VINKO VIŠNJIĆ, Ph.D.
E-mail: vinko.visnjic@fpz.hr
University of Zagreb,
Faculty of Transport and Traffic Sciences
Vukelićeva 4, HR-10000 Zagreb, Republic of Croatia
MARKO PUŠIĆ, M.Sc.
E-mail: marko.pusic@akz.hr
GKG d. o. o., Bus Station
Avenija Marina Držića 4, HR-10000 Zagreb,
Republic of Croatia

Safety and Security in Traffic
Review
Accepted: Nov. 6, 2007
Approved: Mar. 11, 2009

ANALYSIS OF TRAFFIC ACCIDENTS IN THE AREA OF SMALL TOWNS IN THE REPUBLIC OF CROATIA

ABSTRACT

The safety of road traffic in small towns in the Republic of Croatia is not at a satisfactory level. As proof, the safety of road traffic participants in the area of the town of Nova Gradiška and its wider environment has been studied and analyzed. The paper includes the available data in the period from 2000 to 2007. The analysis and the assessment of road traffic safety can be applied also to other towns and counties of the Republic of Croatia. Having in mind that there are 531 settlements in the Republic of Croatia (119 towns and 412 districts), out of which only 78 are larger than 10,000 inhabitants or 14.69% of the total number, which means that the analysis could be made for any settlement in the Republic of Croatia. The road traffic safety assessment was conceived according to the modified Smeed model which may be applied for any settlement or town. The road traffic safety analysis has led to the conclusion that safety of all the traffic participants is endangered. This paper provides solutions about what has to be done in order to reduce the danger to all the road traffic factors.

KEY WORDS

drivers, traffic, traffic accidents, safety and small towns

1. INTRODUCTION

The statistics shows that the number of human victims in traffic accidents is constantly increasing and is acquiring very serious dimensions.

Of course, the basic problems of traffic safety include: human driver, motor vehicle, and road. The occurrence of traffic accidents can also be influenced by the atmospheric conditions (fog, rain, snow, ice, wind), lack of traffic regulation facilities (signs, warnings and other devices), incomplete legislation on traffic, and inadequate and inefficient control.

Among the factors that contribute to traffic accidents the biggest one is the effect of human-driver, vehicle and traffic surfaces. Wrong decisions, estimates and lack of skills in driving lead to traffic accidents, loss of human lives and to material losses. On the other hand, lack of other knowledge, skills and psycho-physical capabilities are the drawbacks that can be influenced, improved by education, in order to increase traffic safety.

2. ANALYSIS OF SAFETY IN THE AREA OF THE TOWN OF NOVA GRADIŠKA

2.1 Road network and level of motorization

In the wider area of the town of Nova Gradiška which is the coverage area of the Nova Gradiška Police Station, there is a network of state, county and local roads. The structure of road network consists of 29.08km state roads, 125.50km county roads and 46.05km local roads (Figure 1).

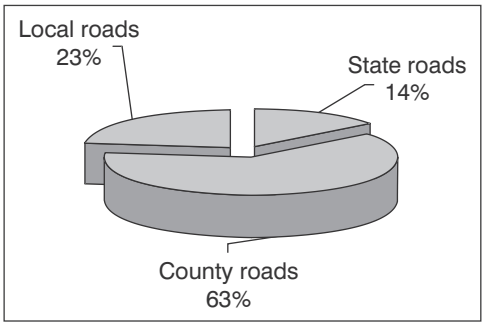

Figure 1 - Structure of the existing road network [1]

In the region of Nova Gradiška Police Station 15,160 motor vehicles were registered by 31 December 2007. Out of this number, regarding structure, 11,067 or 73.0% passenger vehicles, 1482 or 9.77% tractors, 1021 or 6.73% freight vehicles, 992 or 6.54% mopeds, etc. were registered. By comparing these data

with the data from 2006 (Figure 2) one may find that the number of registered motor vehicles is greater by 672 or 4.43%.

Also, 18,700 drivers were registered, out of which regarding gender, there were 12,632 or 67.94% male drivers and 6068 or 32.06% female drivers. Apart from this division and division that may be derived, it is also possible to make the breakdown according to age, in which the biggest group of drivers is between 35 and 44 with 4556 or 24.36% out of the total number of drivers. Comparing these data with the same period from 2006 leads to the conclusion that the total number of drivers is expanded by 413 persons or 2.25% of drivers.

