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Safety Analysis of Foreign Traffic from Visegrad Countries on the Hungarian Network

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RESEARCH ARTICLE

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Abstract

The paper investigates the road safety characteristic of foreign traffic arriving from the Visegrad Countries to Hungary. The connection among Visegrad Countries has been getting more and more important, since the East-European Region recognized their common interests in intensifying economic cooperation. In this process, the understanding of road safety characteristic of foreign traffic among Visegrad Countries is a crucial step forward to the common future.

Keywords

Road safety analysis · Visegrad Countries · Road Safety Inspection

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1 Introduction

The project aims to develop road safety related cooperation among the countries of Visegrad Group. The improvement of road safety was always an important objective of the four Visegrad countries; accordingly it has continuously reappeared in the presidency program of V4s. For instance between 2009 and 2010, the presidency program considered the issues of road safety and the cross-border enforcement of the corresponding rules as priorities, however this cooperation field has still remained an actual challenge. Therefore, the recent presidency also considers road safety issues as an articular field of collaboration.

Hence, the main objective of the project is to support and harmonise the coordination of preparations and implementation of national road traffic safety programmes involving the most appreciated specialists of the discussed professional field. A key factor for the safety of road transport is the infrastructure design (Ivan and Koren, 2013; Török, 2013).

The project will focus on the professional fields below:

1. Road safety aspects of cross-border tourism among Visegrad countries,
2. Road infrastructure safety management (2008/96/EC).

The project will realise activities which cover the main project objectives below:

1. Information sharing on current activities (transfer of knowledge, preparing research collaborations),
2. Sharing of experiences (professional conferences, publications, discussions),
3. Dissemination of results.

2 Applying gravity model to analyze road safety characteristic of foreign traffic

To analyze road safety characteristic of foreign traffic in Hungary, number of injuries should be compared to traffic differentiated by nations. However traffic data differentiated by nations and roads is not available in Hungary, hence it is necessary to involve other to estimation model in the analysis.

Traditionally, in social sciences, values related to traffic among countries are estimated with the gravity model, which describes a traffic-like parameter based on a mass-like economic parameter (e.g. population) in the nominator of the fraction divided by the squared value of a resistance-like parameter (e.g. distance). The formula below represents the mentioned relationship between traffic (T) and population of the countries (P) proportioned to squared value of distance of capitals (d).

$$T = f\left(\frac{P_1 \cdot P_2}{d_{12}^{\ 2}}\right) \tag{1}$$

Tab. 1. Estimated accident index of foreign traffic

	Nr. of Total accidents	Population	Distance [km]	T / Nr. Of Tot. Acc.
Hungary	65361	9 942 000	1	0.01
Russia	10	104 300 000	1800	0.31
France	19	60 900 000	1550	0.75
Greece	6	10 700 000	1480	1.23
Spain	8	40 400 000	2500	1.24
Ireland	1	4 100 000	2300	1.29
United Kingdom	27	60 600 000	1725	1.33
Croatia	51	4 500 000	350	1.39
Italy	64	58 100 000	1225	1.65
Austria	249	8 200 000	240	1.75
Czech Republica	66	10 200 000	525	1.78
Denmark	6	5 500 000	1300	1.84
Slovakia	250	5 400 000	200	1.85
Finnland	3	5 200 000	1900	2.08
Latvian	2	2 300 000	1550	2.09
Germany	246	82 400 000	875	2.29
Poland	115	38 500 000	875	2.29
Slovenia	22	2 000 000	460	2.33
Switzerland	22	7 500 000	1000	2.93
Lithuania	7	3 600 000	1300	3.29
Sweden	8	9 000 000	1950	3.38
Belgium	18	10 400 000	1400	3.39
Moldova	19	4 500 000	950	3.81
Ukraine	154	46 700 000	1120	4.14
Bulgaria	51	7 400 000	780	4.19
Netherlands	39	16 500 000	1400	4.63
Romania	1019	22 300 000	860	33.80

Tab. 1. represents the estimated accident rate of different nationalities in Hungary. Based on the definition of the traffic-like T parameter, it is possible to specify an accident rate-like parameter with the comparison of the T parameter and the total number of traffic (last column of *Tab. 1.*).

