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Implementation status report on security improvements in PT

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			WP6 Innovative mobility services
			WP7 Energy-efficient freight logistics
			WP8 Transport telematics
			WP9 Project coordination
			WP10 Project management
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1. Summary

The activities in the measure 5.8 ZAG - **Security improvement in public transport**, that are part of **WP 5 - Safe and secure mobility**, were planned to contribute to safer, more secure and thus increased use of public transportation in Zagreb.

By introducing new low-floor trams and buses, accessibility of public transport increased and transportation by bus was made more sound and attractive to the general public. Thanks to activities within this measure, the security standard for passengers, vehicles and staff through the use of CCTV in vehicles has improved, too.

A survey done by ODRAZ with more than 400 citizens has shown that the new technology improvements, e.g. the displays in the vehicles, were also praised. This is due to reduction of vandalism, damages and graffiti in the vehicles, but also of assaults on drivers.



The new tram in the centre of Zagreb

2. Introduction

2.1. *City of Zagreb*

Zagreb is the capital city of Croatia, with nearly 793,000 (2011) people living within the city boundaries, while the metropolitan area has more than 1 million inhabitants.

The city's historic street grid was largely defined in 19th century, which today causes traffic problems, as the centre houses main administrative, cultural, commercial and social institutions. The grid could hardly support traffic until 1990, but with the number of vehicles almost doubled since, the situation becomes dramatic, so there was urgent need to act.

Modal split in Zagreb, according ZET data, is slightly in favour of individual transport (52-55%). Public transport is organized through bus, tram and rail services. The split is visible in the graph below:

2.2. *About ZET*

Zagreb Municipal Transit System or ZET (Zagrebački električni tramvaj) is a branch of the Zagreb Holding, specialized for passenger transportation in the city of Zagreb and one part of the Zagreb County. It is exclusively owned by the City of Zagreb and it is mainly financed through the City budget. ZET provides transport to citizens through bus, tram and funicular services, but also provides special transportation to people with disabilities.



It was founded in 1891 as Horse Tram Association, which turned into Zagreb Tram in 1892. Zagreb Electric Tram – ZET was established in 1909. Since July 2006 ZET is a branch of the Zagreb Holding.

ZET, aside from its primary function, passenger transportation, in more than one century of its existence, greatly influenced the development of Zagreb, and this influence continues to grow by covering important daily transport routes in Zagreb and suburban areas with its extensive tram and bus system. ZET follows the city development and connects many newly built districts, and together with the City District Councils adapts the routes and stations to address the needs of citizens.

In last several years ZET has started new projects for upgrading public transit system. Before CIVITAS ELAN 70 new, modern, low-floor trams were purchased. CIVITAS ELAN has contributed to delivery of the second series which includes additional 70 low-floor trams.

ZET also acquired 214 low-floor buses. Following the environmental standards, ZET started to use biodiesel in public transportation vehicles and compressed natural gas (CNG).

The radio connection system is modernized and traffic monitoring and control are also computerized by introducing vehicle location system. Setting up the infrastructure for 147 dis-

plays on tram and bus stops, on which passengers should be able to receive real-time arrival information, is in progress.

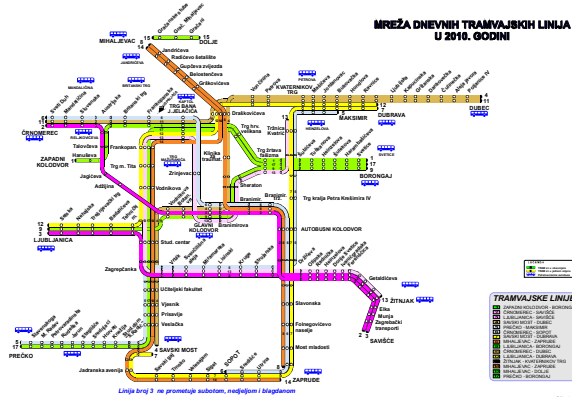
Since July 2007 service users can buy a ticket by using mobile services and sending an SMS. The activities of introducing digital and automatic public transport charge, so called smart cards, were implemented as a part of CIVITAS-ELAN activities.

With the realization of all planned activities, ZET and the City of Zagreb, when it comes to quality of public transportation service, will meet European standards.

2.2.1. Tram service

Field servicing of public transport (tram, bus) in city of Zagreb is an extremely large area. On the area larger than 640 km² is located more than 2000 stops of public transport, of which 257 tram stops is in a narrower field of city.

