise speed and acceleration level impacts on hot stabilized emissions. Transportation Research Part D: Transport and Environment, 10(1), 13-30. doi: 10.1016/j.trd.2004.09.002.

FIAT. Eco-Driving Uncovered- the Benefit and Challenges of Eco-Driving Based on the First Study Using Real Journey Data. (2010). http://www.futuremobilitynow.com/assets/ECODRIVING_UNCOVERED_summary_2010_EN.pdf. Accessed 2 October 2018.

Fujikawa, T., & Taniguchi, M. (2002). Effects of Ordinary Users' Driving Condituons on Automobile Fuel Consumption. Proceedings of the Society of Automative Engineers of Japan (JSAE) Annual Congress, 100-02, 5-8.

Husnjak, S., Forenbacher, I., & Bucak, T. (2015). Evaluation of Eco-driving Using Smart Mobile Devices. Promet-Traffic & Transportation, 27(4), 335-344.

Inteligent Energy Europe. (2008). European Campaign on improving driving behaviour, energy-efficiency and traffic safety (ECODRIVEN). Final Progress Report. EIE/05/007/SI2.419394.

Intelligent Energy Europe. Benefits of Eco-driving. Project - Together on the move, http://www.together-eu.org/docs/102/TOGETHER_Eco-driving_5_Handout_15.pdf. Accessed 2 October 2018.

Koch-Groeber, H,. Coasting on Highways – Potentials and Realization, professional paper. Heilbronn University, https://www.hs-heilbronn.de/5023311/coasting-on-highways.pdf, Accessed 3 October 2018.

Kojima, K., & Ryan, L.,. (2010). Transport Energy Efficiency. Information paper. Paris.https://www.iea.org/publications/freepublications/publication/transport_energy_efficiency.pdf. Accessed 2 October 2018.

Lauper, E., Moser, S., Fisher, M., Matthies, E., & Kaufmann-Hayoz, R. (2015). Psychological predictors of eco-driving: A longitudinal study. Transportation Research Part F: Traffic Psychology and Behavior, 33, 27-37.

Matsuki, Y. (2006). The Relationship between Driving Behavior and Fuel Consumption, Institute of Electronics Information and Communication Engineers (IEICE). Technical Report. Proceedings of the Society of Automative Engineers of Japan (JSAE) Annual Congress, 106(266), 1-6.

Mensing, F., Bideaux, E., Trigui, R., & Tattegrain, H. (2013). Trajectory optimization for eco-driving taking into account traffic constraints. Transportation Research Part D: Transport and Environment, 18, 55–61.

Omnitracks. Is Truck Idling Fuel Consumption Burning Your Bottom Line? Yes (and it doesn't have to). Omnitrack's road ahead blog. https://www.omnitracs.com/blog/truck-idling-fuel-consumption-burning-your-bottom-line-yes-and it-doesnt-have. Accessed 3 October 2018.

Onoda, T. (2009). IEA policies—G8 Recommendations and an Afterwards. Energy Policy, 37, 3823–3831.

Shakouri, P., Ordys, A., Darnell, P., & Kavanagh. P. (2013). Fuel Efficiency by Coasting in the Vehicle. International Journal of Vehicular Technology, 2013, 14 pages, http://dx.doi.org/10.1155/2013/391650

Ukita M., & Shirota, H. (2003). Study on the Effect of Eco-Driving by Equipping with Fuel Consumption Meter. Proceedings of Annual Meeting of Environmental Systems Research, 31, 413-419.

Wilbers, P., (1999). The New Driving Force: A New Approach to Promote Energy-Efficient Purchasing and Driving Behaviour. Proceedings of the EcoDrive Conference. Graz, Austria, 44–47.

Zarkadoula, M., Zoidis, G., & Tritopoulou, E. (2007). Training bus drivers to promote smart driving: A note on a greek eco-driving pilot program. Transportation Research Part D: Transport and Environment, 12, 449-451.