

## Sustainability of Trucks Parking in European Union

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### Abstract

**INTRODUCTION:** Parking in road freight transport has been a problem for a long time. Several EU legislative decisions have contributed to reducing the sustainability of the parking system in recent times.

**OBJECTIVES:** The aim of this paper is to point out the negative impact of social law requirements on the parking of freight vehicles. The aim is also to propose the methodology of determining the necessary number of parking spaces for possible compliance with the requirements of social law.

**METHODS:** Own research is realized by the numbering of parking spaces on selected routes in the EU and comparing with the number of freight vehicles on the route.

**RESULTS:** We have shown that there are not enough parking areas for current transport flows in frame of whole EU. In assessing of the requirement of EU social law to prohibit weekly rest in the cab of a vehicle, we have come the conclusion that in current capacity of hotels in highway resting areas, it is not possible to meet this requirement of social law.

**CONCLUSION:** The proposed methodology defines the needed number of parking places for a specific area. From the point of view of the sustainability of road freight transport, it is essential that parking areas are planned in accordance with regulatory requirements. Otherwise, drivers are forced to cheat, what leads to distortion of the whole road freight transport market.

**Keywords:** transport, sustainable, parking.

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### 1. Introduction

The road freight transport is presently the most significant mode of transportation in frame of inland freight transport. The White Paper on Transport supposes increasing of transport to 80 per cent in 2050 compared to the year 2010. The supposal of transport increasing is fulfilling in real practise and is followed by increasing number of trucks in road infrastructure. To ensure the safety and sustainability of transport it is necessary to built not only higher roads capacity but also the infrastructure for cars parking that is connected with safety breaks and drivers' rest ensuring. On the other hand, the increasing drivers' demands on rest causes also the increasing demands on parking places (e. g. judgement [17]). The aim of this contribution is to answer a research question whether the infrastructure of car parks

sustainabl built following the development of road freight transport output in the frame of European Union. We realised the research directly in drivers of road freight transport and also in selected area we analysed the real possibilities of vehicles parking. Because the goods transport is significant aspect of the economic increase, we dealt with transport output sustainability in connection to parking policy. Therefore, are processed the proposals of the European Union parking ensurance sustainability.

### 2. Literature review

In the relation of road transport output sustainability and trucks parking places capacity is interested only a few of studies. Chatterjee and Wegmann in 2000 in [5] noted that in United States are the parking places for trucks in public car parks and resting areas along highways in the state of

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Tennessee fully occupied what causes big trucks parking on highway feeders to these areas. Based on interviews with drivers they found out that although there are existing facilities for resting and sleeping in public places, many drivers of trucks cannot use these facilities from the reason of parking place unavailability mainly during top hours of nightly rest. Al-Kaisy and col. in 2012 in [1] published that the existing studies about rest areas are not actual or they came out from old datas. By using of datas collected from folders of surveillance videocameras with a view of whole parking place during one week in 44 car parks was found out that in USA the average trucks' parking time is longer than personal cars' average parking time in less occupied highways [2]. That means 30 minutes during a day and approximately 3 hours and 22 minutes during a night. Kay in 2014 introduced the results of binary logistics regression and negative binomial regression on demand characteristics of 47 road resting places in Michigan [8]. He found out that with increasing distance between resting areas is the number of cars approaching to the road resting areas increasing. He used on-line datas that were obtained from the monitoring information transport system from Michigan's transport department.

The problem of car parks capacity was dealt in Japan by Muramatsu and Oguchi which published a study in 2017 [13] and from results of this study it is possible to claim that parking places for freight transport are underrated in Japan. Authors suggest to implement the time toll to motivate the drivers to use a public area of car park as short as possible. But the listed approach is counterproductive in relation to road transport safety demands. Stated claim is possible to support by studies' results that is processed by author Jung in 2017 [6]. A study in conditions of Korea showed that complementing resting areas, that are relatively small resting areas between common resting areas and serve mainly for drowsy drivers' rest, could decrease a number of accidents caused by sleepiness to approximately to 14 per cent, mainly in highway parts with two and more driving lines. Matsushita and col. realised a survey of the resting areas distribution and developed a model of selection and model of attractiveness evaluation [10]. Their results show that transport time, area's attractiveness and the number of passengers over 65 are positively increasing on car park solution while the available areas, cleanliness of sanitary facilities and availability of restaurants or shops are contributing to higher attractiveness evaluation. Next it emphasizes also the importance of information providing that concerns the resting areas and relaxing places. A study of Hajime Seya examines truck drivers' behaviour in car parks [14]. Author uses six-month datas about vehicle's trajectory from digital tachograph and introduces a car park solution and parallelly a situation by multilevel continual model development. Given that digital tachographs note trucks' time and area information in Japan, it is possible to analyse not only behaviour in car parks but also way of usage that means the parking time in this study. Information in the study are drawn from 1600 vehicles disposed by tachographs that are similar to those used in European Union. Basis on datas from digital

tachographs it was possible to identify an average driver's resting time, but was not possible to identify a parking places occupancy.