Tram service is the basic type of public transport in Zagreb. Regular tram cars transport includes 116.843 meter long tracks, 193 lead (motor) cars and 41 trailers. 15 day lines run during the day on 148 km long tracks and four night lines on 57km long tracks. The city has 257 tram stops. 178.000.000 passengers are transported in Zagreb by trams per year. (Data for 2010).



TRAM TODAY

TRAM VEHICLES
Producers: HR companies (Duro Đaković, Kočaer, Gredelj)
ČKD TATRA, Düwag

NUMBER OF TRAM VEHICLES	
Motor cars	303
Trailers	85
TOTAL	388

TRAM GAUGE 1 000 mm

LENGTH OF TRACKS (in m)	
on separate body	62,534
on roadways	54,309
Subtotal	116,843
Depot Trešnjevka	6,164
Depot Dubrava	9,312
Subtotal depots	15,476
TOTAL	132,319

2.2.2. Bus service

ZET's bus transport is used in Zagreb, towns of Velika Gorica and Zaprešić and villages Bistra, Luka, Klinča Sela and Jakovlje. ZET runs 132 day lines and 4 night lines. There are 2103 bus stations, 1614 of which are in Zagreb. On working days 284 buses are used on regular bus routes, Saturdays 185, and on Sundays and holidays 123 buses. Every year ZET's buses transport about 81,687.000 passengers (data for 2010).

BUSES TODAY

NUMBER OF BUSES	
Producers	MAN, Mercedes
Solo	228 (55%)
Articulated	171 (41%)
Mix	10 (4%)
TOTAL	412



2.3. **Situation before CIVITAS related to security**

Vehicles in public transport (trams, buses, trains) are occasionally subject to vandalism by passengers. Public transportation vehicles are also victims of football rowdies at times of important football games. Also drivers are sometimes victims of assault. These incidents cumulate at night times: All this contributed to a lower usage of public transport by night, particularly by women.

3. **Measure 5.8-ZAG – Security improvement in public transport**

This measure is part of **WP5 Safe and secure mobility**. The activities in this measure have contributed to safer, secure and increased use of public transport in Zagreb.

Objectives of this measure were as follows:

- Identify black spots concerning safety & security in public transport
- Improve safety conditions in public transportation
- Improve image and patronage of public transport

The most important activity of CIVITAS-ELAN to achieve this is through the introduction of CCTV into PT vehicles:

- More than 200 vehicles (trams and buses) were equipped with CCTV (5.8-M2)
- Training of drivers on how to increase the safety of passengers in vehicles were held since April 2008 (5.8-M4, M5)
- New buses and trams were promoted at different occasions, through events with citizens (at the info point, presentation of project at various events, etc.) and media.

3.1. **Security in public transport**



Security in traffic, ZET report 2010.

An increase in the number of registered vehicles and the expansion of the municipal transport network continuously change the security level of public transport and require constant and involved monitoring of the current traffic situation. In the city of Zagreb 434 driving units participate in the traffic every day and pass 98.487 km on average. Therefore, every disturbance of traffic security is, expectedly, automatically dispersed among all traffic participants.

The aim of ZET's report "Security in traffic 2010" was to provide a statistical analysis and an overview of traffic accidents in order to determine the degree of danger or risks concerning all traffic factors (people, vehicles, roads) and implement the necessary preventive measures accordingly, along with performing fast and prompt recoveries of critical sections and sites. Traffic accidents are processed by: type, time and place of event; their prevalence on specific tram or bus lines; hours of work and age of drivers along with their driving experience in ZET.

The database of traffic accidents is based on the analysis of statistical sheets for recording traffic accidents filled in by competent persons in the field, and afterwards processed by professional services in ZET. The statistical monitoring of these manifestations in the course of a several-years period is a sure indicator of certain regularities that can help recognise the cause of the occurrence of traffic accidents to a large degree.

The detailed results are included in the Annex of this report.

