RESEARCH JOURNAL OF THE UNIVERSITY OF GDAŃSK

Transport Economics and Logistics Vol. 76 (2018)
http://dx.doi.org/10.26881/etil.2018.76.03

Danuta Rucińska[a)], Małgorzata Kędzior-Laskowska[b)]

a) Chair of Transportation Market, Faculty of Economy, University of Gdańsk, Poland
b) Chair of Microeconomics, Faculty of Eonomy, University of Warmia and Mazury in Olsztyn, Poland

SUSTAINABLE TRANSPORT DEVELOPMENT AND THE QUALITY OF ROAD FREIGHT TRANSPORT

Abstract

The aim of the article is to show the relationship between quality and sustainable development of road freight transport. The macro and microeconomic perspective of the possibilities of impacting the greening of transport, which is a development of the sector and entrepreneurs, was presented. Recommendations regarding the development of road freight transport including the EU and Polish transport policy were discussed. The possibilities for the development of road carriers in the conditions of transport greening, with particular emphasis on pro-quality activities were introduced.

The analysis of the problem was based on literature studies, statistics were also taken into account. In addition, the results of primary studies regarding the impact of the sustainable development principle and the quality of road freight transport services were presented. The research was conducted on the basis of a questionnaire, and in the interpretation of the results, position, variability and one-dimensional analysis of variance (ANOVA) were used.

Keywords: sustainable development, road freight transportation, transport service quality, service quality

Introduction

Quality in road transport of freight can be considered in two dimensions. Endogenous sources of quality development are related, among others, to the broadly understood sphere of regulation and infrastructure. In addition to the conditions provided by the market environment, entrepreneurs may engage in pro-quality

development (exogenous sources of quality). The development of activities (including economies) should take into account the long-term perspective. Satisfying the current needs of societies cannot limit the chance of satisfying future generations (Kusztal, 2005). This approach is a basis of sustainable development based on a balanced way of achieving economic, social and environmental goals (Wronka, 2006).

Elementary features of needs indicate their constant dynamics in time and structure. The driving force behind this development is globalization, which results in an increase in demand for transport. By 2030, further transport development is forecasted at an average annual level of 3.3%, and in the years 2015–2050 at a slightly lower level. Demand for road freight transport in the years 2015–2030 is to grow on average annually by 3.2%, and up to 2050 – by 2.8% (ITF Transport Outlook, 2017). The tendency of demand growth, with slight changes in their structure, will have a negative impact on the natural environment. What is particularly worrying is the comparable increase in fore demand of road and rail transport (Figure 1). The forecasts do not indicate intensive development of rail transport while the importance of road transport is decreasing. The development of ecological sea transport is likely to be due to the growing importance of international trade (mainly with the Asian countries). In addition, the dynamics of cargo transport in air transport does not constitute a sustainable development of the transport system.

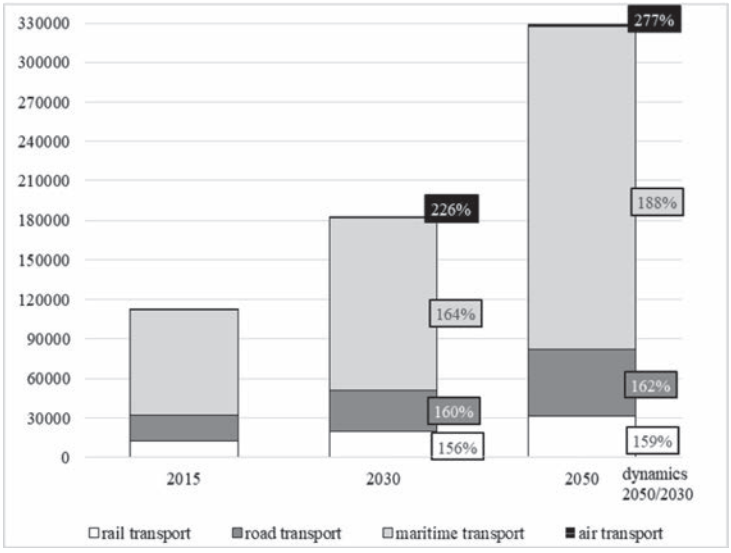

Figure 1. Freight transport demand by mode (bln tkms) in Europe
Source: (own elaboration based on: OECD 2017).

The prosperity in transport negatively correlates with the quality of the natural environment. It is necessary to take actions that will limit the harmfulness of transport (mainly road transport) in the functioning of societies and ecosystems. The idea of transport greening sets the directions for the development of the transport market and the carriers operating there. It indicates the desirable quality features in the sector and road freight transport services.