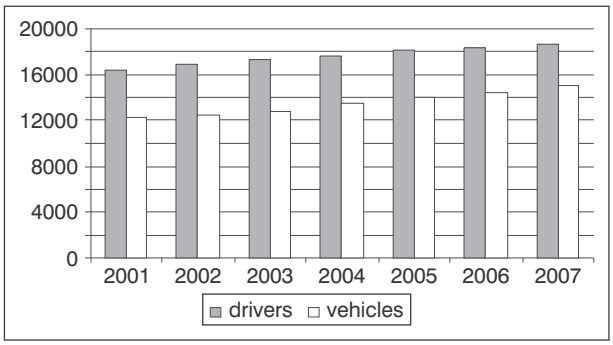

Figure 2 - Drivers and vehicles over the time period from 2001 to 2007 [1]

However, when the analysis includes several years (Figure 2) of the number of registered motor vehicles and the number of registered driving licences, i. e. drivers, one obtains the differences from year to year, and for 2007 the difference is 3,540 driving permits. This number is in fact the number of drivers who have no motor vehicles but do have driving permits. It is precisely this number that can be considered minimum demand for motor vehicles. In other words, the town of Nova Gradiška requires 18,700 motor vehicles (currently 15,160 motor vehicles) or the actual demand is greater by 23.34% motor vehicles the use of which is not possible for numerous reasons (the biggest reason is the purchase power of the driving permit owners).

2.2 Classification of traffic accidents

In the area of Nova Gradiška, during 2007, there were 329 traffic accidents (Table 1), out of which 4 traffic accidents with fatalities, 104 or 31.61% with injured persons and 221 or 67.17% with material damage.

Traffic accidents had 168 victims. Out of this number 4 persons or 2.4% were killed, 34 persons or 20.24% suffered serious body injuries, and 130 persons or 77.38% suffered light body injuries.

Comparing the data (Table 1) on traffic accidents with the data from 2006 one may see the larger number of traffic accidents by 10.40%, i. e. 41 traffic accidents. Here, the number of traffic accidents with fatalities is smaller by 2 persons or 33.33%, whereas the number of traffic accidents with injured persons is smaller by 8 traffic accidents or 6.69%; however, traffic accidents with material damage are reduced by 41 damages or 23.16%.

However, when a longer time period is considered (Table 1), from 2000 to 2007, one may notice an increase in traffic accidents by 2.1% and in the number of victims by 35.4%. The situation is similar (Table 2) when an even longer time period (13 years) is considered, where the relations between the number of traffic accidents and the number of victims are even more pronounced (32.29% 1995 compared to 32.83% in 2007), noticing that the number of traffic accidents was falling until 2006, but marked an increase in 2007 with constant increase in the number of victims until 2006 and a light fall in 2007.

This is especially expressed in injured persons where there is a constant increase of the injured from 1999 to 2006 (on the average 4.40% annually).

In case of fatalities the situation is very different. It is of variable character and unfortunately after 2003, 2004, and 2007 when there was a decreasing trend and levelling off in the number of fatalities, in 2006 there came to a sudden increase in the number of fatalities.

Table 1 - Number of traffic accidents and consequences in the recent 8 years [1]

	2000	2001	2002	2003	2004	2005	2006	2007
Total of traffic accidents	322	327	385	441	351	338	298	329
– with fatalities	7	5	7	5	3	2	6	4
– with injured persons	90	98	104	106	93	113	114	104
– with material damage	225	224	274	330	255	223	178	221
Total number of victims	141	148	157	158	155	160	179	168
– fatalities	7	5	9	5	3	3	6	4
– seriously injured	38	37	24	27	36	41	41	34
– lightly injured	96	106	124	126	116	116	132	130

Table 2 - Traffic accidents (TA) and consequences from 1995 to 2007 [1]

Year	Traffic accidents [TA]	TA with injured	Share of TA with injured persons in total number	Fatalities	Injured	Share of fatalities in total number of victims
1995	449	145	32.29	7	191	3.66
1996	339	116	34.21	5	156	3.20
1997	219	92	42.00	2	125	1.60
1998	239	94	39.33	7	141	4.96
1999	258	81	31.39	3	116	2.58
2000	322	97	30.12	7	141	4.96
2001	327	103	31.49	5	148	3.37
2002	385	111	28.83	9	157	5.73
2003	441	111	25.17	5	158	3.16
2004	351	96	27.35	3	155	1.93
2005	338	115	34.02	3	160	1.87
2006	298	120	40.26	6	179	3.35
2007	329	108	32.82	4	168	2.42
Total:	4295	1389		66	1991	
Average:			32.33			3.21

2.2.1 Traffic accidents according to road characteristics

Table 3 shows the structure of traffic accidents according to road characteristics indicating that the biggest number of traffic accidents is in the wider area of the coverage of the Nova Gradiška Police Station, i. e. from the total number of accidents 163 or 49.50% occurred on the straight sections of roads.

On the straight sections of the roads, the victims included 68 persons or 41.72% out of the total number of victims. Two persons or 50% were killed and 10 persons or 6.1% were seriously injured, while 53 persons or 32.32% were lightly injured.

There were 69 or 20.97% of traffic accidents at intersections. Fifty-one persons or 15.50% were victims, 1 person was killed, 12 persons suffered serious body injuries, and 38 persons suffered light injuries.

There were 63 or 19.15% traffic accidents in curves. Thirty-eight persons or 12.75% were victims, 11 persons suffered serious body injuries and 27 persons suffered light body injuries.

