

## The development of vehicular traffic intensity in Pardubice region

T. Horník<sup>1</sup>, M. Ledvinová<sup>2</sup>

<sup>1</sup> University of Pardubice, Faculty of Transport Engineering, Department of Transport Technology and Control, Studentska 95, 532 10 Pardubice, Czech republic, E-mail: [tomas.hornik@student.upce.cz](mailto:tomas.hornik@student.upce.cz)

<sup>2</sup> University of Pardubice, Faculty of Transport Engineering, Department of Transport Technology and Control, Studentska 95, 532 10 Pardubice, Czech republic, E-mail: [michaela.ledvinova@upce.cz](mailto:michaela.ledvinova@upce.cz)

### Abstract

Abstract: The contribution will pursue an data prognosis of vehicular traffic in the Czech republic (in region of Pardubice). The author will work with the data provided by the Road and Motorways Directorate of the Czech Republic in the context of nationwide traffic censuses. This traffic censuses were held in years 2000, 2005, 2010 and 2016. The main aim of this contribution is to offer a perspective at the development of annual average traffic intensities on the roads in the Pardubice Region. Methods of statistical analysis of data will be used during the analysis and the analysis will take into account the geographical and administrative division of the territory.

**KEY WORDS:** data prognosis, development of traffic intensity, vehicular traffic,

### Introduction

Every 5 years, a nationwide traffic census is conducted in the Czech Republic by the Road and Motorway Directorate. The last nationwide traffic census was carried out in 2016, not in 2015 due to the contractor's problem of extortion (until 2010, the census was made by the Road and Motorway Directorate itself; since 2016 it has been carried out by a private entity). Census is realised on all sections of motorways, A-roads and on selected sections of II. - III. Category and local roads. The aim of the census is to provide quality data of traffic intensity on the road network. At the same time, the number of registered vehicles in the Czech Republic (Czech Republic) is also totalling up and can be said that their number has increased significantly over the past 16 years. **The aim of the article is to prove whether there is a direct proportionality of the growing number of registered vehicles and increasing traffic intensity.**

The first two chapters of the article are devoted to the development of methodologies for census and forecasting of traffic intensities in the Czech Republic, when there have been significant changes in the way of census and determination of traffic intensity in recent years. The authors take these changes into account in order to merge (combine) data from the years 2000-2016 and thus to continue working with data as a coherent whole. The main outputs of this analysis are given in Chapter 3.

#### 1. Determination of traffic intensities in the Czech Republic

The census follows the methodology of technical conditions TP 189 Determination of traffic volumes on the road, which has been twice updated for 11 years. The most significant update took place in 2012 [Bartoš, 2012], when the course and evaluation of traffic surveys changed. Until 2012, vehicles and trailers of these vehicles were added separately, but since 2012, according to the methodology, vehicles without trailers and trailers have been (Table 1).

Tab. 1: Merging methodologies for determining traffic intensities

Methodology 2005	Methodology 2010	Description
N1	LN	Light trucks (up to 3.5 t), without trailer and with trailers
N2	SN+SNP	Medium trucks (payload 3.5-10 t), (with or without trailers)
PN2		Trailers for medium trucks
N3	TN+TNP	Heavy trucks (payload over 10 t), (with or without trailers) and Semitrailer towing vehicle
PN3		Trailers (Heavy trucks)
NS	NSN	road tractor with semi-trailer
A	A+AK	Bus (with or without trailers)
PA		Bus trailers
TR	TR+TRP	Tractors (with or without trailers)
PTR		Tactor trailers

O	O	Passenger cars and vans
M	M	Motorcycles
S		The sum of all motor vehicles and trailers
	SV	The sum of all motor vehicles

Apart from the change in vehicle census, a significant change occurred in the counting of semi-trailers. Until 2005, the semi-trailer was added once as N3 (or heavy trucks with a payload of over 10 tons (does not correspond to the definition of N3 vehicles over 12 tons) or a semi-trailer tractor) and once as NS (semi-trailers), which caused that the semi-trailer was counted twice in the census. After the revision of the methodology, it has been clearly identified that the semi-trailers are defined under the acronym NSN and are added together (Figure 1).