1. The impact of road freight transport on the natural environment

Pollution of environment is a problem and a challenge for modern economies. At the EU level, attempts are being made to reduce the ecological burden of transport. They mainly focus on:

– vehicle production processes and infrastructure-innovative, taking into account current and future environmental needs,
– the structure of passenger transport and loads, including the development of individual motorization,
– decisions at the microeconomic level.

These attempts are to counteract climate change resulting in a decrease in quality of life and ecosystems, ie. an increase in average temperatures, change in rainfall, melting glaciers and an increase in the average sea level (*Prevention of climate effects*). The increase in the concentration of greenhouse gases is the result of human activity. According to the European Environment Agency (EEA), the transport sector, the industrial sector, the energy sector and households are mainly responsible for CO_2 emissions due to the combustion of fossil fuels.

Excessive CO_2 emissions from road freight transport are considered the main barrier to sustainable development in EU countries. By 2050, an increase by 2.5–3 times in emissions was forecast (base year 2000). Maintaining the level of emissions from 2010 in the road transport sector will be possible if there is a drop in average fuel consumption in individual and other vehicles from 81 in 2008 to 51 in 2030, to less than 41/100 km in 2050 (Outlook Transport, 2011). An important barrier to the implementation of these assumptions is the development of international trade. International Transport Forum assumes that the result of this development will be a fourfold increase in emissions (Global Trade, 2015).

The estimates of the impact of road freight transport on the environment should take into account information about the energy consumption of this sector and information on the so-called empty runs. These are data that determine energy and operational efficiency (ITF Transport Outlook, 2017). In global terms, in 2015 CO_2 emissions from the transport sector accounted for 18% of the total emissions resulting from human activities. It should be noted that with the forecasts of the growth in demand for transport (on average around 3% annually), the emission of this gas will increase by over 70% (in 2015–2050) (ITF Transport Outlook, 2017).

The problem of gas emissions from road transport in the EU is aggravated by congestion. Overloading of roads is also an important element of the increase in its energy consumption (including fuel consumption). In commercial road transport, the average CO_2 vehicle emissions with an average load capacity of 17 tons is at the level of 62g/1 tone-kilometer. In addition, the emissions are more than 10 times higher in conditions of strong congestion compared to the smooth ride of the vehicle. Table 1 presents examples of CO_2 emission values resulting from the intensity of traffic and vehicle speed.

Commercial operations are also accompanied by other external environmental damages (Graczyk, 2015), i.e. soil, water, plant, animal pollution or noise influence on the environment. It is estimated that small deviations from the norm (0.03%)

of CO_2 in the atmosphere cause significant changes in the functioning of ecosystems. Polluted air also affects the functioning of society, physical and mental health (neurotic states, cardiovascular disorders). Through vibrations and vibrations of buildings, they determine the comfort of living of people living near major communication routes (Grzywacz, Szewczuk, 1978).

Road freight transport generates damages resulting from road accidents that are not the subject of vehicle insurance. These costs include treatment and loss of life of people involved in the accident or loss of production. The internalization of external costs can contribute to reducing the negative impact of transport on the environment and changing the branch structure of transport.

2. Sustainable transport and quality in road freight transport in the macroeconomic perspective

The White Paper sets out measures to reduce the ecological burden of transport while respecting the principles that support a competitive and resource-efficient transport system. It sets the conditions for the functioning of markets and indicates the desired directions of development of transport activities. The directions of this development are created by, among others, a new quality of service conditions. These include limiting the role of road freight transport to the haulage-supply function in supply chains, the need to use modern, energy-saving and low-emission vehicles. It is important that the greening of transport will not be possible without the increase of operating costs resulting from the internalization of external costs.

The most important goal of transport decarbonization is to reduce greenhouse gas emissions by 60% by 2050 (Biała Księga, 2011). The implementation of this strategy is supported on three reference levels. In road freight transport they concern the development and implementation of fuels and propulsion systems for decarbonization of transport, optimization of intermodal logistic chains, increase of transport efficiency and infrastructure. Particular objectives are presented in Table 1. A special role in this development is played by road infrastructure supported by intelligent transport systems (ITS), with added value – improvement of road safety and providing conditions for providing high quality services, which are safe and timely ones.

Table 1. Strategic goals of the EU transport policy including the direct impact on road freight transport

Issues	Detailed goals
Development and introduction of new fuels and propulsion systems compliant with the principle of sustainable development	Increasing by half the number of vehicles with conventional propulsion in urban transport by 2030 and their elimination from cities until 2050; achieving CO_2 – free logistics in large urban centers by 2030.

