DRAFT METHODOLOGY FOR THE CREATION OF TARIFFS OF FEES FOR USE OF ROAD NETWORK

NÁVRH METODIKY PRE TVORBU TARIFY POPLATKOV ZA POUŽÍVANIE CESTNEJ SIETE

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Summary: The submission defines a problem of pricing in general cargo by impact of toll in the first part. A different usage of the vehicle in individual transportation causes that it is not possible to calculated the toll uniformly for all cargos by constant price for customer in same transportation keeping. In the rest part is a draft of the new method of toll share for general transport determination processed.

Key words: transportation, pricing, cargo, toll, road

Anotácia: Príspevok v prvej časti definuje problém cenotvorby pri preprave kusových zásielok vplyvom mýta. Rôzne využitie vozidla pri jednotlivých prepravách spôsobuje, že nie je možné rozpočítavať mýto jednotne na všetky zásielky pri udržaní konštantnej ceny pre zákazníka pri rovnakej preprave. V ostatnej časti je spracovaný návrh novej metodiky stanovenia podielu mýta na kusovú zásielku.

Kľúčové slová: preprava, cenotvorba, zásielka, mýto, cesta

1. INTRODUCTION

In the European Union member´s countries are gradually changing to the performance charging of road network, which replaces the fee for its using by highway sticker. From countries that recently introduced electronic toll´s collection can be mention for example Germany, Austria, the Czech Republic and Slovak Republic, whereby the change to the system rests in fairer system of charging for the using of the road network in which each carrier will bear fees that are dependent on actually traveled distance [1]. For carriers, the introduction of performance fee by charging toll brings an increase in the extent of charging and thereby increasing the cost. For example in Slovak Republic introducing a performance fee of the road network has increased the extent of charging road network of 715 km in 2009 to 2,400 km in 2010[2]. Considering that the increasing costs of using the road network can not be paid from reserves carriers, it is necessary to transfer these costs into the price consumers3. From the position of the carrier with full track loads is not a problem to assign higher costs of a particular charged road network traffic and thus a particular consignment to be transported

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[2] data published on www.e-myto.sk

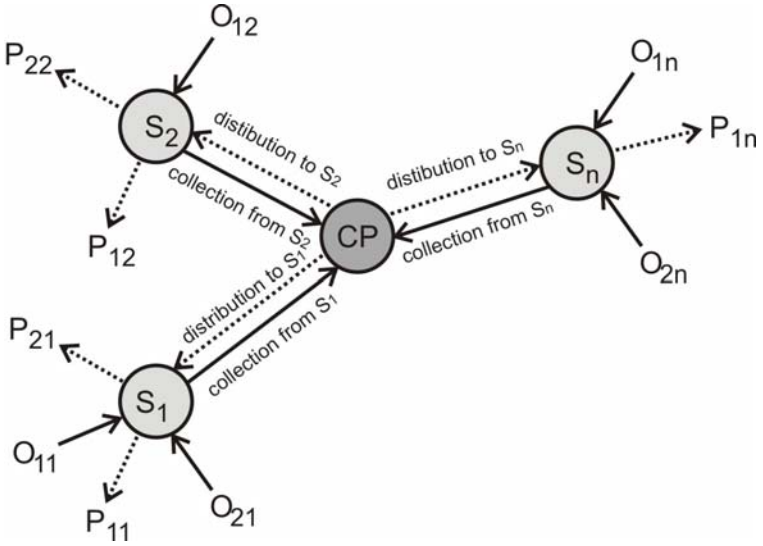
[3] the analysis published in [12]

during the transport. The problem arises with general cargo (packages) that is transported during the transport by several means of transport, when the transport is mostly carried out along with other items. At present there is no single approach to the assessment of the allotment of consignments to charge a fee for the road network. Therefore, within the project *Methodology for setting rates for the transport of general cargo on the territory of Slovak Republic after the introduction of electronic toll collection system* was developed theoretical insight into these issues with the recommended procedure, which is applicable in each country to introduce a performance road charging system.