3.1.1. SUMMARY OF THE REPORT "THE SECURITY IN PT"

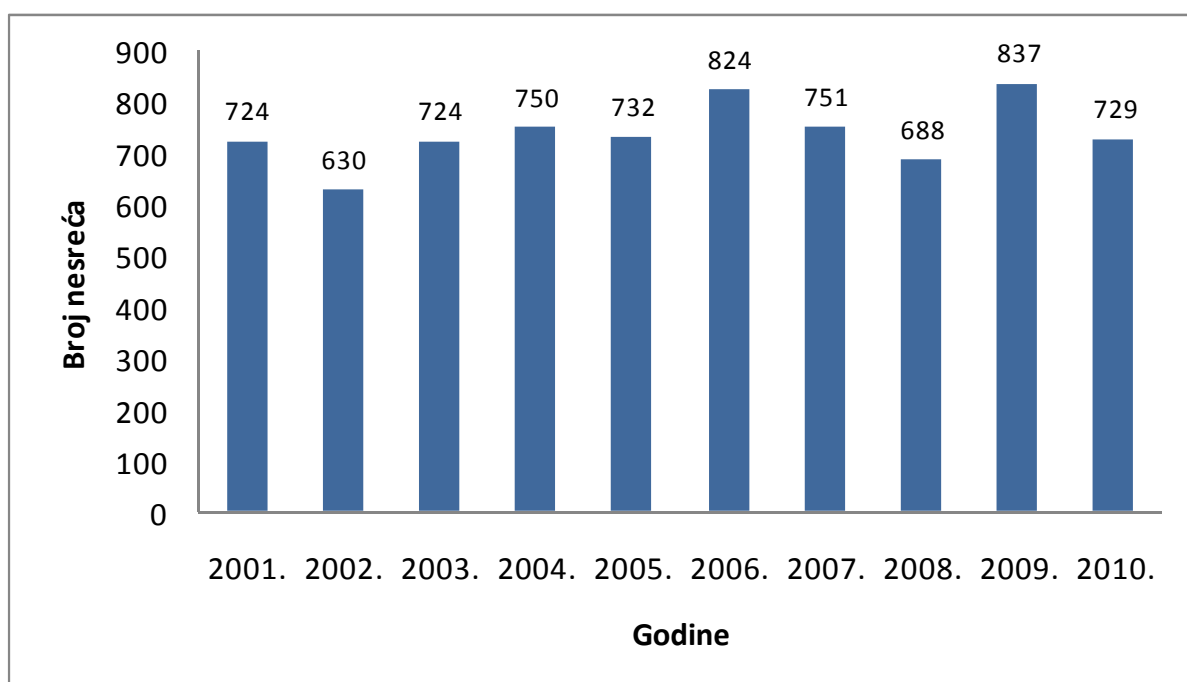
In 2010, ZET's trams and buses (tram motor cars and buses) realized a total of 42.743.428 kilometres. There were **434 vehicles** participating in traffic on average every day.

In the course of the observed period in 2010 there were 729 traffic accidents which represents a **decrease of 12,08 %** when compared to the year 2009 (837).

On 100.000 realized kilometres there were 1.53 traffic accidents, which is **13,56 % less** than in 2009.

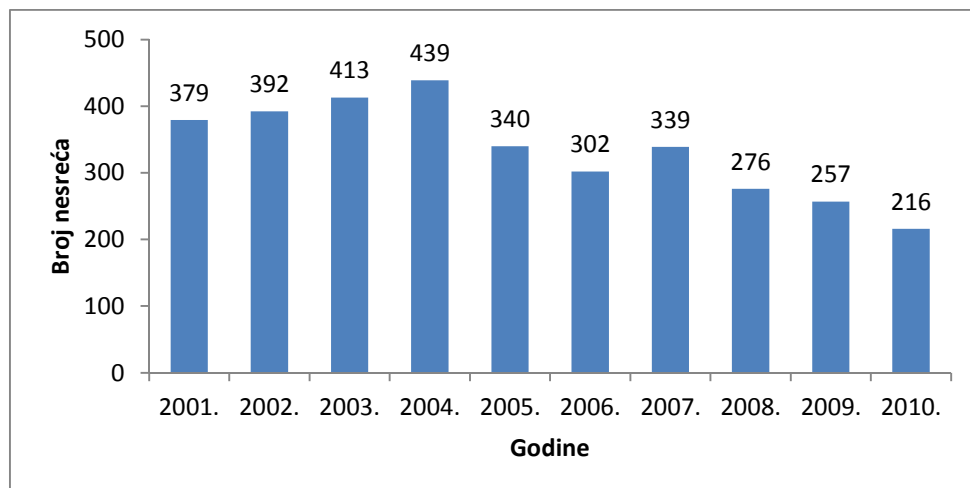
In 2010 a total of 182 persons were injured in traffic accidents, which is **25,41 % less** when compared to 2009, when 244 persons were injured.