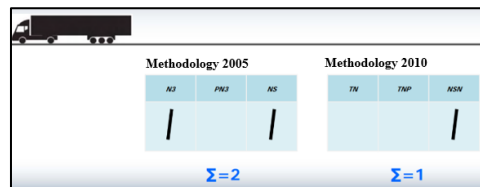


Fig 1: Method of counting semi-trailer

## 2. Forecasting traffic intensities in the Czech Republic

As well as setting traffic volumes within the national traffic census, as well as forecasting the intensity of automobile traffic follows the technical conditions - namely TP 225 Forecasting intensity of automobile traffic. TP 225 has been the updated third times in the past 9 years. The most significant change in the updates is the development of individual growth coefficients, which determine the future traffic intensity on the roads. TP 225 of 2010 [Bartos, 2010] assumed lower growth of automobile traffic, which was due to the fact that it was created at a time when the world faced an economic crisis (34% average increase in vehicular traffic in 19 years). TP 225 of 2012 [Richter, 2012] was created after the economic crisis, when growth coefficients were assumed to grow as it grew before the crisis (up to 42% increase in vehicular traffic over the next 19 years). Nevertheless, this estimate emerged to be wrong, which is due to the fact that infrastructure capacity is not endless. It is on account of the construction and transport conditions that are limiting for increasing capacity. Therefore, in 2018 TP 225 [EDIP, 2018] was updated, which now predicts a 21% increase over the next 19 years (due to data availability). The difference between the individual development coefficients by which traffic is forecasted is shown in Figure 2. The year 2016 is the base year and for displaying the traffic intensity is selected a prime example with a basic vehicular traffic intensity of 1000 vehicles / 24 hours.

