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ORIGINAL PAPER

TRUCK PLATOONING IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT'S TARGETS DEFINED IN EUROPEAN UNION'S STRATEGIES

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ABSTRACT. **Background:** Consequence of growing consumer market is grow of transportation and logistics sector estimated in Europe at 42% by 2050. Therefore innovations in transportation have recently become one of key focus areas for enterprises' supply chains and for authorities. Challenge is not only how to meet market expectations but also how to achieve this in line with sustainable development's principles. The aim of the paper is to resolve the research problem regarding the magnitude of contribution of truck platooning to the sustainable development in the context of selected European Union's strategies.
Methods: Based on literature review, author attempted to add value by this publication by establishing the connection between truck platooning and sustainable development's targets defined in European Union's strategies.
Results: Author was able to identify strengths and weaknesses of truck platooning in the context of sustainable development criteria: economical in terms of generating efficiencies for transport industry thanks to fuel reduction, ecological in terms of contributing to lower CO_2 emission and social in terms of giving the possibility of transforming the job of a truck driver as well as increasing the safety on the roads.
Conclusions: Conducted research indicates that the thesis that truck platooning fits in with the European Union's strategies as one of the elements supporting sustainable development has been partially confirmed and partially denied. Truck platooning may support sustainable development's targets, however due to its limitations the magnitude of its contribution is not significant.

Key words: truck platooning, sustainable development.

INTRODUCTION

Growing consumer market and constant pressure to shorten the lead times of deliveries up to next-day or even same-day-deliveries is a challenge for transportation and logistics. Free delivery and free return offers lead to increase of transported volume. On one hand freight sector in Europe is estimated to grow by 42% by 2050. On the other hand European Commission targets to decrease carbon emission by 60% by 2050 [Boysen et al. 2018]. Road transport represents ¾ of all goods transported in Europe and is estimated to continue to grow. Result of that growth is increasing pollution, congestion on the roads, higher risk of road accidents. On top of that comes shortage of drivers, as well as high fuel costs which became 1/3 of operational cost of an average fleet operator [Krüger et al. 2018].

Correlation between development of economy and environment has been identified already in 1960s. The more economy develops, the more concerns about the negative impact of human activity on environment. That requires looking for new solutions which would not only help the business to be more efficient but which would also take care of environment. Increasing demand for transport shall not be in correlation with increasing CO_2 emission,

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congestion and number of accidents any more. The opportunity lays with increasing transport efficiency. Challenge is however not only how to meet high market expectations but also how to do this in line with sustainable development's principles. That is why transportation is one of the areas where diverse innovations take place. One of such innovations is truck platooning.

Truck platooning fits in with the European Union's strategies as one of the elements supporting sustainable development. The aim of the paper is to resolve the research problem regarding the magnitude of contribution of truck platooning to the sustainable development in the context of selected European Union's strategies.

THE ROLE OF SUSTAINABLE DEVELOPMENT

The origin of sustainability comes from Brundtland's report "Our Common Future" from 1987. In its point 30th it was said that sustainable development is a process of changes which take into consideration not only present but also future needs. Sustainable development means that needs of the present shall be met by growth of economy but without compromising the ability of future generations to meet their needs too [Chin et al. 2015]. As noticed by Pichlak [2017], the definition was not very detailed and left room for interpretation. Despite that, it was acknowledged by United Nations in 1992, set the direction and widespread in literature since.

Sustainable development shall not be understood as pure eco-development as eco-development focuses only on ecologic. After [Kumar 2017], [Chin et al. 2015] there are three main criteria of sustainable development: economical, ecological (also called environmental) and social. Purol [2014] defines those areas as follow:

1. Economical criteria are about research and development supporting economic growth.
2. Ecological criteria are renewable resources coming from natural ecosystem and pollution prevention.
3. Social criteria are improvement of living conditions.

Advantage of sustainability is not only positive impact on those areas but also the fact of being a driver of innovative thinking leading to improving efficiency, cost and risk reduction as well as identification of new products and services [Purol 2014]. In the area of transportation there have been several innovations aiming to make transport more sustainable, one of which is Truck Platooning.

TECHNOLOGY OF TRUCK PLATOONING

Platooning or platoons has its origin in military and means a unit composed of 2 or more trucks that travel in a reduced distance between them, connected using wireless Vehicle-to-Vehicle (V2V) communication. Platooning is also called electronic drawbar and means automatic following of one or more conventional vehicles at reduced distance in a shape of a convoy. Driver of the first (leading) vehicle controls direction and the speed of the vehicles behind him (following vehicles) [Wang et al. 2019].