Issues	Detailed goals
Optimization of the operation of multimodal logistics chains	Transfer of 30% of road freight transport over distances greater than 300 km to greener means of transport by 2030; by 2050, increase by another 20%. Establishment of a fully functional multimodal TEN-T base network by 2030; in the perspective of 2050, increasing the capacity and quality of this network, which will be supported by information services.
Increased efficiency in the use of transport and infrastructure thanks to information systems and market incentives	Introduction of land transport management systems by 2020 and introduction of the European satellite navigation system (Galileo) for use. By 2020, establishing a European framework for information, management and payments in the field of multimodal transport. By 2050, reaching almost zero deaths in road transport (increasing by a half road accident victims by 2020); guaranteeing global EU leadership in the field of security and protection in all modes of transport. The implementation of the „user pays" and „polluter pays" principles and the involvement of the private sector in order to eliminate distortions, including harmful subsidies, generate revenues and provide financing for future investments in the field of transport.

Source: (own elaboration based on: Biała Księga, 2011)

The prerequisites for the ecological and qualitative development of road transport are modern vehicles used in transport processes. In the so-called "green supply chains" vehicles characterized by low energy intensity and emissions should be used. Innovative solutions contribute to reducing the negative impact of road transport on the environment and the quality of life of societies. They favor the development of alternative drives and fuels, but they are characterized by a long period of research and their high capital intensity. These technologies are described as breakthroughs, which affects the risk of implementing innovations (Burnewicz, 2010) which are:

– electric (Mercedes-Benz is planning the mass production of the first fully electric-powered truck in the second decade of the 21st century with a GVW of 26 t and a range of around 200 km; it is supposed to be a quiet monthly vehicle for servicing daily deliveries (Daimler website);
– hydrogen, in which energy is generated using hydrogen-based fuel cells (in 2020 Nikola Motor Company intends to introduce a hydrogen-assisted engine for series production, which will guarantee zero emissions (Dolecki, 2016), on 30/01/2018 the company said it plans to invest $ 1 billion in the truck plant for hydrogen cells in Arizona (Nikolamator website);
– compressed air-hybrid air technology connecting the internal combustion engine and compressed air drive (Nikolamotor website), dedicated to passenger vehicles.

The use of modern propulsion mechanisms or special wings installed on so many vehicles will help reduce fuel consumption and emissions (European Parliament for safer trucks, 2015).

In addition to innovative technologies that reduce the ecological nuisance of road vehicles, their constructions must also support the assumption of sustainable transport development. In order to increase the efficiency of transport, the technical dimensions and weight of vehicles are increased (MPW, load capacity). These vehicles are referred to as mega trucks. Most analyzes confirm the positive relation between the use of vehicles with increased load and the reduction of greenhouse gas emissions. The use of a smaller number of vehicles in road transport should limit its harmfulness. However, it should be noted that larger vehicles (e.g. with longer trailers and with a larger load weight) can contribute to an increase in fuel consumption. Moreover, the demand for transport with increased sets is assumed to go up (Steer, et al., 2013) due to the decrease in unit costs of transport. As a consequence, it may decide to strengthen disproportions in the modal structure of cargo transport.

The next factor supporting the sustainable development of transport is modern road infrastructure. It is of fundamental importance in shaping the quality of transport services. Modern and innovative transport processes require a holistic approach, they must take into account the current and future needs of users. The use of modern vehicle functions is not possible without infrastructure support with advanced telematics systems.

The global infrastructure development forecast assumes that it will be a hybrid of three areas related to transport, modern technologies and the energy sector (Foresight, 2017). This assumption requires a balance between the need for changes in the energy sector and its current balance against the increase in energy demand due to income growth and the development of the middle class. Synergy between European and national trends in infrastructure development is important, especially in developing countries. Prohibition of registration of vehicles with conventional drive until 2030, among others in Austria and Germany will result in the purchase of relatively cheap vehicles by the societies of developing countries, including Poland. It is estimated that it will contribute to the increased degradation of the natural environment, including by issuing approximately 75 thousand tons of dust, 1 000 tons of sulfur compounds and 42 million carbon oxides annually (Foresight, 2017). In addition, the increase in the number of passenger cars on the road increases congestion, which is essential for the sustainable development of transport and the quality of transport services.

Data on imports of used passenger cars in Poland are very interesting (PZPM, 2016, 2017, 2018). In 2016, the number of registrations amounted to 1,037,726 and was higher by 30% compared to the previous year. In 2017, 16% less cars were registered compared to 2016, but 9% compared to 2015. By contrast, in January 2018 this number was 18% higher than in the same month of 2017 and amounted to 71,401. Moreover, the structure of imports of used cars is dominated by vehicles over 10 years (on average, about 54% of registration). The constantly growing number of vehicles increases the problem of noise and congestion, increases greenhouse gas emissions, affects road safety. Quantitative development of individual motorization determines the quality of commercial operations in road transport. Congestion clearly reduces the quality of services, through difficulties with timely realization of orders and ensuring security in transport processes. Hence the goal of the EU

transport policy is to change the ways of urban transport towards zero-emission transport (electric vehicles, bicycles), dissemination of the principle of sharing resources and their economical use by sharing electric vehicles in public transport.