2.2.2 Traffic accidents according to the condition of road surface

Regarding the condition of the road surface, the largest number of traffic accidents (224 or 68.08%) occurred on dry and clean carriageway (Table 4). These traffic accidents had 104 victims or 42.95% out of which 3 were fatalities, 20 persons suffered serious, and 81 persons suffered light body injuries.

There were 90 or 27.35% traffic accidents on wet carriageways, in which 59 persons were victims, out of which 1 person was killed, 14 persons suffered serious and 44 persons suffered light body injuries.

2.2.3 Traffic accidents regarding meteorological conditions

The majority of traffic accidents (169 or 51.36%) occurred in clear weather (Table 5). They involved 96 victims or 29.18%, with 3 fatalities, 16 seriously and 77 lightly injured persons.

There were 103 or 31.30% traffic accidents in cloudy weather. These traffic accidents involved 32 victims, with 11 persons suffering serious and 21 persons suffering light injuries.

2.2.4 Time of traffic accidents

Out of 329 traffic accidents, 226 or 68.69% occurred during the day and 99 or 30.09% at night, with 2 accidents that occurred at dusk and 2 at dawn.

According to days in a week, the largest number of traffic accidents occurred on Fridays – 53 or 16.10% (Table 6), and the fewest on Mondays – 41 traffic accidents. Identical is the situation with traffic accidents when taking into consideration the victims and material damage regarding days (Figure 3).

The largest number of traffic accidents, namely 41 or 12.46% from the total number of traffic accidents occurred in the time period between 6 p. m. and 8 p. m. (Table 7). In the time period from 6 a. m. to 2 p. m. 40.73% of all persons were victims compared to the

Table 3 - Number of traffic accidents according to road characteristics [1]

Road characteristics	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
– T intersection	14	4.69	33	10.03
– Y intersection	1	0.33	-	-
– four-arm intersection	42	14.10	36	10.94
– intersection – other	-	-	-	-
– bridge	-	-	-	-
– underpass	-	-	-	-
– overpass	-	-	1	0.33
– physically protected level crossing	4	1.33	6	1.82
– light signalisation at level crossing	1	0.33	2	0.60
– unprotected level crossing	-	-	1	0.33
– curve	54	18.12	63	19.15
– straight road	159	53.35	163	49.50
– parking lot	13	4.36	17	5.17
– passenger crossing	1	0.33	-	-
– pavement	3	1.02	3	0.91
– other	6	2.04	4	1.22
Total:	298	100.00	329	100.00

Table 4 - Number of traffic accidents according to the condition of road surface [1]

Road surface condition	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
– dry – clean	207	69.46	224	68.08
– dry – sand, gravel	7	2.36	8	2.43
– wet	79	26.51	90	27.36
– mud	-	-	-	-
– snow – ploughed	2	0.67	2	0.60
– snow – not ploughed	2	0.67	3	0.91
– ice – treated against ice	-	-	-	-
– ice – not treated	-	-	1	0.31
– earth – dry	1	0.33	-	-
– earth – wet	-	-	1	0.31
Total:	298	100.00	329	100.00

total number of victims regarding the time of traffic accidents. This time span is followed by afternoon accidents in the period from 2 p. m. to 8 p. m. which account for 34.04% of traffic accidents.

2.2.5 Locations of traffic accidents

Most of the traffic accidents occurred in the town of Nova Gradiška, namely 143 or 43.46%, followed by those on the county road Ž 4158 (N. Gradiška - Batrina) 68 or 20.66%; on the state road D 51 (Banićevac – toll booths N. Gradiška) 24 or 7.29%, and on other roads 94 or 28.57%.

In the town of Nova Gradiška, most of the accidents occurred in the Street of Maksimilijan Benković (18), followed by those in the street of Ljudevit Gaj (13), Štrosmajerova Street (13) and the street of M. A. Reljković (10).

Table 5 - Number of traffic accidents regarding meteorological conditions [1]

Meteorological conditions	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
– clear	158	53.02	169	51.36
– cloudy	94	31.54	103	31.31
– rain	41	13.76	51	15.50
– fog	4	1.35	2	0.61
– snow	1	0.33	4	1.22
– hoar-frost	–	–	–	–
– other	–	–	–	–
Total:	298	100.00	329	100.00.

Table 6 - Number of traffic accidents per days in a week [1]

Day in a week	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
– Monday	41	13.76	41	12.46
– Tuesday	37	12.42	48	14.58
– Wednesday	43	14.43	45	13.68
– Thursday	42	14.09	51	15.50
– Friday	38	12.76	53	16.10
– Saturday	49	16.44	49	14.88
– Sunday	48	16.10	42	12.80
Total:	298	100.00	329	100.00