First platooning attempts were based on adaptive cruise control systems (ACC). Leading vehicle was suppose to maintain the constant speed and the following vehicles were suppose to maintain same distance behind the vehicle in front of them. It turned out very quickly not to be an efficient way of generating fuel savings due to changing road topography. In order to avoid excessive acceleration while uphill climbing and sharp breaking on the downhill descents, more sophisticated systems are used now which enable the following vehicles to vary the speed and to keep a range of required distance at the same time [Torabi et al. 2018]. Those systems are data exchange based solutions which enable communication between the vehicles as well as between the platoon and the back office coordinating the movements of the platoon [Bergenhem et al. 2013].

In a platooning the driver of the lead vehicle is fully engaged in the driving tasks, gives the direction to the platooned vehicles, accelerates, breaks, changes the lanes. The others vehicles follow him automatically, keeping short distance which occurs without

a need for their drivers for doing those maneuvers themselves. That means that trucks following the leading truck do require drivers too but the technology enables them to be partially engaged also in other activities besides driving. Today's technology, however, is not advanced the way that human driver could be replaced by the software in any possible traffic situation. The software is not capable of all maneuvers which may be needed on the road. For this reason, conditions of the permits for platooning tests on selected motorways not only require a driver to be present in each of the following trucks but to even have constantly hands on the steering wheel in order to take over control over the vehicle whenever required and alerted by the system. Requirement for the driver in each vehicle is a reason for platooning to be classified as level 3 automation in scale of automation standardized by Society of Automotive Engineers (SAE), US-based global standards developing organization for automotive industry. Level 3 means conditional automation which still requires presence of a human driver but allows the system to perform all aspects of driving such as lane change, turning or using signals. Human driver is on stand-by mode to intervene whenever required [Wang et al., 2019].

MAIN EUROPEAN UNION'S STRATEGIES TARGETING SUSTAINABLE DEVELOPMENT

Sustainable development is vital target for European Union and is reflected in its strategies since the Sustainable Development Strategies from 2001. The direction Europe has taken is to invest in innovations in order to create sustainable economy based on efficient usage of resources [Wysokinska 2018]. The catalogue of targets aligned on United Nations level has been incorporated into European strategies. At first, in year 2000, European Union committed to achieve Millennium Development Goals (MDGs) by 2015. Afterwards, in year 2015, United Nations General Assembly set a catalogue of 17 Sustainable Development Goals to be achieved by 2030 which became basis for European Union's development programs too. Out of 17 Sustainable Development Goals, the following ones are in particular relevant for the Truck Platooning according to the author of this paper:

- Goal 3: Good health and well-being
- Goal 8: Decent work and economic growth
- Goal 9: Industry innovation and infrastructure
- Goal 13: Climate action

Europe 2020 is the current strategy valid till 2020. The years 2021-2027 will be covered by follow up program called Horizon Europe. In both of them focus is on and large portion of budget is dedicated for achieving targets of sustainable development. Ultimately European Union has set a target for 2050 called Climate-neutral Europe.

In Europe 2020, established by European Commission in 2010 as a follow up of Lisbon Strategy 2000-2010, and dedicated to "smart, sustainable, inclusive growth", European Union set main goals as follow: smart growth (based on knowledge and innovation), sustainable growth (more resource efficient economy) and inclusive growth. The targets are to increase employment rate, invest more in research and development and to meet so called 20/20/20 climate targets. Those climate targets mean to reduce greenhouse emission by 20% (in comparison to 1990 level), increase share of renewable energy sources by 20% and increase energy efficiency by 20%. This program itself, likewise Lisbon strategy, was a vision of European Commission of where Europe should put its priorities in order to adopt to economical and environmental changes faced at the beginning of new century, in particular in the time of global economic slowdown started in 2018.

Horizon Europe is a European Commission's document from April 2019 and is meant to cover years 2021-2027. Budget is believed to be increased again in comparison to the previous strategies and is estimated to be defined at 94 billions of Euros, 35% of which is meant to be spent for tacking climate change. The other focus areas are supporting achieving sustainable development goals and growth of European Union. Already in its opening sentence, proposal of Horizon Europe draws attention to research and innovation on

the economical, ecological and social areas which are the principles of sustainable development. One of its five core missions is called "climate-neutral and smart cities" which covers such areas like CO_2 reduction and mobility solutions – both fully in line with core functions of platooning. At the end of 2019, document is still in the draft version and continues to follow its alignment process.