Internalization of external costs generated by road transport is an attempt to change the branch structure of cargo transport. Co-financing of activities which purpose is to change, among others behavior of road carriers, is one of the instruments for the implementation of ecological EU policy (Graczyk, 2015). An example is also the partial internalization of environmental costs in fuel prices, which should limit the demand of carriers for fuels (Buhler, Jochem, 2008). The amount of fees for using road infrastructure is conducive to the development of a low-emission fleet, optimization of transport routes. Examples of factors supporting sustainable transport development at the macroeconomic level are presented in Table 2.

Table 2. Internalization of external costs instruments in road freight transport

Cost-generating issues	Instruments
Accidents	Diversification of insurance rates, covering full costs Speed limits Determining security standards and security programs
Noise	Emission fees (when purchased and periodically) Road tariffs Emission standards and noise level control Zones with limited speed Determination of parking spaces Separation of privileged traffic lanes
Air pollution	Tax on fuel The vehicle registration tax depends on the level of exhaust emissions Road charges Emission standards The kilometer tax depends on the issue

Source: (own elaboration base on: Mindur, 2014)

The current structure of cargo transport which is not in line with expectations, results, among others from low and dispersed expenditures on infrastructure investments. In Poland and in most Eastern European countries, the fund was directed to the development of road network (70% of outlays), while in Western Europe 80% of outlays in ground transport concerned the development of the railway network (Wojewódzka-Król, Rolbiecki, 2013). In addition, investments in the construction of inland waterways (Wojewódzka-Król, 2014) can also be considered marginal in Poland. High-quality road infrastructure is shaped by the vision of "green corridors" (separated lanes for cargo vehicles). Separation of heavy vehicles from other road users determines the efficiency, speed and safety of transport processes. It constitutes the quality of the road transport system. The concept assumes a fixed speed of vehicles (90 km/h) – road trains-in an aerodynamic tunnel, which reduces fuel consumption and CO_2 emissions, increases process efficiency, saves time by eliminating compulsory driver breaks (required in traditional vehicles). The development of this vision are truck platooning – technical and technological solutions that enable cooperation between a minimum of two vehicles moving in a convoy.

The optimal solution is to use fully autonomous vehicles in the platoon, excluding the first (leader), in which the transport process is controlled by the driver. Similarly, the Super Green project supports the idea of green corridors (Green transport corridors for freight). It specifies, among others quality attributes in sustainable supply chains, i.e.: transport time, reliability, frequency, use of ICT applications, transport and cargo security (SuperGreen, 2010).

Support for sustainable transport development is the basis for the development of intermodal transport. The White Paper on Transport emphasizes the complementarity of ecological means of transport and "green corridors" as a form of reducing pollution from transport. Intermodal transport limits the role of cars to the shortest possible processes, handing over the service of essential routes to greener means of transport.

The customer decides about the choice of the transport means basing decisions on the price and quality. High costs of access to, among others railway infrastructure is a barrier to the development of intermodal technologies in Poland (Mincewicz, 2016). Favorable economic situation will be shaped by the support and incentives that affect the decline in prices for rail transport services. Effective actions will create the possibility of faster execution of the order, increase flexibility and availability of rolling stock, will allow to compete in the scope of additional services (loading work, short-term storage, forwarding activities) and higher commercial speed of vehicles.

3. Microeconomics perspective of shaping quality in road freight transport of loads taking into account the greening of transport

The change in the conditions of functioning of road carriers, resulting from the greening of transport, enforces changes in the strategies used so far (Mazur, 2006). The modernization of the fleet and shaping pro-environmental awareness determine the contemporary standards of market activity. In transport activities social responsibility is of particular importance to reliability in the delivery of services, their physical and social effects (Antonides, van Raaij, 2003). It strengthens the relationships with customers, the environment, determines the market maturity of road carriers.

Activities undertaken by road transport entities for environmental protection are defined as a "green strategy". It manifests itself among others with: fuel consumption monitoring, economic driving trainings, reduction of CO_2 emissions (by minimizing the so-called empty mileage, purchase of good quality fuels), cooperation with contractors promoting sustainable development, proper utilization of spare parts (tires or oils) (Głodzińska, 2010). Ecological awareness is shaped gradually. This development begins by seeking and gathering information, by adapting its activities to the formal and legal conditions and the stage of eco-efficient companies, and the maximum involvement in environmental issues (sustainable companies) (van den Broek, 2010).