2. PROCES PERSONÁLNEHO PLÁNOVANIA

Transportation technology of general cargo can be organized in different ways, the common feature is that by one means of transport are transported consignments for multiple users [2]. Number of vehicles depends on transportation technology which can include:

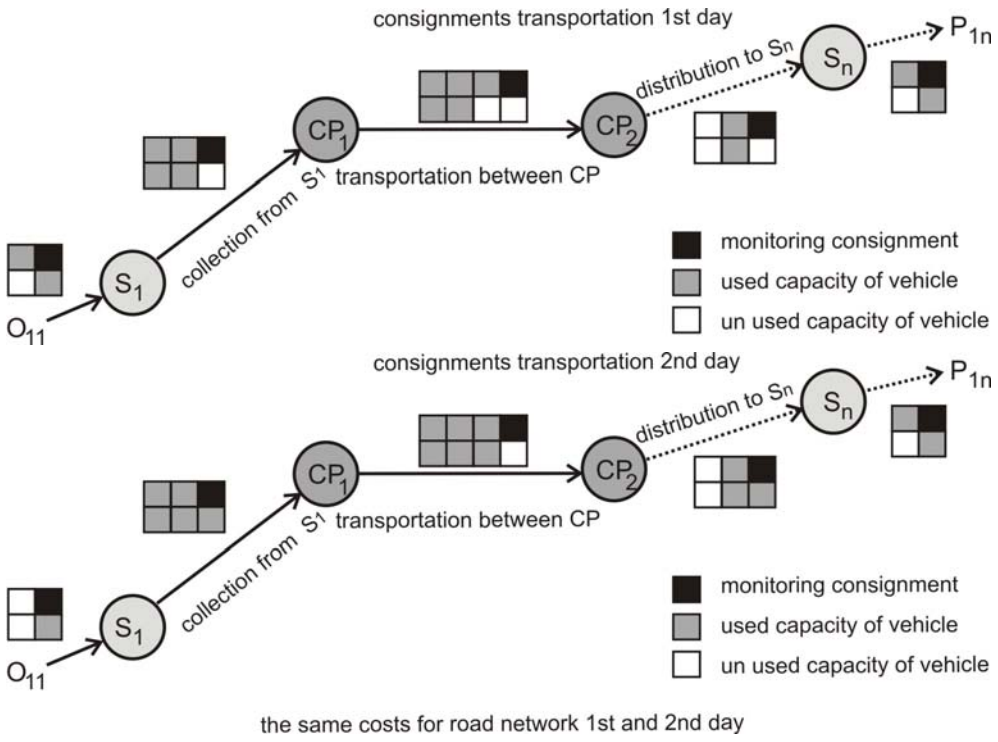
- **star system of one central transit shed** [3] – work technology of the system is concentrating consignments in the central transit shed (CP), which is assembled from individual collection centers (Si), which provides collection of consignments from different consignors (O_{ij} i - is the order of the consignor, j - the sign is a collection center). After completion of items in the CP consignments are distributed to individual centers (Si), followed by deliveries to individual consignee (P_{ij} i - is the order of the consignee, j - the sign is a collection center) (Figure 1).



Source: own processing of the author

Fig. 1 - Star structure of the transportation of consignments

- **system of two central transit sheds** [4] - is used in case of higher traffic flows between the two territories. Carriage between two central transit sheds is carried out by vehicles with greater transportation capacity. Collection and distribution of the central transit sheds is implemented as in case of a star system of one central transit shed (Figure 2).