It has to be mentioned that the lack of reliable data on driven kilometers of foreign drivers differentiated by nationalities makes it difficult to provide irreproachable results (Borsos, 2010). "Self-explanatory" roads decrease the number of accidents by showing the participants of road transport where they should be progressing and how they can safely use the public roads (Bosurgi, 2013). Due to this reason the applied methodology can only estimate the relation of traffic from foreign countries and the injuries affected by foreign drivers hence the results should be evaluated carefully. There is further development needed in the area of the investigation methods regarding the analysis of the relationship between the road parameters and transport safety risk (Dabbour, 2012; Podvezko and Sivilevičius, 2013).

It obvious that drivers from Visgrad countries cannot classified into the group of most risky drivers. Among the group of most risky drivers interesting results have been evolved. It is not so surprising that Romanian drivers have been assigned risky, however the assignment of Dutch drivers is rather unexpected, since the Netherlands are said to be possessing the most developed road safety environment including all infrastructure, human and vehicle aspects of the system (Borsos et. al., 2012). This contradiction draw the attention to the weakness of the introduced analysis and explain the necessity of the further investigation of road safety effects of foreign traffic as it stated in Koren (2012).

3 Data analysis on road safety characteristic of traffic from Visegrad countries

The first step of the analysis is to define the most important tourist regions in Hungary, especially those, which are the most popular among tourists from the other V4 countries. Based on the data of the Hungarian National Tourist Office, the tables below present the most important tourist destinations in Hungary among tourists from the Czech Republic, Poland and Slovakia. In the first table we can see that most tourists visit Western-Transdanubia from the Czech Republic.

Tab. 2. Guest nights of citizens from the Czech Republic

Regions	Czech Republic			
	Guests	Distribution	Nr. of guest nights	Distribution
Balaton	**23 937**	**12.80%**	**86 445**	**16.10%**
Budapest and its surroundings	**56 329**	**30.10%**	**122 305**	**22.80%**
Southern-Great Plain	3 210	1.70%	7 018	1.30%
Southern-Transdanubia	6 300	3.40%	27 941	5.20%
Northern-Great Plain	3 851	2.10%	13 375	2.50%
Northern -Hungary	5 196	2.80%	17 722	3.30%
Central-Transdanubia	4 012	2.10%	9 713	1.80%
Western-Transdanubia	**83 436**	**44.60%**	**247 992**	**46.30%**
Lake Tisza	856	0.50%	3 037	0.60%
Sum	187 127	100.00%	535 548	100.00%

The second favourite destination of Czech tourists is Budapest and the third one is Balaton as it can be seen in the figure below. The fourth most popular destination is Southern-Transdanubia, this is followed by Northern –Hungary, Central- Transdanubia, Northern- Great Plain, Southern-Great Plain and finally, Lake Tisza.

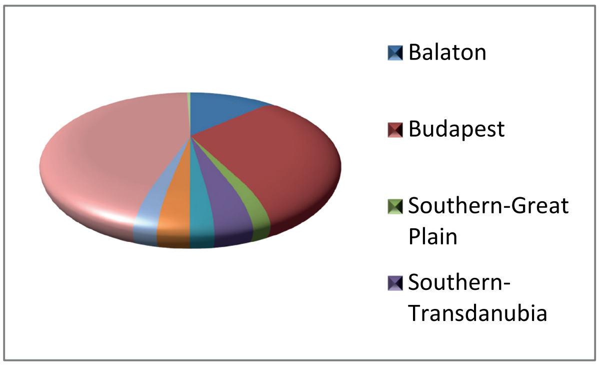

Fig. 1. Guest nights of citizens from the Czech Republic

The table below presents the distribution of Polish tourists in reference to tourist destinations in Hungary. The most popular destination is Budapest, this is followed by North-Great Plain and the third favourite destination of Polish tourists is Northern -Hungary.