The principle of environmental management also fits into the need for greening transport. In accordance with the Strategy for the sustainable development of Poland until 2025 it integrates the ecological and economic aspects of transport activities, confirming the so-called a double benefit strategy (Ministerstwo Środowiska, 1999). Certification of management systems in accordance with the ISO 14001/EMAS standard provides for a pro-quality development of the company, active participation in environmental protection, and in the economic aspect – cost reduction (including waste management, distribution, energy). Confirmation of carriers' involvement in sustainable development is shaping the right attitudes among employees, driver training in the field of eco-driving and development of competences in servicing modern vehicles. In addition, systems for monitoring transport processes, alternative drives, structural engine changes, exhaust gas cleaning systems are another innovative tools that reduce fuel consumption and emissions (Merkisz-Guranowska, Andrzejewski, 2015).

The bottom-up initiatives supporting environmental protection may be the result of changes in the functioning of the transport system, e.g. in the EU. Optimally, if the changes in the strategy result from the awareness of entrepreneurs. One of the tools supporting the pro-ecological activity is the provision of services using a modern, low-emission fleet. Higher standards of exhaust gases in new commercial vehicles show less and less emission of carbon monoxide spores, nitrogen oxides and particulate matter. The purchase of vehicles (long-term rent, leasing) is a costly investment, although in terms of modal structure perspective cars are relatively cheap means of work. At the same time, it shapes economic benefits due to lower costs of access to linear infrastructure. Implementation of services with modern vehicles also contributes to the increase of road traffic safety and transport processes. With the decline in the global number of commercial vehicle registrations, there was an increase in demand on the European, American, Middle East and African markets. The largest increase was recorded in EU countries – by 21% and was almost twice as high as in European countries (11% in 2013–2015) (ACEA, 2016–2017). The increase in demand for new vehicles can be treated positively. The modern fleet fits into the trend of transport greening. Nevertheless, an increasing number of vehicles have a negative impact on the environment.

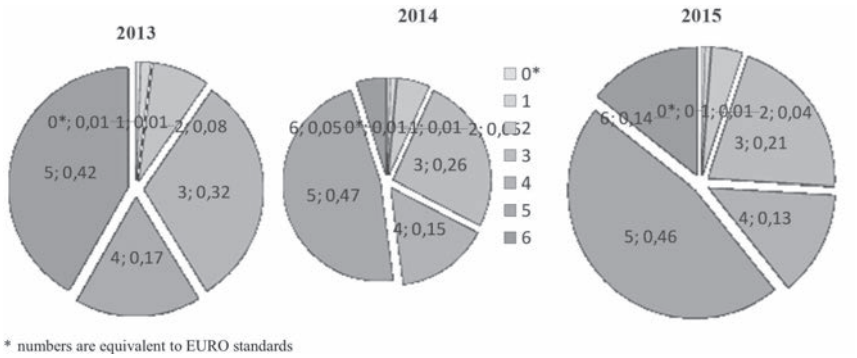

Figure 2. The structure of commercial vehicle according to EURO standard emission
Source: (own elaboration based on: GITD 2014–2016)

In Poland in 2013–2015 the number of registered commercial vehicles also decreased. The change in the structure of vehicles should be considered positively. The share of high-emission vehicles in favor of modern vehicles with EURO 5 and 6 standards decreased (Figure 2). Vehicles with the EURO 5 standard constituted on average 45% of the fleet of transport vehicles. The dynamics of the number of vehicles with the highest EURO standard should be viewed positively. In 2015, there was over threefold increase in the number of vehicles in this category. This is a confirmation of the pro-quality attitudes of road carriers. Confirmation of these attitudes is also a decrease in the number of vehicles with the EURO 4 standard (by 7%) and EURO 2 and 4 (almost 40%).

The direction of development of the fleet of Polish carriers is appropriate, consistent with the principle of sustainable development of transport and quality development of the sector. Modern rolling stock favors the implementation of environmental protection objectives. Technological progress contributes to the reduction of exhaust emissions as well as the lower fuel consumption and energy intensity of the sector.

4. The relation between quality and sustainable development of transport in the opinions of entrepreneurs

Activities for eco-development are at the same time the premises for the qualitative development of the road freight transport sector. Macro and microeconomic actions should result in increased awareness and, above all, activities in line with sustainable development. Complementarity of country's actions and individual decisions of road carriers should favor the greening of transport. Undoubtedly, it will contribute to the qualitative development of the road freight transport sector.