Source: own processing of the author

Fig. 2 - Using of vehicles for single transportation

The problem of determining growth prices for using of the road network is that the simple transfer of charges for using of the road network to a particular consignment is not possible to provide a constant amount of the fee for the same transporting. In Figure 2 it is possible to highlight the problem of a concrete example. We consider that the transport technology of general cargo is provided in the two days the same way. Consignments are transported in the system for multiple consignees from multiple consignors. When comparing the collection to the center 1 (S1) is in the first day the capacity of the vehicle used for the 3 / 4 (1/4 is used by the consignor of a particular consignment and acceptance of consignment the car already transports consignments from other customers of capacity utilization at 50 per cent), in the second case, only the half (1/2), because in that day one consignor on the collection route did not send a consignment. The S1 is transported consignments on higher capacity vehicle and they are transported to a central transit shed. By this transportation there is a different using of the vehicle (2. day the capacity is used for 100 per cent), which means that the constant charge for the use of the road network the allotment in the consignment would not be constant. This principle applies to the rest of the transportation.

The price changing for the customer for each transportation can by considered only in the case that the transportation would by realized on the market with inelastic demand, where the percentage change in demand would be significantly lower than the percentage change of price [5]. The analysis of customer demand for transport services[4] is clear that the same means of transport of same consignments from the position of the carrier is not appropriate to

[4] for example the results published in [13]

change the price of each transportation because at these days it operates on the carrier market with high competitive offer of transport, causing an elastic demand for transport services.

3. PROPOSAL FOR A UNIFORM PROCEDURE FOR DETERMINATION THE TOLL RATES FOR THE TRANSPORTATION OF GENERAL CARGO

The purpouse of the proposed methodology is primarily the application in any State, which charged the using of the road network through toll and therefore it must respects any distribution of rates in terms of the structure of used vehicles and also a time limit of the rates in each country.

On the Basis of the analysis of methodologies of using of charged road, I propose for assessing the impact of tolls on the transport of general cargo to apply following procedure:

- **determination of the partial rate of charging of a particular road category of the road network** – for each charged category of a road network and in case each day of a week has different rates, as well as separately for each day, i tis necessary to determine the rate according to equation (1). On the basis of this equation we get as many of partial rates, as categories of a road network are charged. Eg. in Slovakia highways and carriegeways are charged with one rate and selected roads of I. class are charged with another toll rate, which means that there would be two partial-rates. In the Czech Republic, are also two types of charged roads - highways and carriegeways, but with special rates in a special time at the end of the week. It means that there would be four partial rate in the Czech Republic (for higways in ordinary period, for highways on Friday from 3 pm to 9 pm, for selected road of I. class in period and for selected road of I. class on Friday from 3 pm to 9 pm). In case of tariffs applicable to all charged roads in the same amount would be only a one partial rate. Seeing that equation (1) is adjusted for the allotment of the traveled distance on roads of a single category, partial-rate is the part of the overall average rate.

$$S_j = \sum_{i=1}^{n} \left({}^{j}s_i \cdot v_i \right) \cdot d_j \qquad (1)$$

S_j average toll rate for j - type of road network (eg, highway, carriegeways, roads of I. class, etc..)

${}^{j}s_i$ toll rate for the j - the type of road network, especially for i - type of vehicle of a carrier

v_i allotment of the i-th kind of fleet of a carrier percentage

i dependance of a vehicle on factors that affect the toll rates for specific vehicle (eg. Dependance on emission standards Euro, the number of axles, etc.).

d_j percentage share of driving performance of vehicles, which are carrying general cargo passed after j - the type of a road network for the time period of the overall driving performance for the time period

- **determination of the average rate of charging a particular category of roads of the road network** - the average toll rate in a single region is determined as the sum of all partial-rates, according to equation (2). The average rate is in equation (2), designated as S_P.

$$S_P = \sum_{j=1}^{m} \left(S_j \right) \qquad (2)$$

The proposed methodology within the study [7] has been applied to the conditions of Slovakia. The analysis of the fleet used for transportation of general cargo in the Slovakia by members of the Zväz logistiky a zasielateľstva SR (Association of Logistics and Freight Forwarding of the Slovak Republic) was found the allotment of vehicles listed in Table 6. The highest allotment of vehicles in the weight range from 3.5 to 12 t with an engine which fulfils the Euro III emission class (44 per cent).