According to the analyses processed by Andras Nowak, there are missing more than 30 000 parking places in Germany [18]. In average 7000 trucks is parking in restricted places like highways feeders and exits and emergency parking areas in highways. They are blocking an approach to gas stations or are standing on places defined for personal cars parking. A study [18] points out a fact that from 2016 the number of injuries and collisions with trucks is continually increasing because of incorrect parking. In Germany the listed state causes problems with finding drivers that are willing to drive a vehicle for longer distances like 500 kilometres. More than 15 per cent of all drivers spends the night next to highway with no comfort, no WC or possibility to wash themselves [19]. According to the studies [18] the increasing of road freight transport in Germany introduces 4 per cent per year that evokes a necessity 4000 freight transport parking places establishment. Problems with establishment of parking places next to highways have also an economic aspect. According to [12] the building of parking areas is very uneconomic because the investing difficulty for one parking place is 70 000 - 120 000 €.

On the base of realized analysis it is possible to claim that road freight transport output increasing and also demands in social area cause problems with trucks parking. The capacity of resting areas is not built together with road freight transport output development.

### 3. Research

Authors team realised from October 2018 to March 2019 an extensive research of drivers' skills in road freight transport with vehicles' parking. Responded were drivers from Slovakia, Poland, Bohemia and Germany that provide international road transport. The survey was taken part by 825 drivers from which 64.24 per cent are providing transportation with road trains by total weight of 40 tons. Considering by [16] realised survey showed that drivers' quality of sleeping is better at night, we reconnoitred whether the drivers have a problem with rest drawing because of lack of parking places in night hours. 86.67 per cent of drivers answered that they have problem with a place for parking finding. Most often they have problem to find a parking place by highways. It is followed by main roads, border crossings and driver are able to find a parking place in industrial areas the easiest. Drivers, according to the social demands [9] a [11], can drive a vehicle not more than 9 hours, then follows necessary a daily rest in duration at least 11 hours. Excluding a daily rest, the drivers have to draw also the working breaks that have to be drawn not later than after 4.5 hours of driving. Length of the break is 45 minutes at least. That means that every truck has to stop in car park after 4.5 hours of driving latest. The authors also analysed how the drivers plan their rest. It was found out by the research that drivers often

cannot drive whole 9 hours per day or 4.5 hours without break, because they are afraid that they will not be able to find a car park. Drivers' answers were often: I park the vehicle earlier or start the driving earlier only because of finding a free place. The survey showed that to 92 per cent of drivers adjust the driving time and their own working time to the situation in car parks. As resulting from listed the drivers are not using their working time effectively because they cannot rely that they find a safe parking place to the end of working time. A research realised by authors was also aimed to the comfort of drivers during rest drawing in car park. From the point of view of safety only 12.73 per cent of drivers feels safe in vehicle during rest drawing. 49.45 per cent of drivers is afraid of fuel and personal things robbery from vehicle, 14.3 per cent feels sometimes endangered and to 23.5 per cent of driver has own personal experience with a robbery in car park. In spite of that lack of car parks is presently a fact, the research realized by authors dealt also with car parks facilities. A significant deal of car parks doesn't provide suitable comfort for drivers. Basis on research results the drivers also claimed demands for car park facilities from the point of view the daily rest drawing, which length is more than 11 hours. Results are listed in Table 1. The most important demand is cleanliness of toilets and showers.

Table 1. Demands of drivers on car park's facilities.

Demand	Weight of importance	Rating
Clean toilets and showers	20.27	1
Calm environment	16.52	3
Eating facility	14.72	4
Foods shop, supermarket	12.97	5
Social room for drivers	8.90	7
Active guarding	16.82	2
Laundry room	9.80	6

Source: Authors' own processing

On the basis of research, it is possible to claim that sufficient capacity of parking places for freight transport doesn't exist nowadays. This situation gets worse with increasing output of road freight transport. In spite of significant effort of logistic companies and public institutions, the output cannot be moved to other transport mode [15] and also in close future it is not possible to consider with autonomous trucks in road traffic. On the basis of research, it is possible to claim that from the point of view of sustainability it is necessary to deal with parking policy. Nowadays already 87 per cent of drivers doesn't feel safe in car parks, 87 per cent of drivers has problem with vehicle parking, 92 per cent of drivers adjust own working time to the bad situation in car parks and car parks have insufficient equipment. Without parking policy solution with freight transport output increasing it is

possible to await that drivers will search parking places by exiting highways to urban areas, what is from the point of view of comfort, congestions and environment undesirable condition.