In November 2018 European Commission issued a long-term vision document called "A clean planet for all". It foresees achieving zero greenhouse emissions in Europe by 2050. It follows the direction taken by targets set for 2030. That document of European Commission treats about clean, safe and connected mobility. It underlines usage of low and zero emission vehicles, more efficient batteries, and autonomous driving which would not only lead to cleaner environment but it would also enable noise and road accident reduction. This is believed to improve the quality of life of European citizens.

TRUCK PLATOONING AS AN ELEMENT SUPPORTING SUSTAINABLE DEVELOPMENT IN EUROPEAN UNION'S STRATEGIES

Author of this paper has examined sustainable development targets in the context of truck platooning to determine interdependencies between them. The result is that truck platooning may support sustainable development in the following areas:

1. Economical
   - Fuel saving
   - Labor cost reduction
2. Ecological
   - CO_2 reduction
3. Social
   - Change of truck driver job
   - Congestion reduction on the roads
   - Increase of safety level on the roads

Below Table 1 provides an overview on selected European strategies in the context of sustainable development where truck platooning may be a supportive element.

Table 1. Overview on selected European strategies in the context of sustainable development where truck platooning may be a supportive element

Sustainable development's aspects		**European Union's strategies**			**Worldwide context**
		Europe 2020 (2010-2020)	Horizon Europe (2021-2027)	Climate-neutral Europe 2050	Sustainable Development Goals (SDGs) of United Nations
Economical	Fuel saving	Resource efficient economy	Pilar 1: Excellent Science	No usage of fossil fuel	Goal 9: Industry innovation and infrastructure
	Labor costs reduction	fostering a high-employment economy delivering social and territorial cohesion.	Pilar 3: Innovative Europe	People well being	Goal 8: Decent work and economic growth
Ecological	CO_2 reduction	"Resource efficient Europe" to help decouple economic growth from the use of resources, low carbon economy, use of renewable energy sources, energy efficiency	Pilar 2: Climate, Energy and Mobility	Zero emission mobility	Goal 13: Climate action
Social	Change of truck driver job	"An Agenda for new skills and jobs" Europe 2020	Pilar 3: Innovative Europe	People well being	Goal 8: Decent work and economic growth
	Less congestion on the roads	"Resource efficient Europe" to modernise transport sector	Pilar 2: Health	Connected mobility	Goal 3: Good health and well-being
	More safety on the roads	Intelligent traffic management	*Pilar 2: Health*	*Safe mobility*	*Goal 3: Good health and well-being*

Economical aspect

Fuel reduction

Trucks in a platoon have proven to achieve fuel saving thanks to lower air resistance which is also called slipstream driving while moving in shorter distance between each other [Wang et al. 2019]. Lower full consumption was identified not only in the following but also in the leading vehicle. Depending on the tests, fuel saving varies from 4 to 15% per vehicle [Słowik et al. 2018]. Higher efficiency could be achieved thanks to implementation of local controllers to facilitate formation process of multi brand platoons means platoons built out of the vehicles of different fleet operators. Such platoons are more likely to happen than single brand platoons, however costs of local operators have to be considered in the overall calculation [Larson et al. 2013].

Real saving potential from driving in a platoon depends, however, on several factors such as position of the vehicle in the platoon, inter-vehicle distance and time needed for platoon forming process [Boysen et al. 2018]. Also the speed of the vehicles in platoons influences the real fuel savings. The lower speed, caused for example by traffic congestion, the lower aerodynamic drag benefit and therefore lower fuel reduction [Larson et al. 2015]. Not always platoons are formed at the moment when all 2 or 3 vehicles are loaded and share the whole path from the start to the same consignee. The idea of platooning is also to enable the ad-hoc joining and leaving the platoons whenever required. In such cases drivers are required to wait until platoon can be formed and they must be willing to cooperate. This is a factor which shall be considered when estimating cost reduction of platooning transportation as the benefits thanks to fuel reduction can be offset by the waiting time to form a platoon [Muratori et al. 2017]. Truck platooning's limitations related to its forming process are also related to the costs of early or late deliveries. Current market expectations to deliver the goods next day or even same day lead to considerably less possibilities of increasing waiting time in order to form a platoon. [Boysen et al. 2018] prove also in their analysis that potential fuel saving due to driving in a platoon does not justify the investment in the technology. It can be therefore concluded that theoretical fuel saving are much lower in reality due to the fact that optimal truck platooning conditions are rare to happen on European roads.