Tab. 1 - The structure of the fleet of analyzed carriers in Slovakia in per cent

Vehicle Category	EURO 0 – II (per cent)	EURO III. (per cent)	EURO IV, V, EEV (per cent)
3,5 t – to 12 t	18	44	10
12 t and more - 2 axles	0	3	0
- 3 axles	0	1	0
- 4 axles	0	1	3
- 5 axles	6	11	3

Source: prepared by the author on the basis of [7]

In terms of allotments of roads used for distribution of general cargo can on the basis of the analysis prepared in [7] be made the following allotments of used road network which is needed for the determination of the allotment of costs for individual transported general cargo:

- 32 per cent of traveled distance on carriegeways and highways,
- 25 per cent of traveled distance on charged roads of I. Class,
- 43 per cent of traveled distance on the not charged road network.

On the basis of the analysis it can be concluded that in the Slovak Republic a 43 per cent of the driving performance on not charged roads is realized. Methodologies used in Austria and Germany do not take this fact and in applying of these methodologies would be to pricing of transported general cargo counted the toll for driving distance which is traveled on not charged roads.

- **determination of the average rate to take into account of using of the fleet –** the fact that the carrier must bear the fee for using the road network for the vehicle regardless of whether the the cargo is transported, or whether he is using the road network without the cargo[5]. And there are routes of the transportation, for which the return capacity utilization of the vehicle[6] is not possible. The average rate of the charge for using of road network for a particular transported packages should be increased by the fee for using of the road network for drive with an empty vehicle. It is also necessary to increase the average fee by the unused loading area of the vehicle, which can not be used in the order of the quantities in the region. Process of increasing of final rates is treated in detail in [8]. The degree of capacity utilization of the vehicle is expressed with a coefficient of payload utilization of the vehicle γ [9]. On the basis of this coefficient the average rate, which takes into account the utilization of the fleet ${}^{\gamma}S_P$ by equation (3), can be determined.

$$ {}^{\gamma}S_P = \frac{S_P}{\gamma} \tag{3}$$

  The payload utilization of the fleet is not applied in the methodology used in Germany and in the Czech Republic. In this case it means, that it is considered that each drive is vehicle used in terms of capacity on 100 per cent and it will not make any journey without a cargo. In practice this can not be achieved and on the basis of an analysis prepared in [7] it can be concluded that the capacity utilization of vehicles reached the level of 55-70 per cent (coefficient of payload utilization from 0,55 to 0,7).

- **Proposal of development of the tariff** – for the analysis of methodologies used abrad it can be stated that there is no uniform tariff structure for taking the toll into the price of transport of packages. The differences are both in comparison of distribution of tariff bands and in grades of tariff. In developing the proposed rates should be uniform:
    - a distribution of tariff distance – the distribution of traveled distance into the various tariff bands,
    - a distribution of tariff grades – the distribution of weight of carried consignment into the single weight bands.

  Specifically, rates S_{ij} of tariff setting addition of the toll by the transport of packages will be determined by equation (4). The rate must be dependent on the actual traveled transport distance and on the weight of the transported consignment. Product of the average rate taking into account the utilization of payload of the vehicle and tariff´s distance (center of the tariff zone) is called the average cost of a toll for the transported vehicle. In order to determine the allotment of a toll on specific general cargo, it is necessary to calculate the allotment of the total toll to base value of the vehicle´s payload.

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5 Eg. by www.e-myto.sk

6 eg. according to analysis published in the weekly newspaper Dopravní noviny No. 24/2010 (R 6063 - 46 325 MIC) for some regions in international traffic, there is the return capacity utilization of the vehicle at the level of 15 per cent of vehicles

$$S_{ij} = \frac{^{\gamma}S_P \,.\, l_i}{M} \,.\, m_j \qquad (4)$$

S_{ij} specific rate of the tariff for the i-th tariff´s band and j-th tariff´s grade,

l_i i-th tariff´s zone,

m_j j-th tariff´s grade,

M payload of the vehicle.