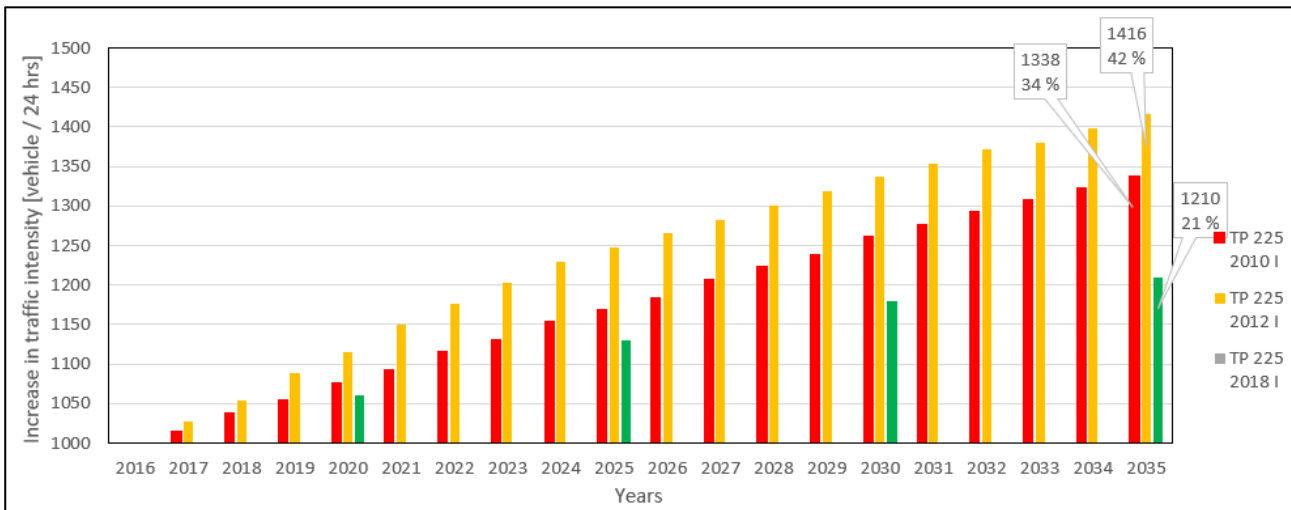


Fig. 2: Forecast of vehicular traffic intensities in years 2017-2035

As part of the TP 225 update, the growth coefficients were also defined for particular regions in the Czech Republic. Nowadays it's possible to predict vehicular traffic intensities in two ways. The first is the forecasting transport model, which takes into account the fact that the factors influencing the formation of transport relations do not develop evenly in the territory (this method is used when at least the transport model of the initial state has already been processed for the given territory). In the case where the transport model has not been processed or its updating is too demanding, so it is used the so-called. Method of single factor of growth, which is based on the assumptions of the same development of traffic intensities on all roads of the same type in the whole defined area. In this case, it is necessary to take into account changes in the use of PK and their functions. Figure 3 represents the difference in the growth of vehicular traffic intensities

in particular regions, when the largest increase in vehicular traffic is expected in the Central Bohemian Region, then in South Moravia and also in Olomouc region. The high increase is caused by assumption of the fact that the suburbanization is expected to develop, so people will have to commute or move directly to cities.

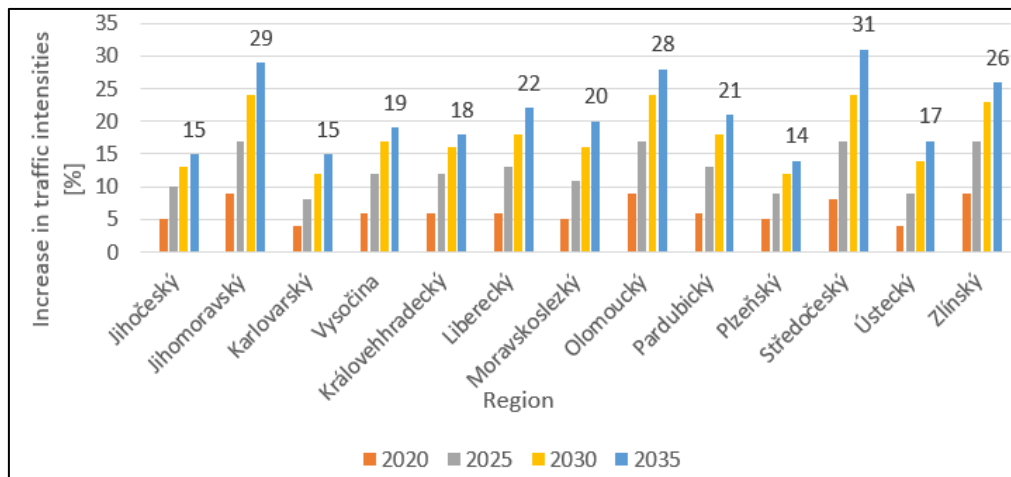


Fig. 3: Forecast of intensive automobile transport by region in years 2016-2035

### 3. Comparison of development of traffic intensity and number of registered vehicles in the Czech Republic

Since 2000, we have seen a sharp increase in the number of registered cars, which is due to the fact that the cars have become more accessible due to GDP / population growth. In the Czech Republic during last 17 years, the number of registered cars has increased by 56% (fig. 4).