## 6. Proposal of freight transport car parks capacity increasing

The most of research teams, e. g. in Germany, deals with car park's capacity increasing by its enlargement or by building totally new car parks basis on road freight transport vehicles intensity in road network. A need of parking places in specified section depends on transport intensity but also on length of staying of vehicles in car park [4]. Ordinary daily rest in EU and contracting states of AETR (e. g. Russia) is at least 11 hours, to what is necessary to add at least one break in duration of 45 minutes that have to be exhausted after 4.5 hours of driving [9]. This means that a vehicle in time interval of 24 hours can drive not more than 12 hours and 15 minutes. A number of places for parking depends also on freight transport vehicles speed, which, basis on research, is 60-80 kilometres per hour. A needed number of parking places in specified section of highway or road is possible to define by relation (1).

$$PP = I \cdot (R/24) \cdot (D/(S \cdot T_d)) \quad (1)$$

where: PP – needed number of parking places, I – traffic intensity in solved section, R/24 – driver's rest in hours/24 hours, D – length of solved section, S – average speed of truck in solved section, T<sub>d</sub> – average driving time of vehicle per 24 hours.

After application of introduced relation into selected sections of roads of European importance in Slovakia, it is possible to claim that car parks achieve demanded capacity in no one section (table 2).

Table 2. Needed number of parking places in selected sections of road network.

Road	Section	Intensity	Speed	Length	Existing number of places	Needed number of places
D1	Bratislava – Trnava	8956	80	50	65	214
D1	Trnava – Trenčín	6675	80	75	190	235
D1	Trenčín – Žilina	6272	80	87	63	261
D1,18	Žilina – Ružomberok	4441	60	64	14	181

D1	Ružomberok – Poprad	3586	80	80	91	137
D1	– Prešov	2794	80	102	85	136
D1	Prešov – Košice	4555	80	40	12	87
D2	Rajka – Brodské	10168	80	80	310	388
R1	Trnava – Nitra	5825	80	42	9	117
R1	Nitra – Žiar n. Hron.	3486	80	82	79	136
R1	Žiar n. Hron. – B. Bystrica	4044	80	40	21	77
R2,16	Zvolen – Lučenec	2521	70	60	4	83

Source: Authors' own processing

In spite of that analysed car parks in individual sections don't achieve demanded capacity, what was confirmed also by results of survey among drivers, it is possible to increase of capacity by existing car places management.

#### 4.1. Return allowing car park

A proposal of car park is solved by two solutions that improve management and comfort in car park and together partly decrease demands on build-up area by parking places (Figure 1).

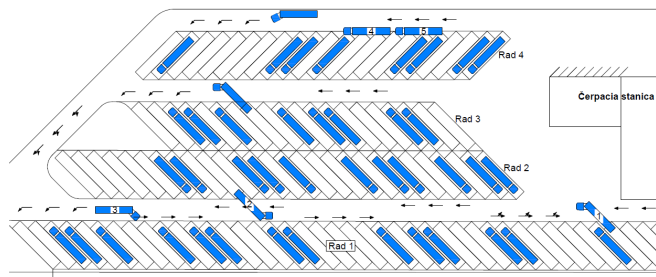


Figure 1. Return allowing car park.

The first solution is allowed return of vehicle. There is not allowed return of vehicle in existing car parks in the vast majority. If a vehicle searches a free parking place, it only drives through one line and if it can't find a free place there, it has to abandon the car park also in case of free places in another line. There is a possibility to reverse at the beginning, but it is very difficult, tedious and dangerous in crowded car park. The driver has no certainty of success because after coming next vehicle, the driver is forced the car park to abandon anyway. The proposal contains a car park where the bi-directional traffic is possible, that means

after unsuccessful searching of free parking place is vehicle able to return at the beginning and to try to find a free place in another parking line.

The second solution is parking organization where vehicles reverse into parking place in line. In presence, when the parking place are occupied, other vehicles park longitudinally behind parking places. Of course, earlier parked vehicles abandon the parking place earlier and longitudinally parked vehicles block an approach to the parking place (see Fig. 1 – vehicles 4 and 5). In this case the vehicles have to reverse into parking places too, many time with right-hand cornering, when the driver is limited by nearly zero view in a rearview mirror, because if the articulated semi-trailer corners to right-side with a bigger angle, the driver can't see the end of semi-trailer in a right mirror, he sees only right side of semi-trailer and in a left mirror he sees only a front of trailer (see Fig. 2).



Figure 2. Right-hand cornering of semi-trailer.