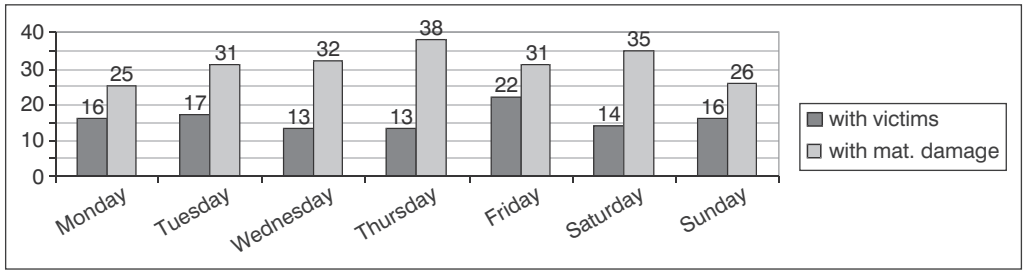

Figure 3 - Number of accidents in a week and per days in 2007

2.2.6 Types of traffic accidents

Side collisions of vehicles resulted in 91 or 27.66% traffic accidents, skidding off the road caused 67 or 20.36% of traffic accidents, driving in line resulted in 45 or 13.67% of traffic accidents (Table 8 and Figure 4).

2.2.7 Traffic accident victims

There were 821 persons involved in traffic accidents: 532 drivers or 64.79%, 279 passengers or 33.98% and 10 pedestrians or 1.23%. In the structure the victims were:

– 1 driver killed, 19 suffered serious and 76 suffered light injuries;

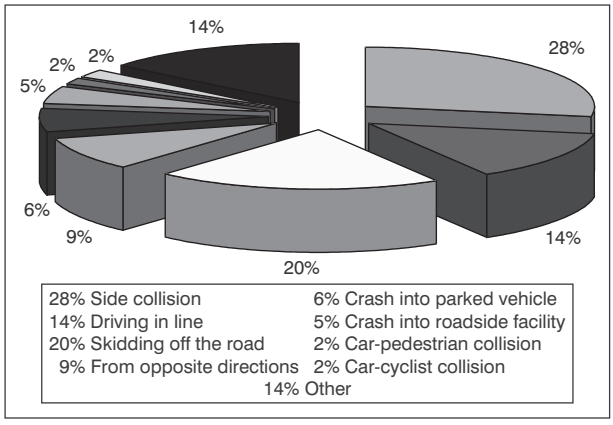

Figure 4 - Traffic accidents according to method of occurrence [1]

Table 7 - Number of traffic accidents per time of occurrence [1]

Time of occurrence	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
midnight – 04 a.m.	24	8.05	27	8.21
04 a.m. – 06 a.m.	5	1.68	9	2.74
06 a.m. – 08 a.m.	19	6.38	23	6.99
08 a.m. – 10 a.m.	28	9.40	36	10.94
10 a.m. – noon	45	15.10	39	11.85
noon – 02 p.m.	22	7.38	36	10.94
02 p.m. – 04 p.m.	30	10.07	38	11.55
04 p.m. – 06 p.m.	33	11.07	33	10.03
06 p.m. – 08 p.m.	35	11.75	41	12.46
08 p.m. – 10 p.m.	28	9.40	32	9.73
10 p.m. – midnight	29	9.72	15	4.56
Total:	298	100.00	329	100.00

Table 8 - Number of traffic accidents per types [1]

Types of traffic accidents	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
– collision of vehicles driving in opposite directions	28	9.40	30	9.12
– collision of vehicles – side collision	76	25.50	91	27.66
– collision of vehicles – parallel driving	6	2.01	5	1.52
– collision of vehicles – driving in line	29	9.73	45	13.68
– collision of vehicles – reversing	4	1.34	7	2.13
– crash of vehicle into a parked vehicle	24	8.05	21	6.38
– crash of vehicle into roadside facility	11	3.69	16	4.86
– skidding off the road	68	22.82	67	20.36
– car-cyclist collision	9	3.02	7	2.13
– car-pedestrian collision	12	4.03	5	1.52
– car-motorcyclist collision	-	-	-	-
– collision with rail vehicle	1	0.34	1	0.30
– car-animal collision	10	3.36	14	4.26
– other types	20	6.71	20	6.08
Total:	298	100.00	329	100.00

– 2 passengers killed, 12 suffered serious and 48 light body injuries;
– 1 pedestrian killed, 3 suffered serious and 6 light body injuries.

The victims differ also regarding age which can be clearly seen from Table 9. The comprehensive structure of victims per age is clearly defined by living activity of the population, so that it can be seen that mostly persons in the age from 15 to 35 suffered as victims.

2.2.8 Special conditions

Under the influence of alcohol there were: 88 drivers, 1 passenger and 1 pedestrian as victims (Table 10), with 1 fatality, 6 persons suffering serious and 15 persons suffering light body injuries.

2.2.9 Circumstances preceding the accident – participants' errors

Most of the traffic accidents, namely 310 or 94.22% occurred because of direct driver's error.