An attempt was made to determine the significance of selected factors that demonstrate the greening of transport in the context of the qualitative development of road cargo transport. The research was conducted in 2013 on a sample of 134 enterprises whose activity was registered in the Warmian-Masurian Voivodeship. The respondents included managers and owners of road freight transport companies. The vast majority of entrepreneurs represented the micro-enterprise sector (with employment below 10 people), which reflects the structure of the sector in Poland. Most of them had no more than five vehicles (49%) and were characterized by many years of professional experience (46% of respondents started their activity before 2000).

The evaluation of the respondents was subject to 6 factors proving the sustainable development of transport. They were evaluated in terms of their importance in creating the quality of services. These factors and basic descriptive statistics are summarized in Table 3. They were rated on a scale of 1–6 (1 – it does not matter, 6 – it is very important).

Table 3. Quality determinants in road transport in aspect of sustainable development

Ranking of factors	Descriptive statistics								
	Average	Median	Dominant (D)	Dominant count	Minimum	Maximum	Range (R)	Standard deviation (SD)	Coefficient of variation (V)
1. Monitoring of fuel consumption	3.49	4	2	46	1	6	5	1.525455	43.67754
2. Modern rolling stock	3.46	4	5	52	1	5	4	1.505163	43.46806
3. Separated lanes for trucks	3.18	3	multiple	36	1	5	4	1.249666	39.30875
4. Eco-driving training	3.12	3	multiple	32	1	5	4	1.371267	43.95927
5. Care for the natural environment at the enterprise level	2.94	2	2	54	1	5	4	1.375189	46.77040
6. Multimodal services	2.97	3	4	44	1	5	4	1.225913	41.27444

Source: (own elaboration)

Of the proposed factors, none was significant in creating the quality of road freight transport (it did not achieve the required threshold of average rating ≥ 4). At the same time, the majority of respondents stated that modern rolling stock and multimodal services affected quality (D = 5 and D = 4, respectively). The highest variability of assessments was observed with the factor indicating initiatives taken by the enterprise to improve environmental protection (V = 47%, R = 4). The assessment of fuel consumption monitoring was also very volatile (V = 44%, R = 5), which was the highest classified factor affecting the quality of services. Values of variability measures (R, SD, V) confirm that the respondents are a heterogeneous sample.

The results of the one-way analysis of variance showed that the average assessment of the factors determining the quality of services differed statistically significantly (Table 4), with the assumed significance level of $\alpha = 0.05$.

Table 4. One-way analysis of variance for quality determinants

Source of variance	SS	df	MS	F	p-value	Test F
Between groups	37.73134	5	7.546269	3.961791	0.001483	2.225325
Within groups	1520	798	1.904762	–	–	–
Total	1557.731	803	–	–	–	–

Source: (own elaboration)

The average estimations were subjected to further statistical verification. It includes the structure of respondents – three features, i.e. the size of employment, the number of vehicles at the disposal of enterprises and the year of commencement of operations. The aim of the study was an attempt to answer the question whether they influence the average assessment of factors. Null hypotheses (H_0) were formulated, stating that the given feature had no influence on the average assessment of the factors shaping the quality against alternative hypotheses (H_1) – the features

influenced the average assessment of the factors shaping the quality. The size of employment and the size of the fleet allowed to determine the average ratings as homogeneous groups (not significantly different statistically). Regardless of the size of the enterprise (with employment of 1–9 or 10–49 people, having 1–5, 6–10 and more than 10 vehicles) the importance of factors in creating quality was similarly perceived. The year of commencement of operations determined statistically significant differences in the average ratings of the eco-driving training factor ($p = 0.048856$) and multimodal services ($p = 0.00904$). Indeed, the entrepreneurs who were characterized by the longest market experience assessed these factors significantly – they started operations before 2000 (Table 5).

Table 5. ANOVA analysis of quality conditions according

The factor shaping the quality	SS	df	MS	F	p-value
The size of employment					
Modern rolling stock	0.702151	1	0.702151	0.299985	0.585054
Care for the natural environment	2.271632	1	2.271632	1.146895	0.286655
Separated lanes for trucks	0.287838	1	0.287838	0.183521	0.669242
Monitoring of fuel consumption	0.356823	1	0.356823	0.158131	0.691691
Eco-driving trainings	1.381411	1	1.381411	0.717987	0.398732
Multimodal services	2.189034	1	2.189034	1.438253	0.233122
The number of vehicles at the disposal of entrepreneurs					
Modern rolling stock	6.396766	2	3.198383	1.4207	0.245241
Care for the natural environment	2.03754	2	1.01877	0.534938	0.58698
Separated lanes for trucks	0.074599	2	0.037299	0.023534	0.976745
Monitoring of fuel consumption	3.121325	2	1.560663	0.667317	0.514819
Eco-driving trainings	6.462658	2	3.231329	1.73751	0.179988
Multimodal services	2.412794	2	1.206397	0.800323	0.451368
The year of starting operations					
Modern rolling stock	8.318041	2	4.159021	1.859523	0.159834
Care for the natural environment	6.792434	2	3.396217	1.81794	0.166432
Separated lanes for trucks	1.777069	2	0.888534	0.565246	0.5696
Monitoring of fuel consumption	7.278712	2	3.639356	1.577544	0.210379
Eco-driving trainings	11.26497	2	5.632487	3.089531	0.048856
Multimodal services	13.85725	2	6.928624	4.879225	0.00904