According to the analysis prepared in [6] and in other materials[7] it can be concluded that by the transport of individual packages are used vehicles ith the next payload (M):

- For consignments to the weight of 3000 kg are used vehicles with an average payload of 8 000 kg,
- For consignments from the weight of 3000 kg are used vehicles with an average payload of 12 000 kg,

By the proposed setting of rates a unwanted fact occurs, that by the comparing of two consecutive consignments to 3,000 kg and over 3 000 kg, that are carried on the same transport´s distance it reduces the rate of the toll´s addition by the changes of the vehicle´s payload. For the customer it does not matter by what means of transport the transportation is realized, hence the requirement that the rate may not decrease with increasing weight. The problem can be resolved by the procedure, that is implemented in the methodology used in Austria. It means, that in the specific interval of change of a weight of transported consignment. It means that the payload of the vehicle is continuously increased. Proposal for allocation of the average payload of vehicles used for specific consignment´s weights are listed in Table 7.

For the transportation of the package with the weight more than 12 000 kg it should be considered with the fact that in practice the consignment is usually carried like teh full track load. It means that in the vehicle is carrying anly one item. In this case there is no need of toll from the transportation to calculate on several consignments and it can be set directly to a specific consignment based on equation (5) like the product of the average rate, that takes into account of using of payload of the vehicle and diameter of the i-th tariff´s band of the transportation of general cargo.

$$S_i = {^{\gamma}S_P} \,.\, l_i \qquad (5)$$

[7] for example: *Mautgebühren für den Spediteursammelgutverkehr*, Vereinigung der Sammelguspediteure im BSL, 2003, Bonn

Tab. 2 - Proposal for allocation of the average payload of the vehicle depending on the weight of the consignment

Weight of the consignment (kg)	Capacity utilization of the vehicle (kg)
2250 – 2500	8 000
2500 – 2750	8 800
2750 – 3000	9 600
3000 – 3500	10 400
3500 – 4000	11 200
4000 – 4500	12 000

Source: prepared by the author [6]

4. CONCLUSION

The introducing of fair pricing of the road network through toll, for which a fee for using of the road network is based on the number of traveled kilometers on the charged road network, greatly increases the cost of the carrier. According to [10], costs of the carrier, which are currently by the operation of the combination of vehicles costs without the toll from 0,8 to 1 € / km after the imposition of tolls will increase for about of 0,1 to 0.15 € / km, it represents an increase of costs of 10 up to 20 per cent. The increase depends on the amount of toll´s rates and also on the extent of charging of the road network. In any case, it is not possible the increased costs to pay from carrier´s own reserves. Even in Slovakia, where the introduction of tolls was offset by a reduced rate of excise duty on mineral oils of € 113,31 € / 1 000 liters[8] it increased the cost of the carrier, as is demonstrated by an analysis prepared in [11], according that the annual costs of vehicle were increased of 5 076,44 € / year for vehicles with a total weight of 40 t.

The increase in costs should be passed on the customers of transportation. For full track loads for all transportation is possible to identify increased costs of transportation. Indicative it is possible to calculate increased costs for example through toll´s calculator, which is published on the websites of toll´s operators[9]. For general cargo it is complicated to calculate increased costs, which was formed to the carrier for using of a charged road network for the transportation of various consignments, because of different weights and transport´s distances of consignments. It is therefore necessary to apply tariff, which is used in several countries with established toll. In each country, associations of forwarders and carriers have developed a individual methodology, which is applicable only to the conditions of that country. This methodology is not possible to apply in another country. Therefore, this contribution presents the methodology for determining the surcharge to the price for transportation of packages for the toll, which is applicable in any territory, in which they introduce a performance charging of the road network. It means, without the modification the methodology can be applied in Slovakia, but also in Hungary and in Poland, where implementation of road network´s chaging throught the toll is expected.

[8] Law no. 30/2010 Z. Laws, which amends Act no. 98/2004 Z. z. the excise duty on mineral oil
[9] eg. to www.tollcollect.de for Germany, www.e-myto.sk for the Slovak Republic and so on.

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