Table 9 - Number of victims per age [1]

Age	Number of victims		Number of victims	
	2006	%	2007	%
up to 5 years of age	2	1,11	4	2,38
from 5 to 10 years of age	4	2,24	11	6,55
from 10 to 15 years of age	12	6.71	9	5.36
from 15 to 35 years of age	87	48.60	71	42.26
from 35 to 50 years of age	37	20.67	39	23.21
from 50 to 88 years of age	37	20.67	34	20.24
Total:	179	100.00	168	100.00

Table 10 - Number of participants in traffic accidents regarding special conditions [1]

Special condition	Number of participants		Number of participants	
	2006.	%	2007.	%
– alcohol	86	28,86	90	27,36
– narcotics	-	-	-	-
Total number of accidents:	298	-	329	-

Table 11 - Number of traffic accidents per circumstances that preceded the traffic accident [1]

Preceding circumstances	Number of traffic accidents		Number of traffic accidents	
	2006	%	2007	%
– speed not adjusted to conditions	32	10.77	34	10.33
– speeding	1	0.36	5	1.52
– driving with insufficient spacing	22	7.41	32	9.73
– delayed perception of danger	-	-	-	-
– illegal overtaking	12	4.04	20	6.08
– illegal passing	2	0.67	9	2.74
– illegal passing by	9	3.03	11	3.34
– illegal merging	23	7.74	27	8.21
– illegal turning	10	3.37	17	5.17
– illegal turning around	1	0.34	-	-
– illegal reversing	13	4.38	16	4.86
– violation of right-of-way	42	14.14	44	13.37
– violation of light traffic signals	5	1.68	8	2.43
– unprotected freight on vehicle	3	1.01	1	0.30
– careless handling of vehicle	1	0.37	1	0.30
– other drivers' errors	107	36.03	85	25.84
– other passengers' errors	1	0.34	2	0.61
– other errors – failures	-	-	2	0.61
– unexpected danger	11	3.70	15	4.56
– sudden malfunction of vital vehicle part	2	0.67	-	-
Total:	298	100.00	329	100.00

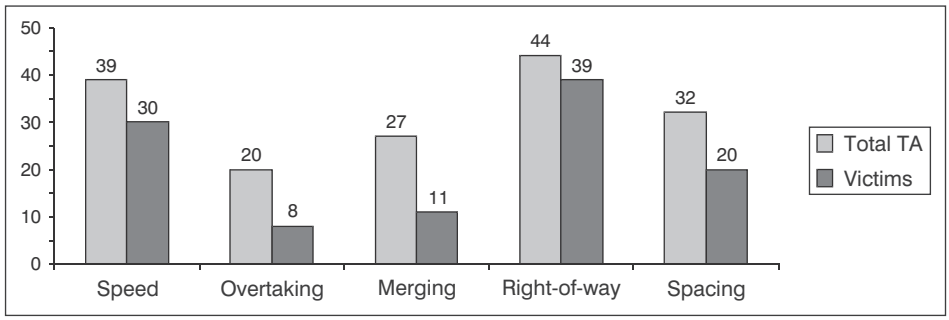

Figure 5 - Traffic accidents and number of victims due to drivers' errors in 2007

Violation of right-of-way is the most frequent error causing 44 or 13.37% traffic accidents (Table 11 and Figure 5) with 1 fatality, 10 persons suffering serious and 28 persons light body injuries.

Speeding was cause of 34 or 10.33% traffic accidents (Table 11 and Figure 5) with 2 fatalities, 8 persons suffering serious and 14 persons suffering light body injuries.

Table 12 - Traffic accidents caused by drivers who were not allowed to drive a motor vehicle in 2007 [1]

Traffic accidents caused by motorists	Traffic accidents	
	Total	%
Under the influence of alcohol	88	16.54
Without driving exam	44	8.27
All motor vehicle drivers	632	100.00

Table 13 - Traffic accidents according to level of alcohol abuse in 2007 [1]

Traffic accidents caused by motor vehicle drivers	Traffic accidents	
	Total	%
Up to 0.5g/kg	15	17.05
From 0.5 to 1.5g/kg	30	34.09
Over 1.5g/kg	43	48.86
Total	88	100.00

Table 14 - Traffic accidents caused by young drivers (from 18 to 24 years of age) who were not allowed to drive a motor vehicle in 2007 [1]

Traffic accidents caused by young drivers of motor vehicles	Traffic accidents	
	Total	%
Under the influence of alcohol	17	19.54
Without driving exam	11	12.64
All young drivers of mot. vehicles	87	100.00

2.3 Classification of motor vehicles

There were 570 motor vehicles taking part in traffic accidents. The structure included: 436 passenger vehicles, 54 freight vehicles, 11 mopeds, 16 tractors, 5 buses, 6 motorcycles, 18 bicycles, etc. (Table 15).

Out of the total number of vehicles 36 or 6.31% were not registered vehicles or with an expired vehicle permit. Besides, 77% of victims were victims in passenger cars, and 23% in other vehicles.

Table 15 - Number of victims per types of vehicles [1]

Type of vehicle	Total no. of victims	Fatalities	Serious body injuries	Light body injuries
Moped	7	-	2	5
Motorcycle	5	-	3	2
Passenger vehicles	127	2	22	103
Freight vehicles	1	-	-	1
Bicycle	16	1	4	11
Tractor	2	-	-	2

2.4 Analysis of traffic accidents

During 2007, in the area of the Nova Gradiška Police Station 4572 traffic violations (Table 16) were registered, which is by 8.44% more than in the previous year.