The number of traffic accidents over 10 years



3.1.1.1. TRAFFIC ACCIDENTS IN TRAM TRAFFIC

The number of traffic accidents in the period between 2001 and 2010 in which trams participated:



In 2010, there were 216 traffic accidents, which represent a decrease of 15.95 % when compared to the year before, when there were 257 accidents.

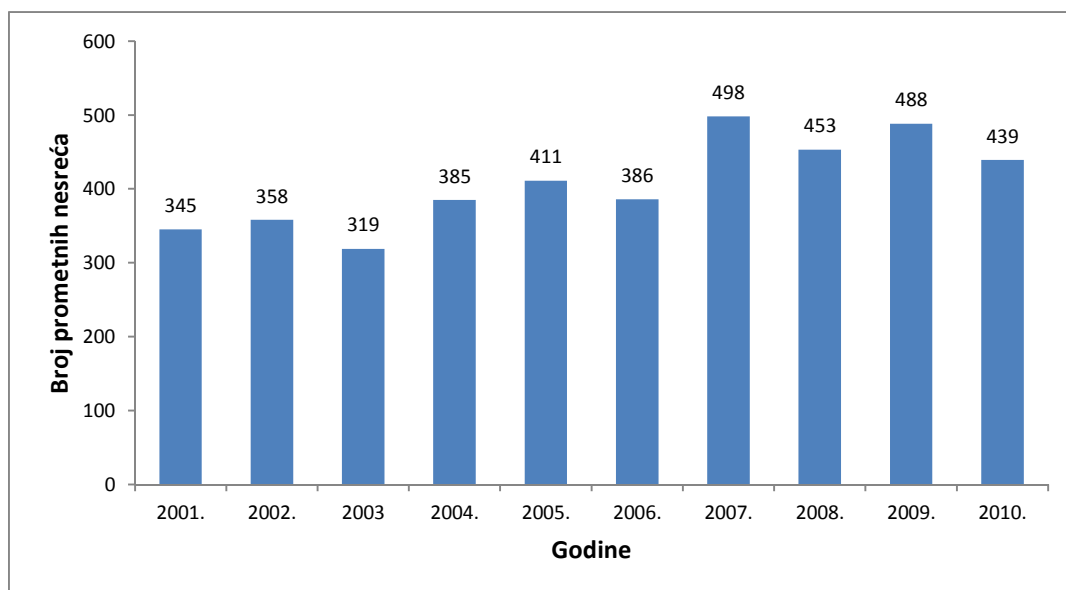
On a daily basis, 36.175 km were realized on average, and 0,6 traffic accidents occurred.

In 2010 there were 0,27 accidents per driver on average.

The number of traffic accidents on 100.000 realized kilometres fell from 1.93 to 1.63 occurrences.

3.1.1.2. TRAFFIC ACCIDENTS IN BUS TRAFFIC

An overview of traffic accidents in bus traffic in the period between 2001 and 2010:



In 2010, there were 439 traffic accidents, which represents a decrease of 10.04 % when compared to the last year, when there were 488 accidents.

On a daily basis, 80 931 km were realized on average, and 1.2 traffic accidents occurred.