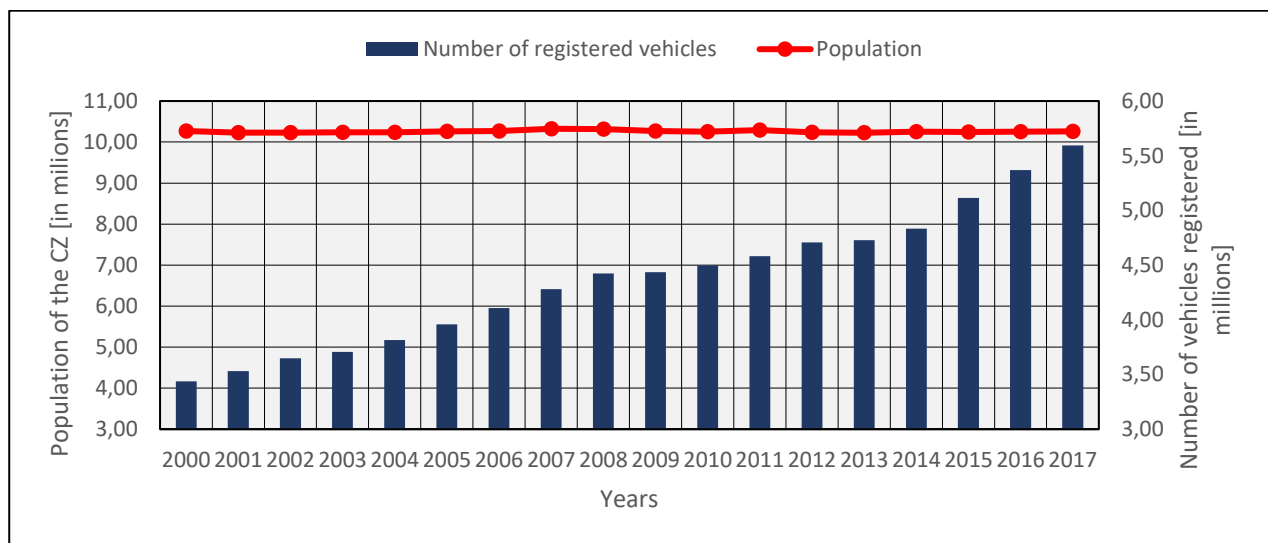


Fig. 4: Development of population and number of registered passenger cars in the Czech Republic  
References: [Ministry of Transport of the CZ, 2019], [Czech Statistical Office, 2019]

According to this trend, it leads to a general assumption that this will also increase traffic on the road network and that the increase will be approaching to the increase in the number of registered vehicles. This did not happen, due to, inter alia, that the capacity of the roads is not inexhaustible. The claim is illustrated by Figure 5, which shows the percentage development of registered vehicles, which is compared with the increase in vehicular traffic intensity at key delays (transit traffic) of major municipalities in the Pardubice Region. These are municipalities where there has been no change in the road network (increasing the capacity of the road, exposing the bypass, a significant change in the sources and destinations of the roads). The increase in traffic intensity is no more than 30%, which is half of the increase compared to the number of registered vehicles. Therefore, it cannot be argued that vehicular traffic is growing in proportion to the number of registered vehicles in the Czech Republic. Within the increasing number of registered cars in the Czech Republic and the steady population in the Czech Republic, we can observe, an increasing degree of motorization (number of vehicles per 1000 inhabitants), which was 335 vehicles / 1000 inhabitants. in 2000 and it is already 545 vehicles / 1000 inhabitants in 2016. Similarly, the automotive level (population per vehicle) is reduced. In 2000 it was 2.99 persons per registered passenger car, in 2016 it is already 1.91 persons per registered car.