Labor costs reduction

Truck platooning foresees that system would maneuver the vehicle. Truck driver could be engaged in other activities. That could potentially help in achieving labor costs reduction when the driver takes care of certain administrative tasks such as route planning. The potential labor cost reduction is, however, only theoretical since the system does require the driver to be able to take over control of the vehicle whenever required. Truck driver has to consciously and constantly observe the road. This is because platooning is an conditional automation which still requires presence of a human driver. That leads to the conclusion that labor cost reduction is only illusory as the driver has to be in the position to immediately start controlling the vehicle when other maneuvers are required [Wang et al 2019]. In the calculation of labor cost reduction also potential requirement for back office to support platooning should be considered. To take advantage from the data exchange between the trucks in platoon and to help in coupling tucks to built a heterogeneous platoons, coordination from back office may be required to support navigation [Bergenhem 2013]. For this reason author of this paper sees potential for labor cost reduction not with platoons but when driverless driving would be popularized on the roads.

Ecological aspect

CO_2 reduction

Transportation causes degradation of ecosystems due to CO_2 emission and due to extension of the transport infrastructure [Berg et al. 2016]. To degradation of the ecosystems counts in particular deforestation, biodiversity loss, higher air pollution [Laurance et al. 2009]. Truck Platooning is one of the recent

technologies which aim to reduce the diesel consumption by the heavy-duty vehicles and by that to reduce the CO_2 emissions. Truck platooning is, however, neither self driving nor electric driving. It does reduce CO_2 emission but only in certain conditions. Benefits of reduced CO_2 emissions thanks to truck platooning can be achieved only on motorway where trucks go at higher speed to stimulate the effect of slipstream driving. Truck platooning does not solve the problem of pollutions on off-motorway roads or in cities or metropolises with congestions caused by vehicles. Truck platooning, even if does support sustainable development targets, does it only to a small extent [Caparros-Midwood et al. 2017]. As noted by [Simionescu et al. 2017], European Commission Directive 2012/0288 expected the member countries to use at least 10% of the energy in transportation from renewable energy by 2020. Renewable energy is a core characteristic of platooning neither. For all those reasons, author of this paper concludes that truck platooning cannot be called sustainable transport. Sustainable transport would be self driving and non emission driving which does not emit greenhouse gas.

Social aspect

Different role of a truck driver

Truck platooning foresees that drivers in following vehicles in a platoon do not have to be engaged in the steering of them but can do other activities such as route planning, phone calls or theoretically also taking the rest time required by the law. That not only could increase productivity but also create different profile of a driver. Facing shortage of the traditional truck drivers on the European market over last years, that could be encouragement to this job. Doing other activities while platooning can be more attractive work environment than conventional truck driving. Platooning can replace the driver in some of his activities but not in all. The other risk or limitation is drivers' behavior and reaction time to take over control over the vehicle whenever needed. Thus, on one hand truck platooning is believed to release the driver from some driving activities but on the other hand driving in a platoon requires from the driver not only driving skills but also multi tasking skills, quick reaction time, monitoring traffic situation while doing other tasks at the wheel. For this reason author of this paper does not see high potential for the development of the driver job because of platooning. More potential seems to be with developing other jobs and functions needed for instance for traffic control support functions while full automation (driverless vehicles) will be achieved and popularized on the market.

Congestion reduction on the roads

Thanks to much shorter distance between the trucks in the platoons, they reduce the space which is needed on motorway for the same number of unplatooned trucks. Three trucks on a motorway occupy 150 meters if unplatooned while 80 meters if in a platoon. Therefore platoons are believed to reduce the congestion on the roads. Simulations estimate almost double road capacity increase [Shladover et al. 2012]. Time spent in traffic could be used in more productive pursuits. Higher congestion leads to more accidents and injuries [Berg et al. 2016]. However, trucks grouped in a platoon sharing the same path to the destination would need to decouple at the exits of motorways. Cumulating of them on the local roads or cities may cause additional congestion and traffic. Against congestion's reduction speaks also platooning forming process. When drivers of several trucks will aim to build an ad-hoc platoon and travel part of their path together, some of them will need to reduce the speed in order to wait for the partners. Several heavy-duty vehicles at lower speed on the motorway may hinder the traffic on the right rightmost lane. For those reasons author of the paper puts in question potential positive impact of reducing congestion on the roads thanks to platooning.