The proposal is processed that vehicles reverse into parking places always with left-handed cornering, when although the driver after cornering of road train has a limited view in right rearview mirror where he sees only front of trailer, but he sees the left side of road train also in mirror and after cornering he sees the whole of semi-trailer from a side driver's window with a bigger angle. Reversing to the left side is more comfortable and safe for the driver. This solution of car park is more economical for built-up area where is eliminated a demand on road behind first park line, also between second and third park line. A fourth park line is visible only from the reason of showing of blocking by longitudinal parking. The first parking line is proposed according to demand of drivers in transport survey that vehicles are arranged to stay with driver's cab away from the highway, for lower noise and higher rest comfort of driver. However, turning the driver's cab only does not sufficiently eliminate noise, mainly in empty car park, so it is necessary to build a noise barrier behind the first line. Also it is necessary to build a visual barrier between lines 2 and 3 that vehicles wouldn't bump into each other. An example of parking management is as follows: A vehicle 1



after coming in car park, parks by reversing in a free place in first line. A vehicle 2 drove through parking line 3 where it didn't find a suitable place, but it hadn't to abandon the car park. It come back on the road between first and second line and park in second line by reversing. Vehicle number 3 failed to park in the third line, but even in the second line could not find a possible place. It is up to the driver whether he chooses to turn to the petrol station and park by left-handed reversing, or park in the first line by driving forward under a condition of a more demanding driving by reversing to a right side.

#### 4.2. Car par with using of ITS

The second proposal concerning the organization of the car park is aimed at using intelligent transport systems in combination with the previous proposal of reverse parking. Compact parking with variable signal (tested in Germany) shows the exit times of the parking space and thus the driver chooses the parking space according to the planned departure on the signal [7]. This system allows multiple vehicles to be parked in a row without blocking, because the vehicles leave the parking places gradually. The system is updated every 15 minutes to provide quality and accurate parking management. The compact parking system in combination with the reverse parking system makes it possible to park the vehicle for indefinite time. In case of a defect appeared on vehicle or the driver parks an unloaded vehicle and he doesn't know the exit time, he has a possibility to park the vehicle in the first line where he parks by reversing or longitudinally along the edge of the car park at reserved places. Since it is not possible to return in this type of parking, a parking space occupancy detection system is installed in the reverse parking line and the driver is informed on the signal before entering the line whether is there a free parking place in the line and so how many free places there are. Based on this information, the driver can decide whether he chooses the ITS way or the reverse parking way. An example of a parking management is as follows: Vehicle No. 1 knows when it plans to leave the car park and therefore ranks straight on a branch with a compact parking system, where it also parks according to the selected time. Vehicles number 2 and 3 do not know when to leave the car park, so they will decide according to the signal at the entrance, where they will park according to the number of available free places (fig.3).

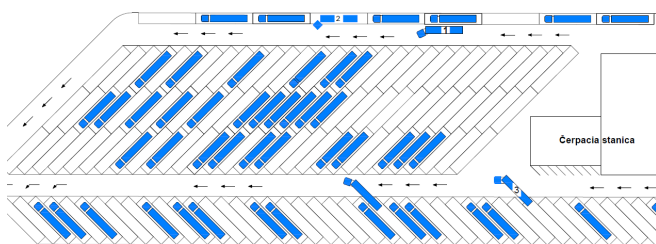


Figure 3. Car park with using of ITS.

The car park thus designed, in combination with the compact parking and reversing parking system, increases the capacity of the car park with the same built-up area. The proposal of the car park with the possibility of return increases the comfort of parking and the availability of the petrol station. On a given sample area (which is not complete for better illustration at the picture), the car park has a capacity of 118 truck parking places. A car park using ITS has a capacity of 147 truck parking places on a smaller area on the same car park length but narrowed width (for unused places).

#### 8. Conclusion

The issue of truck parking is not only in the European Union actual. The problem of insufficient capacity of car parks is also encountered in selected countries outside Europe. The vehicles are also parked in unauthorized places due to the full capacity of the legal car parks and also because the driver is subject to a fine receiving in case of the prescribed rest is not drawn. This situation is not sustainable in the long term, especially in view of the expected growth of road freight transport output. Based on the research we found out that drivers, because of the fear of not finding a suitable parking place, park vehicles earlier before the set rules, respectively earlier than they need for recovering. Alternatively, they park the vehicles during the day and drive at night when they have not a possibility to find a parking place. Such a situation decreases the safety of road transport. Research also pointed to insufficient equipment of existing car parks.

On the basis of research, the research question that currently there is insufficient parking capacity for trucks, was confirmed. In the proposal part of conclusion, the authors point out the method of calculating the necessary car parks capacity for a specified traffic intensity on the road. By its application to the superior road network in Slovakia, it has been found that there is not a sufficient number of car parks for freight transport in any section.

The authors are aware that the establishment of new car parks is economically demanding, therefore they offer two possibilities of increasing the capacity of freight transport car parks without further demands on the car park area.

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