3. SAFETY ASSESSMENT

The problem of assessing and evaluating the road traffic safety in a certain area is a complex problem, which understands the implementation of a certain methodology with a greater number of indicators.

In assessing the condition of road traffic safety in Nova Gradiška, a modified Smeed model can be used [3] in forecasting the fatalities, injured persons and the number of traffic accidents, which is defined by mathematical expressions:

$$D = 0.00012\ (n\ p^2)^{1/3}$$

$$O = 0.0048\ (n\ p^2)^{1/3}$$

$$P_n = 0.012\ (n\ p^2)^{1/3}$$

Table 16 - Comparison of traffic violations in 2006 and 2007 and the percentage of difference [1]

Type of violation	2006	2007	Difference %
Illegal speeding	661	960	45.23
Red light	13	11	-15.38
Illegal overtaking and passing	32	9	-71.88
Violation of right of way	14	17	21.43
Illegal passing by	-	-	-
Failure to give priority to passengers	21	38	80.95
Driving under the influence of alcohol	477	613	28.51
Illegal parking	140	298	112.86
Illegal turning, turning round and reversing	-	-	-
Driving without having passed driving exam	369	378	2.44
Side and direction of driving	5	7	40.00
Technically defective vehicle	58	82	41.38
Driving with lights on the vehicle turned off	78	78	0.00
Non-registered and technically not inspected vehicles	309	321	3.88
Instruction without instructor's exam	-	-	-
Violations of passengers in traffic	2	20	900.00
Safety belt	220	366	66.36
Protective helmet	58	114	96.55
Violation of traffic signs	199	168	-15.58
Driving when the driving permit has been withdrawn	53	55	3.77
Other violations	1507	1037	-31.19
Total:	4216	4572	8.44

Table 17 - Number of persons with negative points in the area of Nova Gradiška Police Station [1] in 2007

Number of points	1	2	3	4	5	6	7	8 and more
Number of drivers	711	168	197	56	95	18	12	2

where:

D – forecast number of fatalities over one year:
n – number of registered motor vehicles;
p – number of citizens;
O – forecast number of injured persons in traffic accidents;
P_n – forecast number of traffic accidents (registered in the police system).

Here the interdependence between the number of traffic accidents, the number of the injured and fatalities can be determined by this model with the given goals being defined in the road traffic safety programs.

The goals set in this way represent one of the acceptable and usual models that are used for the requirements of determining and assessing the condition of road traffic safety.

$$D = 0.00012\ (n\ p^2)^{1/3}$$

$$D = 0.00012\ (15{,}160 \cdot 42{,}874^2)^{1/3}$$

$$D = 3.638 \approx 3.64$$

Table 18 - Number of citizens in towns [2]

Towns	Number of citizens	
	2007	%
Nova Gradiška	15,833	36.93
Nova Kapela	5,118	11.94
Staro Petrovo Selo	6,352	14.82
Davor	3,259	7.60
Vrbje	2,906	6.78
Rešetari	5,171	12.06
Cernik	4,235	9.87
Total	42,874	100.00

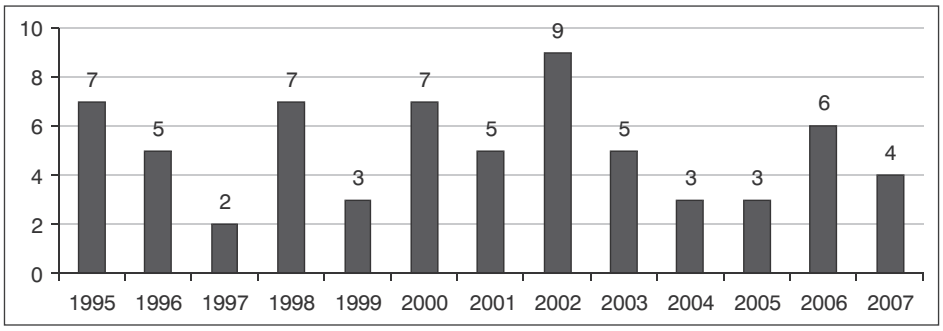

Figure 6 - Fatalities in the time period from 1995 to 2007

Figure 6 clearly shows that Nova Gradiška in its area in the time period from 1995 to 2007 registered 2-9 fatalities, which is compared to the proposed model a deviation of 1.4 to 5.4 more, i. e. 0.6 -1.6 fewer fatalities.

$$O = 0.0048\ (n\ p^2)^{1/3}$$

$$O = 0.0048\ (15{,}160 \cdot 42{,}874^2)^{1/3}$$

$$O = 143.53 \approx 143.5$$

Figure 7 shows that since 2001 the number of injured persons has been constantly increasing from the reference model. The basic reason for such a condition is direct consequence of the increase in the number of traffic vehicles which causes worries and requires a serious program of safety measures (preventive and repressive nature).