Increase of safety level on the roads

Truck platooning is believed to enhance safety on the roads. Connection between the trucks enables much faster reaction time in case of emergency breaking. While human reaction time is estimated to be 1.4 seconds, trucks following the lead truck in platoons start breaking already within 0.1 seconds. Breaking distance of a truck with human driver is longer

due to perception and reaction time of the driver before even the breaking activity starts. Perception and reaction time is the reason why trucks driven by human drivers have to mind the distance of typically 50 meters at minimum when not in a platoon. Platooned trucks are more safe in terms of the breaking, even if the distance between them is much shorter (typically between 7 and 12 meters). There has not been however enough tests to know what would be the reactions of drivers of passenger cars towards platooned heavy-duty vehicles and if those drivers would not cause danger when forcing platooned trucks to decouple. Another element to be considered is also the reaction time of the drivers in case of unexpected traffic situation when they will be asked by the system to take control of the vehicle and to maneuver the truck manually. Drivers in platooned vehicle engaged in other activities such as phone calls or resting time may not react quick enough and cause additional danger on the road. For those reasons author of this paper believes that all in all there is no real added value of platooning in terms of the safety on the roads. Nevertheless, full driving automation could increase the safety on the roads.

CONCLUSIONS

Truck platooning is one of the ideas and innovations on how to increase transportation potential and achieve it in line with sustainable development principles [Boysen et al. 2018]. As demonstrated earlier in this paper, truck platooning is only limited contributor to the sustainable development's targets. This is because its potential benefits can be generated only in specific circumstances which are rare to happen in real business situation in Europe. Theoretically possible savings thanks to fuel consumption reduction when driving in a slipstream are limited to minimum in real traffic circumstances in European conditions with highly congested roads. This is due to platoon forming time, rare possibility for several trucks to share same path at the same time, occasionally long time driving at high enough speed to enable slipstream effect, incompatibilities of software or lack of needed software in case of multi brand platooning, market pressure on shortening the lead times, cost of investments, lack of permissions for platooned driving in European countries. All this puts in question justification of investments in the platoon technology for the fleet operators on European market. For those reason economical target of sustainable development is questionable. If fuel consumption reduction is not proven to happen in real traffic situation or only at as small scale, then also significant CO_2 emission reduction is unlikely to happen. That means that also ecological target of sustainable development may not be achieved either. Also limited level of driving automation in case of platooning does not give the real benefit of replacing human driver by a software being capable of sophisticated traffic maneuvers. If the release of the driver from driving task is not the face for level 3 automation which is platooning, then this jeopardizes the social aspect of sustainable development. For all those reasons, truck platooning is not a technology which would revolutionize the transport industry or have great impact on sustainability in Europe.

Strength of the work is that it treats about truck platooning not only from the perspective of its potential benefits but also that it also puts them into perspective of several different limitations considering economical, ecological and social aspect of this technology.

Limitation of the work is that it treats about the technology which is not commercially available in Europe and therefore there is no real data available except for those from few, isolated tests. What is more, in Europe neither European Union law nor local law of member countries allow platooning. Truck platooning is a technology and innovation in transportation industry which is known for years but which does not have real use cases in Europe so far.

In this paper author concentrated on truck platooning considering European economy, infrastructure and legislation. Author accepts the possibility that impact of truck platooning on sustainable development's targets may be different in other markets such as Australia or United States.

The thesis that truck platooning fits in with the European Union's strategies as one of the elements supporting sustainable development

has been partially confirmed and partially denied. Truck platooning may support sustainable development's targets, however due to its limitations the magnitude of its contribution is not significant, which is demonstrated in the below Table 2.