Tab. 3. Guest nights of Polish citizens

Regions	Poland			
	Guests	Distribution	Nr. of guest nights	Distribution
Balaton	**16 843**	**8.90%**	**52 188**	**10.40%**
Budapest and its surroundings	**98 744**	**52.00%**	**212 260**	**42.10%**
Southern-Great Plain	6 389	3.40%	19 569	3.90%
Southern-Transdanubia	1 612	0.80%	3 590	0.70%
Northern-Great Plain	25 021	13.20%	93 911	18.60%
Northern -Hungary	24 331	12.80%	63 950	12.70%
Central-Transdanubia	3 681	1.90%	10 270	2.00%
Western-Transdanubia	**7 864**	**4.10%**	**22 881**	**4.50%**
Lake Tisza	5 305	2.80%	19 048	3.80%
Sum	189 790	100.00%	503 667	100.00%

The fourth most popular destination is Lake Balaton, followed by Western-Transdanubia, Southern-Great Plain, Lake Tisza, Central- Transdanubia and finally, Southern-Transdanubia.

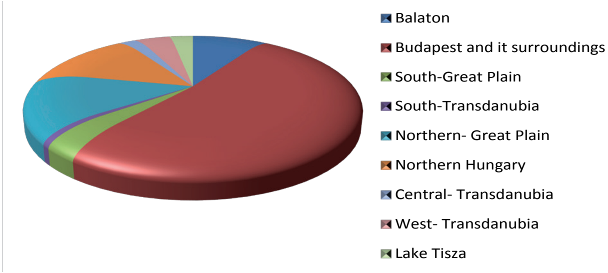

Fig. 2. Guest nights of Polish citizens

Tourists from Slovakia prefer mostly the region of Budapest, whilst West- Transdanubia is in the second place and North-Great Plain in the third place.

Tab. 3. Guest nights of Slovakian citizens

Regions	Slovakia			
	Guests	Distribution	Nr. of guest nights	Distribution
Balaton	**16 039**	**13.60%**	**43 753**	**16.70%**
Budapest and its surroundings	**39 713**	**33.70%**	**75 792**	**28.90%**
Southern-Great Plain	3 907	3.30%	9 474	3.60%
Southern-Transdanubia	1 857	1.60%	4 270	1.60%
Northern-Great Plain	16 499	14.00%	40 420	15.40%
Northern -Hungary	12 662	10.70%	26 197	10.00%
Central-Transdanubia	4 932	4.20%	11 044	4.20%
Western-Transdanubia	**19 043**	**16.10%**	**43 813**	**16.70%**
Lake Tisza	3 357	2.80%	7 066	2.70%
Sum	118 009	100.00%	261 829	100.00%

The fourth most popular destination is Lake Balaton, followed by Northern Hungary, Central Transdanubia, Southern-Great Plain, Lake Tisza and finally, Southern Transdanubia.

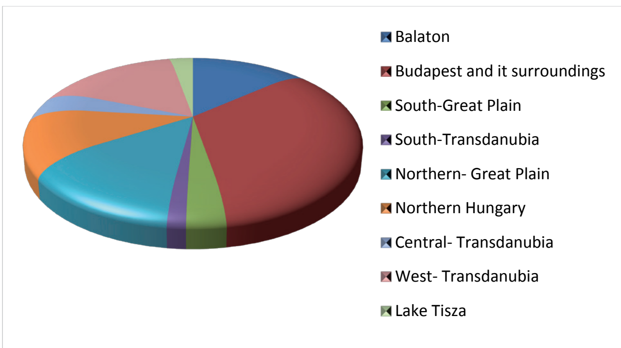

Fig. 3. Guest nights of Slovakian citizens

Based on the comparison above, the three most popular Hungarian destinations among V4 tourists were Budapest, Northern Great-Plain and Western-Transdanubia, therefore the subject of further investigation shall be chosen from the roads connected to these three regions.

Fig. 4. EuroRap accident risk map

The figure above introduces the risk map of the core network of the Hungarian main road system based on the EuroRap method (accident risk increases from green to red) *(Hollo et. al., 2010a; Hollo et. al., 2010b)*.