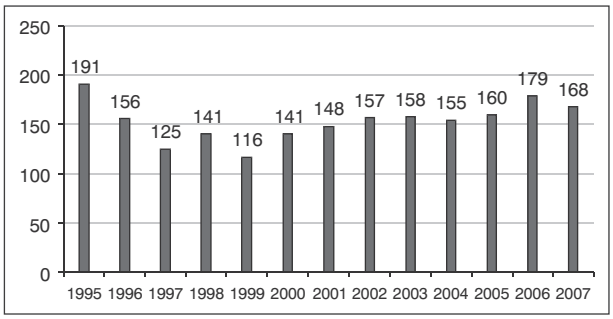

Figure 7 - Injured persons in the time period from 1995 to 2007

$$P_n = 0.012\ (n\ p^2)^{1/3}$$

$$P_n = 0.012\ (15{,}160 \cdot 42\ 874^2)^{1/3}$$

$$P_n = 363.825 \approx 358.8$$

Figure 8 shows that 2002 and 2003 deviate from the set model. Although the remaining considered years could satisfy the set model with the obtained results, because of the number of fatalities and injured persons, the set goals were not realized. However, the existing measures have to be strictly implemented in order to realize the mentioned goals.

The interdependence between the number of the injured and the fatalities can result in the requirements even with traffic accidents on decline, to start developing new programs and plans to achieve the program goals, which would monitor and

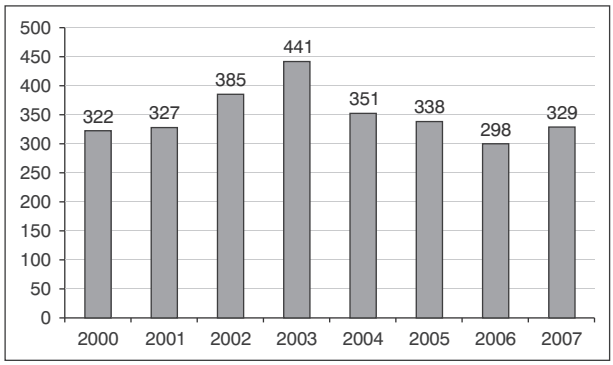

Figure 8 - Number of traffic accidents from 2000 to 2007

forecast measures to reduce both the number of fatalities and the number of the injured and traffic accidents which eventually result in certain consequences.

Such program should be harmonized at the local level with the "National Safety Program in Road Traffic". The basic characteristics of the National Program consist of the set quantitative and qualitative goals defined by programs, carriers of activities, methods of performing the planned measures, and monitoring of results and assessing the program.

Quantitative goals are determined in compliance with the European goals for the same period, referring to the number of fatalities in relation to the number of citizens (Figure 9). The goal of the European Union is the reduction in the number of fatalities in traffic on the roads until 2010 to the level of 7 fatalities per 100,000 citizens.

The tendency in Croatia should be, in fact, to realize the planned European goal. However, it is more realistic to expect a reduction from 13.8 to 10 fatalities per 100,000 inhabitants in 2010. In order to achieve this, it would be necessary to reduce the number of 608 fatalities in 2004 on the roads, to 440 in 2010, which would amount to an average reduction of 34 persons every year.

In the same way, the qualitative goals match the European goals recognizing at the same time all the specific characteristics of the Croatian space which actualize the planned quantitative goal.

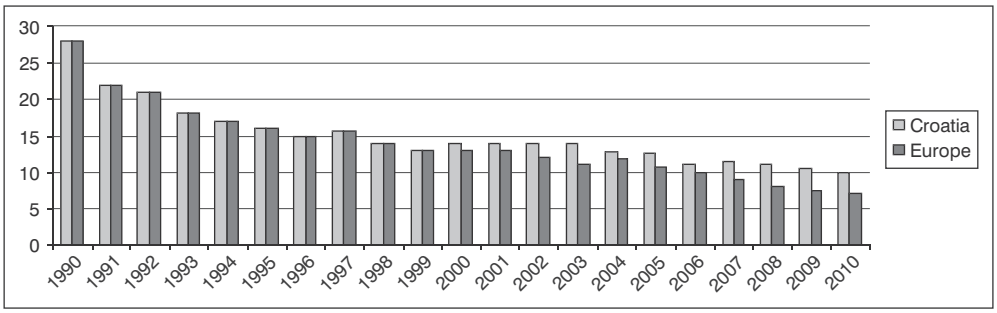

Figure 9 - Number of fatalities in traffic accidents per 100,000 inhabitants with set goal

If the goals set in this way were implemented in the wider area of Nova Gradiška, according to the national program this would then amount to:

$$D = 42{,}874/100{,}000 \cdot 10 = 0.42874 \cdot 10 = 4.2874 \approx \approx 4.3 \text{ fatalities}$$

That is, according to the European Union:

$$D = 42{,}874/\ 100{,}000 \cdot 7 = 0.42874 \cdot 7 = 3.00118 \approx \approx\ 3.0 \text{ fatalities}$$

4. CONCLUSION

The assessment of the road traffic safety condition in small towns in the Republic of Croatia is a complex procedure. This procedure understands the implementation of a certain methodology which indicates the need to make new programs and plans. According to the mentioned, local programs and plans need to reduce the number of fatalities and injured persons on roads. These programs should also be harmonized with the national goals, and in turn, national goals should be harmonized with the European goals regarding road traffic safety, in order to provide better valorisation of the territory of the Republic of Croatia in the European integrations.