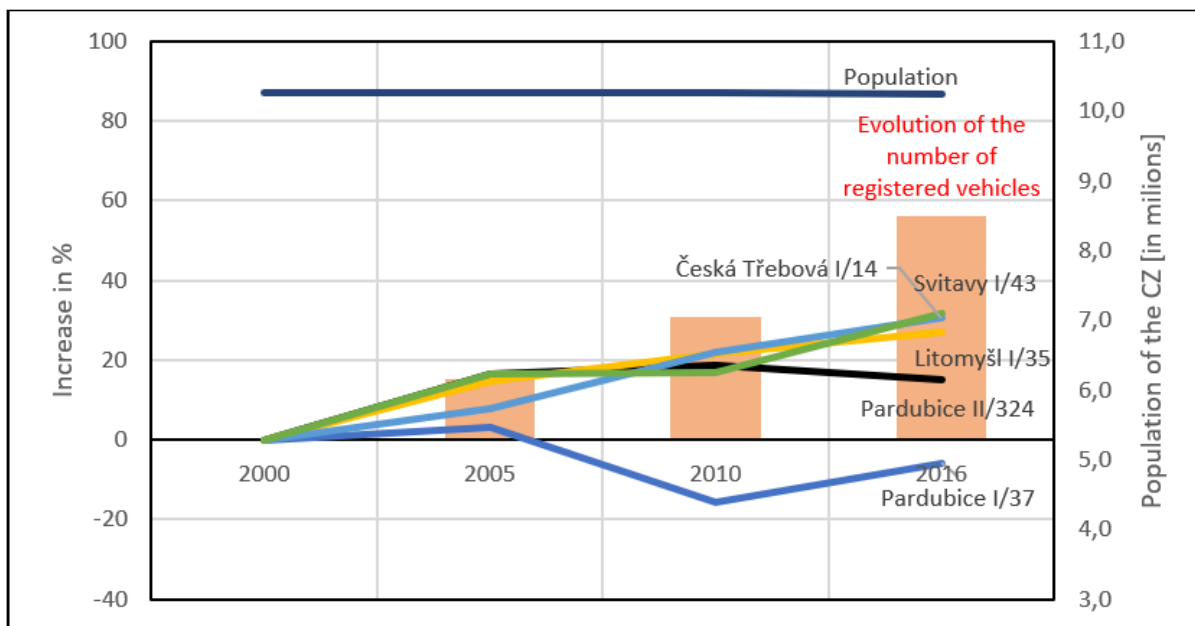


Fig. 5: Comparison of the increase in the number of registered vehicles and the intensity of transit traffic

Figure 6 depicts the same situation as Figure 4, both focusing on transport within the city. If we compare the development of traffic volumes with the number of registered vehicles, we conclude that increases in passenger transport are even smaller than in the case of transit. The maximum increase can be seen in the street Hradecká (class II / 324), when the increase in road traffic by 17% since 2016. Within the comparison of the development of traffic volumes it is interesting to note that on some roads decreased intensity of automobile transport. It is caused by the fact that the capacity of the interconnected roads, where transport functions predominate, is almost exhausted at peak times. The impact on the slow increase (or decrease) in traffic intensity is also reported by the traffic behavior of the inhabitants, when, due to the capacity of the road infrastructure at peak times, people often choose other means of transport. It is evidenced by two surveys of traffic behavior, which the city of Pardubice had it processed in recent years. Traffic behavior survey from 2012 shows modal split: 29% of all trips in Pardubice using private motor vehicles, 35% of journeys by foot, 17% by public transportation and 19% by the bicycle [Jirsa, 2015]. A survey of traffic behavior from 2018 [Ptáček, 2018] affirms a slight decrease in the used car transport, where it states the following modal split: 33% of all journeys in Pardubice are by individual car transport, 31% by foot, 22% by public transport and 14% by bicycle.