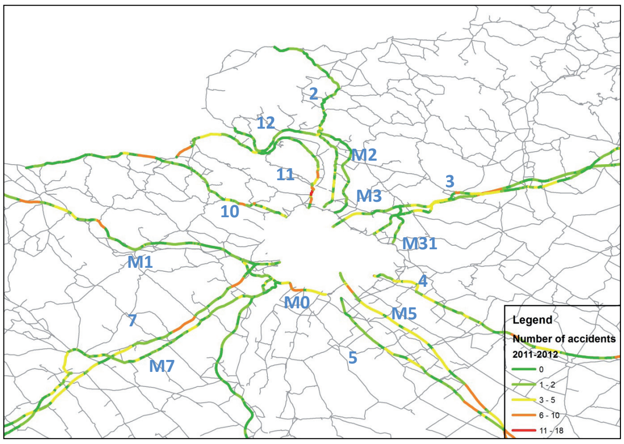

Fig. 5. Number of accidents on the main road network of the central region

4 Road network of the tourist regions

The analysis focuses on the network defined by the National Tourist Office. The National Tourist Office highlighted those network elements, which play key role in the accessibility of the investigated regions.

In the case of Budapest, these main roads are as follows: motorway nr. M0, motorway nr. M1, main road nr. 10, main road nr. 11, main road nr. 12, main road nr. 2, motorway nr. M2, main road nr. 3, motorway nr. M3, motorway nr. M31, main road nr. 4, motorway nr. M5, main road nr. 5, motorway nr. M6, main road nr. 7, motorway nr. M7.For the Northern-Great-Plain, these roads are as follows: main road nr. 4, motorway nr. M35, motorway nr. M3, main road nr. 33, main road nr. 49, main road nr. 42, main road nr. 41.

5 Example for road safety analysis on the Hungarian network

The next part of the study includes the road safety analysis of road nr. 84. The investigation aims to define the most dangerous part of the given network element based on accident data for the road.

The result of the first step is represented by the figure below. It introduces the number of accidents by road section. Sections were defined based on the EuroRap method, making it possible to define those sections, on which most of the accidents could be identified (at least 3 accidents – yellow, orange and red sections). These sections are as follows (starting cross-section [km+m] – ending cross-section [km+m]): 13+188-14+437, 46+846-47+670, 52+567-57+333, 57+888-60+000, 78+944-81+250, 92+613-95+318, 99+815-100+716,101+873-105+872, 110+427-113+864, 128+324-128+559.

In the next step, the aim was to narrow down the set of the investigated network components, therefore the investigation has focused on the serious and fatal accidents that occurred on the selected sections in 2011 and 2012. Accordingly, the investigated cross-sections are as follows (cross-section [km+m]): 93+703, 103+000, 111+918.

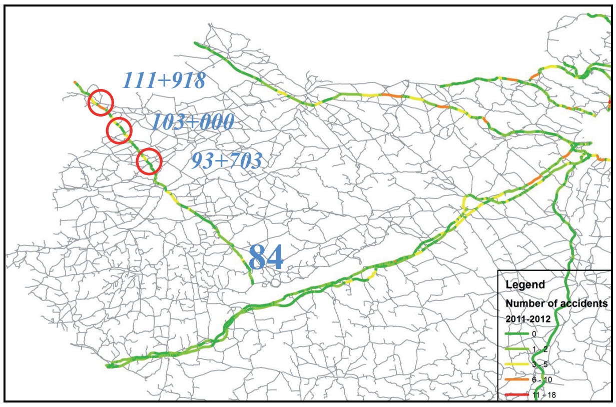

Fig. 6. Number of accidents on the main road nr. 84, in the chosen cross-sections

The first cross-section is in a curve with reduced visibility. In addition, the rural environment and its straight road is followed by an urban area with twists and turns. These specialities make road safety risk of the section higher than the average, hence it is important to approach the road section with special attention.

Fig. 7. The first cross-section

The second cross-section is in a straight road section with appropriate visibility. However, objects near the road are too close to the side of the road. Also, good visibility and a straight road reduce risk awareness and enhance the average speed of the traffic. These special conditions enhance the risk of serious and fatal run off accidents.

Fig. 8. The second cross-section

In the third cross-section, a long straight road section is followed by a slight curve. Visibility is adequate, however it can make drivers to begin unsafe overtaking. These special conditions enhance the risk of serious and fatal frontal accidents.

Fig. 9. The third cross-section

Based on recorded accidents, three spots with concentration of accidents were identified. The suggestion of targeted road safety measures was not the part of the case study.

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