Based on the presented Tables and Figures all the factors that influence the traffic accidents have been analyzed. The analysis of road traffic safety in the wider area of Nova Gradiška in 2007 is marked by the reduction in the total number of traffic accidents, increase in the number of fatalities and the lightly injured persons, with the equal number of seriously injured persons.

The analysis of the applied model has led to the conclusion that the applicability of this paper is multiple and it can be used as reference for any town, i. e. smaller districts or towns of similar sizes in the Republic of Croatia.

It is precisely because of greater safety of all the factors in road traffic, that it is necessary in small towns and districts to start repairing the existing condition in cooperation with the County Road Authorities. With the reconstruction of certain road sections, better visibility of vertical and horizontal traffic signalization, construction of over- and underpasses, roundabouts, etc. higher safety would be achieved, as well as reduction in the number of accidents and material goods would be protected. Of course, all this requires additional financial means which would resolve the observed drawbacks within a short period of time, and that would result in safer roads.

Dr. sc. **VINKO VIŠNJIĆ**
E-mail: vinko.visnjic@fpz.hr
Sveučilište u Zagrebu, Fakultet prometnih znanosti
Vukelićeva 4, 10000 Zagreb, Republika Hrvatska
Mr. sc. **MARKO PUŠIĆ**
E-mail: marko.pusic@akz.hr
GKG d. o. o., Autobusni kolodvor
Avenija Marina Držića 4, 10000 Zagreb,
Republika Hrvatska

SAŽETAK

ANALIZA PROMETNIH NESREĆA NA PODRUČJU MALIH GRADOVA U REPUBLICI HRVATSKOJ

Stanje sigurnosti cestovnog prometa u malim gradovima u Republici Hrvatskoj nije zadovoljavajuće. Kao dokaz, istraživana je i analizirana sigurnost sudionika u cestovnom prometu s područja grada Nove Gradiške i šireg okruženja. U radu su obuhvaćeni raspoloživi podaci u periodu od 2000. do 2007. godine. Analiza i ocjena stanja sigurnosti cestovnog prometa može se primijeniti i u drugim gradovima i općinama Republike Hrvatske. Imajući u vidu da u Republici Hrvatskoj ima 531 naselja (119 gradova i 412 općina) od kojih je samo njih 78 veće od 10.000 stanovnika ili 14,69% od ukupnog broja, što znači da se mogla izvršiti analiza za bilo koje naselje u Republici Hrvatskoj. Ocjena stanja sigurnosti cestovnog prometa koncipirana je prema modificiranim Smeedovom modelu prema kojemu se isti može primijeniti za svako naselje ili grad. Analizom sigurnosti cestovnog prometa došlo se to zaključka da je sigurnost svih sudionika u prometu ugrožena. U ovom radu daju se rješenja što treba učiniti da se smanji ugroženost svih čimbenika u cestovnom prometu.

KLJUČNE RIJEČI

vozači, promet, prometne nesreće, sigurnost i mali gradovi

LITERATURE

[1] PU Brodsko-posavska: *Izvješće Policijske Uprave* (Police Department of the Brod-Posavina County: *Police Department Report*), Slavonski Brod , 1995-2007

[2] Croatian Central Bureau of Statistics: *Census in Croatia*, Zagreb, 2001

[3] **Rotim, F.**: *Elementi sigurnosti cestovnog prometa*, Volume, CIP, Zagreb, 1990

[4] Croatian Government: *National Road Traffic Safety Program of the Republic of Croatia*, 2006 – 2010, Zagreb, 2006

[5] **Županović, I.**: *Tehnologija cestovnog prijevoza*, Faculty of Transport and Traffic Sciences Zagreb, 2002

[6] **Cerovec, V.**: *Tehnika i sigurnost prometa*, Faculty of Transport and Traffic Sciences Zagreb, 2001

[7] **Zavada, J.**: *Prijevozna sredstva*, Faculty of Transport and Traffic Sciences Zagreb, 2000

[8] **Perić, T.**, **Radačić, Ž.**, **Šimulčik, D.**: *Ekonomika prometnog sustava*, Faculty of Transport and Traffic Sciences Zagreb, 2000

[9] **Perić, T.**, **Ivaković, Č.**: *Zaštita u prometu*, Faculty of Transport and Traffic Sciences, Zagreb, 2000

[10] **Štefančić, G.**: *Prometno planiranje*, postgraduate study "Tehničko-Tehnološki sustavi u prometu i transportu", Authorized lecture, Faculty of Transport and Traffic Sciences Zagreb, 2005