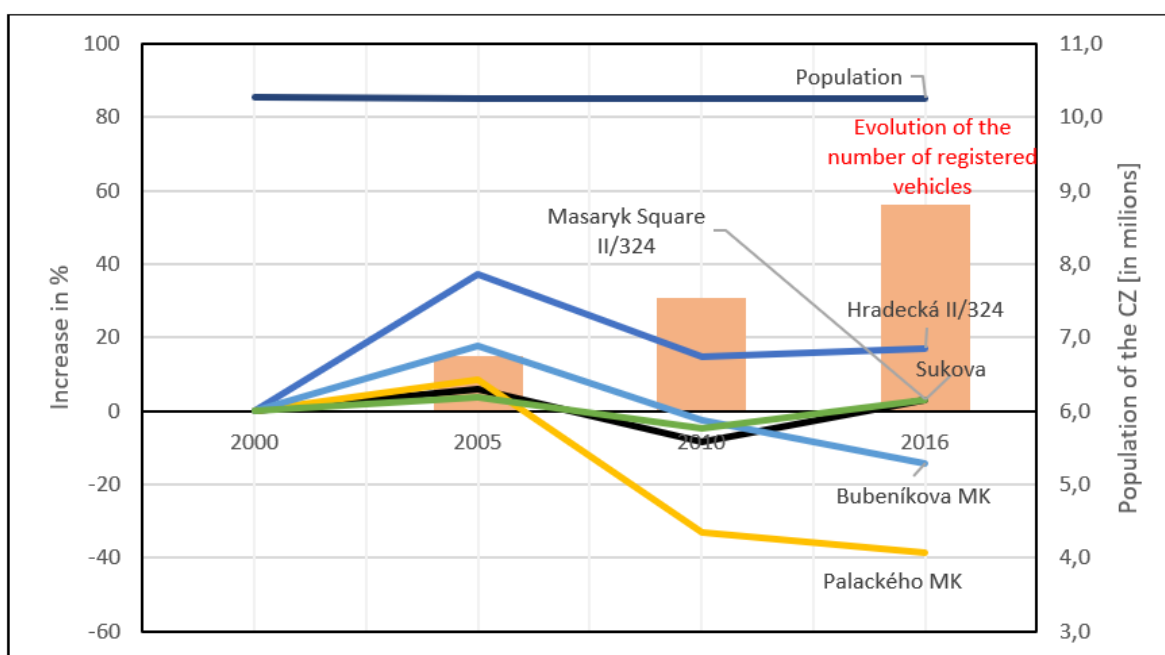


Fig. 6: Comparison of the increase in the number of vehicles and the intensity of traffic within the municipality

## Conclusion

Over the past 16 years (2000 - 2016), there has been a 56% increase in the number of registered cars. As the population of the Czech Republic remained almost the same during the same period, the level of motorization increased in year 2000 from 335 vehicles / 1000 inhabitants. to 545 cars / 1000 inhabitants in year 2016. However, the development of traffic intensities is not directly proportional to the development of the number of registered vehicles in the Czech Republic, which is evidenced by the development of traffic intensity on individual roads. The authors are inclined to the fact that this is due to the exhaustion of the capacity of roads in the rush hour and the associated with the change in traffic behaviour, where people, even if they own more vehicles, often choose a different means of transport for their trips than their own car. There's still a lot to improve, because in most cases there's only one person is sitting in one car. Traffic intensity is therefore not given by the number of registered vehicles but is dependent on the way people live and the behaviour (number of trips...). The increasing number of registered vehicles is particularly evident when parking.

## References

1. BARTOS, Ludek. Forecast of vehicular traffic intensities: TP 225. Liberec: EDIP, 2010. ISBN 978-80-87394-01-4.
2. BARTOS, Ludek. Determination of traffic intensity on roads: TP 189. Mariánské Lázně: EDIP, 2007. ISBN 978-80-902527-7-6.
3. BARTOS, Luděk. Determination of traffic intensity on roads TP 189. 2. edition. Mariánské Lázně: EDIP, 2012. ISBN 978-80-87394-06-9.
4. BARTOŠ, Luděk a Jan MARTOLOŠ. Determination of traffic intensity on roads: TP 189. 3. edition. Pilsen: EDIP, 2018.
5. JIRSA, Vojtech. Traffic behaviour research in Pardubice. Traffic engineering. Prague, 2015, (1), 3. ISSN 1801-8890.
6. PTÁČEK, Martin. Traffic behaviour research in Pardubice: Use of different modes of transport [online]. 2018 [cit. 2019-05-24]. Available from: <https://www.pardubice.eu/projekty/pruzkum-dopravniho-chovani/modal-split/>
7. Forecast of vehicular traffic intensities: TP 225. 3. edition. Pilsen: EDIP, 2018.
8. RICHTR, Ales, MARTOLOS a Jan HÁLA. Forecast of vehicular traffic intensities: TP 225. 2. edition. Pi: EDIP, 2012. ISBN 978-80-87394-07-6.
9. Traffic census: Results of national traffic census 2000-2016. Road and Motorway Directorate of the CZ [online]. 2016 [cit. 2019-05-24]. Available from: <https://www.rsd.cz/wps/portal/web/Silnice-a-dalnice/Scitani-dopravy>
10. Czech Statistical Office: Population [online]. [cit. 2019-09-16]. Available from: [https://www.czso.cz/csu/czso/obyvatelstvo\\_lide](https://www.czso.cz/csu/czso/obyvatelstvo_lide)
11. Ministry of Transport of the Czech Republic: Central vehicle register [online]. [cit. 2019-09-16]. Available from: <https://www.mdcz.cz/Statistiky/Silnicni-doprava/Centralni-registr-vozidel>

**Processing within the student grant competition 2019 (The University of Pardubice).**