Source: (own elaboration)

The structure of the response is an unexpected result. With a significant variability of assessments and homogeneous groups of averages confirmed by the analysis of variance, no relation between quality and sustainable development was observed. It may be a low environmental awareness of respondents. With the knowledge of the principles of the functioning of this market, it seems necessary to observe it in search of opportunities for further development. Assuming further actions aimed at decarbonization of transport, the qualitative development of road carriers must take into account this direction of change.

Conclusions

The EU's sustainable development policy has unambiguously set the directions for the development of transport markets. It carries the hallmark of qualitative changes in transport systems. According to the assumptions, in the near future the share of road transport should significantly decrease by supporting rail freight transport and inland navigation over long distances. In addition, the increase of social awareness in the field of sustainable development will be conducive to pro-quality and pro-ecological changes. Higher environmental standards of vehicles, intermodal transport technologies, limiting traffic of road vehicles to the shortest possible routes in supply chains determine the need for expanded education of service providers and recipients. The chance of effective, sustainable development should also be identified with initiatives undertaken at the level of road transport companies.

The EU recommendations regarding the functioning and changes in transport systems create the conditions for the qualitative development of transport activities. It seems that from the point of view of the effectiveness of transport policy, the involvement of transport users and service providers is of key importance. Hybridization of activities at the micro- and macroeconomic level will determine the effectiveness of measures under the policy of sustainable transport development including road freight transport.

References

ACEA (2009), EU Project on Transport GHG: Routes to 2050?, 4 June. Available from http://www.acea.be/images/uploads/files/20090612_ACEA_comments_On_Transport_GHG_Routes_2050.pdf [Accessed 19 May 2010].

ACEA (2016), The Automobile Industry Pocket Guide 2015/2016, European Automobile Manufacturers Association. Available from www.acea.be [Accessed 2 March 2017].

ACEA (2017) The Automobile Industry Pocket Guide 2016/2017, European Automobile Manufacturers Association, Available from www.acea.be [Accessed 2 March 2017].

Antonides, G., van Raaij, W.F. (2003), *Zachowanie konsumenta. Podręcznik akademicki*, Wydawnictwo Naukowe PWN, Warszawa, p. 24.

Biała Księga (2011). Plan Utworzenia jednolitego europejskiego obszaru transportu – dążenie do osiągnięcia konkurencyjnego i zasobooszczędnego systemu transportu, KOM(2011) 144, Bruksela, dnia 28.03.2011, p. 18.

Buhler, G., Jochem, P. (2008), CO_2 Emission Reduction in Freight Transports. How to stimulate Enviromental Friendly Behaviour?, Discussion Paper No 08-066, Zentrum für Europaische Wirtschaftsforschung GmbH. Available from ftp://ftp.zew.de/pub/zew-docs/dp/dp08066.pdf [Accessed 5 May 2010].

Burnewicz J. (2010), Perspektywa innowacyjna transportu i logistyki, *Zeszyty Naukowe Uniwersytetu Szczecińskiego Nr 603, Ekonomiczne Problemy Usług Nr 59*, Szczecin, p. 56.

Daimler (n.d.). Available from http://daimler.com [Accessed 12 January 2017].

Dolecki, L. (2016), Nikola, ale nie Tesla. Nowe ciężarówki elektryczne wspomoże wodór. Available from http://www.rynekinfrastruktury.pl [Accessed 7 September 2016).

Ekologiczny transport: nowy pakiet Komisji na rzecz zrównoważonego rozwoju, Bruksela, dnia 8 lipca 2008, IP/08/1119. Available from http://europa.eu [Accessed 5 May 2010].

Foresight. Infrastruktura z perspektywy globalnej (2017), KPMG. Available from https://assets.kpmg.com/content/dam/kpmg/pl/pdf/2017/01/pl-Foresight-Ten-emerging-trends-in-2017-PL.pdf [Accessed 9 February 2017].