Table 2. Opportunities and strengths as well as threats and weaknesses of truck platooning in the context of sustainable development

Sustainable development's aspects		**Truck platooning response**	
		Opportunities & Strengths	**Threats & Weaknesses**
Economical	Fuel saving	Lower diesel consumption due to aerodynamic drag	No zero or low emission technology Depends on inter-vehicle distance, speed and vehicle's position in the platoon Depends on platoon formation process
	Labor costs reduction	Driving automation may reduce labor costs	Platooning is not a driverless driving Still driver in each vehicle needed
Ecological	CO_2 reduction	Reduced greenhouse gas emissions	Still usage of fossil fuel
Social	Change of a truck driver job	Drivers to do other activities such as route planning , work on the phone computer while driving – new set of skills required	Legislation requires drivers in each vehicle. Platooning is not driverless driving Driver to be ready to take over control of vehicle whenever needed
	Congestion reduction on the roads	Shorter distance between trucks means less space on the road occupied	Additional congestion due to platoon forming process (waiting for the partners to join the platoon)
	Increase of safety level on the roads	Shorter breaking reaction time	Human-dependent breaking process in the leading vehicle Non standard traffic situations not covered by platooning

Source: own creation

Author of this paper believes that more potential in terms of achieving sustainable development targets would be when using renewable fuel in the trucks or different sources of power such as electricity, not necessary based on currently widely spread lithium-ion batteries. Author's position is that more effort should be devoted in replacing fossil fuel by more environmentally friendly technology rather than looking for isolated, almost artificial use cases where fossil fuel consumption could be only slightly reduced like in case of truck platooning. Once full truck driving automation has been achieved and popularized in the transport industry, efficient transportation it would contribute to the sustainable development's targets to significantly higher extent.

FUTURE RESEARCH

Those conclusions directly lead to future research needs. Truck platooning seems to be only step on the way to the world of driverless vehicles powered by efficient and ecologically friendly source of power. For this reason technology, legislation and people awareness shall be developed in this direction. Truck platooning due to its all limitations shall not be seen as ultimate solution for the transport industry and for achieving sustainable development targets. One-digit fuel savings to be generated only on a part of the vehicle's path and this upon a waiting time in order to built a platoon out of trucks powered by fossil fuel cannot look as an attractive solution. There have been already tests of other promising solutions on the market such as driverless vehicles and zero or even negative

emission transportation (so called Carbon Dioxide Removal or Bioenergy with Carbon Capture and Storage technologies). Future research may investigate magnitude of impact of those technologies on sustainable development.

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PLATOONING POJAZDÓW CIĘŻAROWYCH W KONTEKŚCIE CELÓW ZRÓWNOWAŻONEGO ROZWOJU ZDEFINIOWANYCH W STRATEGIACH UNII EUROPEJSKIEJ

STRESZCZENIE. **Wstęp:** Konsekwencją rosnącego rynku konsumenckiego jest wzrost sektora transportu i logistyki szacowany w Europie na 42% do roku 2050. Dlatego też innowacje w transporcie stały się jednym z kluczowych obszarów dla łańcuchów dostaw. Wyzwaniem jest nie tylko sprostanie oczekiwaniom rynku, ale także osiągnięcie tego zgodnie z zasadami zrównoważonego rozwoju. Celem artykułu jest odpowiedź na pytanie o wielkość wpływu platooningu pojazdów ciężarowych na cele zrównoważonego rozwoju sformułowane w wybranych strategiach Unii Europejskiej.

Metody: Na podstawie przeglądu literatury, autor wniósł wkład tą publikacją, ustanawiając związek między rozwiązaniem platooningu pojazdów ciężarowych a celami zrównoważonego rozwoju określonymi w strategiach Unii Europejskiej.
Wyniki: Autor zidentyfikował mocne i słabe strony platooningu pojazdów ciężarowych w kontekście celów zrównoważonego rozwoju: cel ekonomiczny osiągany poprzez redukcję zużycia paliwa, cel ekologiczny osiągany dzięki przyczynianiu się do niższej emisji CO2 oraz cel społeczny osiągany poprzez zwiększenia bezpieczeństwa na drogach.
Wnioski: Przeprowadzona analiza częściowo potwierdza a częściowo odrzuca tezę o platooningu pojazdów ciężarowych jako jednego z elementów wspierających zrównoważony rozwój zgodnie z założeniami strategii Unii Europejskiej. Platooning pojazdów ciężarowych może wspierać cele zrównoważonego rozwoju. Na obecnym etapie, jednakże, skala wpływu tego rozwiązania na cele zrównoważonego rozwoju nie jest znacząca. Jest tak ponieważ pojazdy ciężarowe w platooningu stosują nadal paliwa konwencjonalne a stan legislacji w krajach Unii Europejskiej nie pozwala jeszcze na pełną komercjalizację tego rozwiązania i generowanie wspomnianych korzyści dla rynku transportowego oraz zrównoważonego rozwoju.

Słowa kluczowe: platooning, zrównoważony rozwój

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