GITD (2014, 2015, 2016), Dane statystyczne dotyczące transportu międzynarodowego. Available from www.gitd.gov.pl [Accessed 15 January 2018].

Global trade: International freight transport to quadruple by 2050 (2015), Paris. Available from http://www.itf-oecd.org/sites/default/files/docs/2015-01-27-outlook2015.pdf [Accessed 27 October 2017].

Głodzińska P. (2010), Zielona strategia dla firmy transportowej. Mniej paliwa, mniej CO_2, *Polska Gazeta Transportowa*, 46, p. 4.

Graczyk, A. (2015), Zorientowana rynkowo polityka ekologiczna w polityce rozwoju Unii Europejskiej, *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania*, Nr 40, T.2, Uniwersytet Szczeciński, doi: 10.18276/sip.2015.40/2-06.

Grzywacz, W., Szewczuk, A. (1978), Transport a otoczenie, Prace Naukowe Politechniki Szczecińskiej Nr 102, Instytut Ekonomiki Transportu, Szczecin, p. 56.

ITF Transport Outlook 2017, OECD/ITF, OECD Publishing, Paris, doi: 10.1787/9789282108000-en.

Kusztal, J. (2005), Ekologizacja transportu, [in:] *Polski transport w europejskiej przestrzeni gospodarczej*, red. A. Lipińska-Słota, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice, p. 115.

Mazur, E. (2006), Konkurencja na rynku usług transportowych w aspekcie wymogów proekologicznych, *Zeszyty Naukowe*, 393, *Problemy Transportu i Logistyki, 2*, Wydawnictwo Uniwersytetu Szczecińskiego, Szczecin, p. 24.

Merkisz-Guranowska, A., Andrzejewski, M. (2015), Nowoczesne rozwiązania zmniejszające emisję zanieczyszczeń z transportu drogowego, *Logistyka*, 3, p. 14.

Mincewicz, J. (2016), Przyszłość transportu: przewozy intermodalne, *Polska Gazeta Transportowa*, 40, p. 5.

Mindur, L. (Ed.), (2014), *Technologie transportowe*, Wydawnictwo Naukowe Instytutu Technologii Eksploatacji – Państwowy Instytut Badawczy, Warszawa – Radom, p. 752.

Ministerstwo Środowiska (1999), Strategia zrównoważonego rozwoju Polski do roku 2025, Warszawa.

Nikolamotor (n.d.). Available from https://nikolamotor.com [Accessed 26 February 2018].

Parlament Europejski za bezpieczniejszymi ciężarówkami (2015), *Polska Gazeta Transportowa*, 11.

PZPM (2016, 2017, 2018), Branża motoryzacyjna. Available from http://www.pzpm.org.pl/ [Accessed 27 February 2018].

Steer, J., Dionori, F., Casullo, L., Vollath, Ch., Frisoni, R., Carippo, F., Ranghetti, D. (2013), A Review of Megatrucks. Major issues and case study, European Parliament,, Brussels, European Union. Available from http://www.europarl.europa.eu/studies [Accessed 15 November 2014].

SuperGreen. Supporting EU's Freight Transport Logistics Action Plan on Green Corridors Issues (2010), Deliverable D2.4 Benchamrking of Green Corridors. Available from http://www.transport-research.info [Accessed 14 November 2013].

Wojewódzka-Król, K. (2014), Infrastrukturalne uwarunkowania zrównoważonego rozwoju transportu w Polsce, *Logistyka*, p. 2.

Wojewódzka-Król, K., Rolbiecki, R. (2013), *Polityka rozwoju transportu*, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk, p. 166.

Wronka, J. (2006), Transport intermodalny jako instrument wspierania zrównoważonego transportu w Europie, *Zeszyty Naukowe Nr 435, Ekonomiczne Problemy Usług Nr 3*, Uniwersytet Szczeciński, Szczecin, p. 149.

Van den Broek, F. (2010), Green Supply Chain Management, Marketing Tool or Revolution?, Breda | Zoetermeer. Available from https://www.nhtv.nl/fileadmin/user_upload/

Documenten/PDF/Onderzoek_en_advies/Green_Supply_Chain_Management.pdf [Accessed 14 November 2012].
Transport Outlook 2011. Meeting the Needs of 9 Billion People. Available from www.internationalforum.org [Accesses 14 June 2011].
Zapobieganie skutkom klimatu (n.d.). Available from http://www.eea.europa.eu/pl/themes/climate/intro [Accessed 04 February 2017].

Corresponding authors

Danuta Rucińska can be contacted at: ekodr@univ.gda.pl
Małgorzata Kędzior-Laskowska can be contacted at: malgorzata.kedzior@uwm.edu.pl