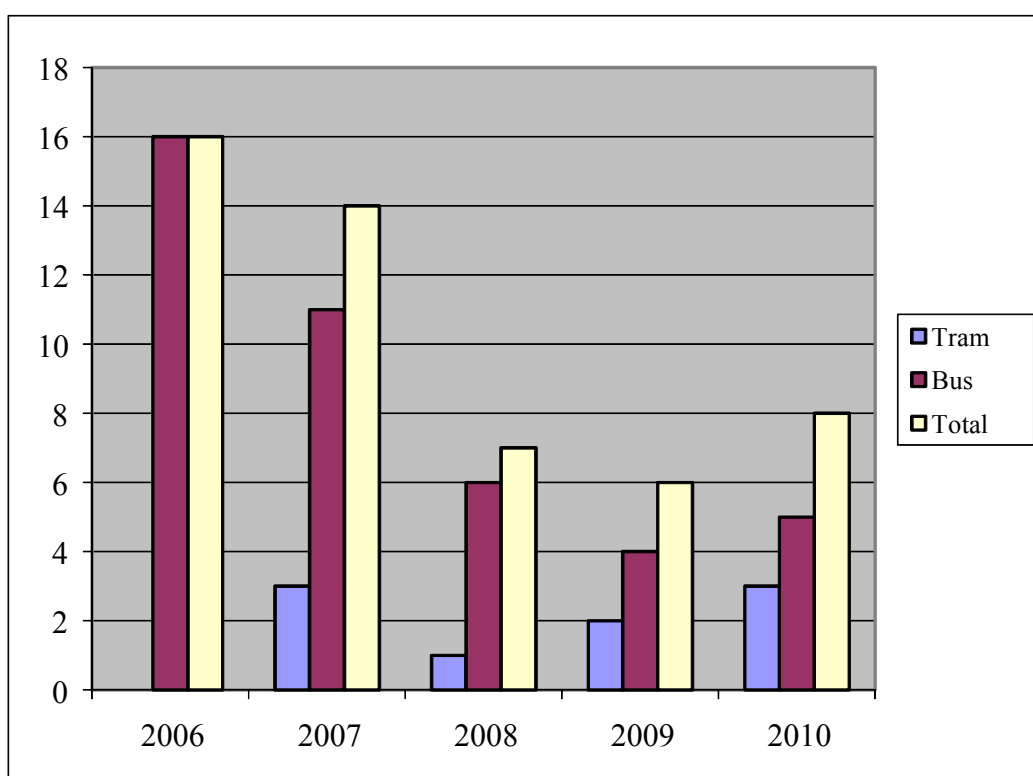
In 2010 there were 0.37 accidents per driver on average.

The number of traffic accidents on 100.000 realized kilometres fell from 1.70 to 1.49 occurrences.

3.1.1.3. VANDALISM

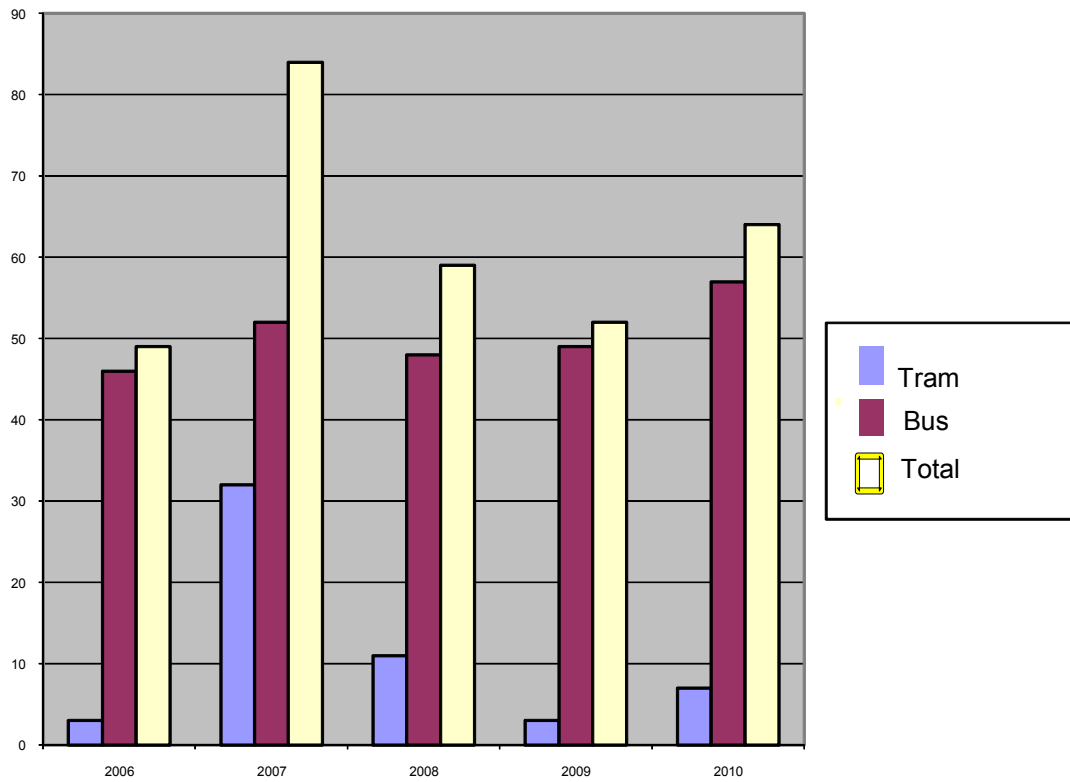
Attacks on drivers are shown in the table below for the period between 2006-2010:

Year	2006	2007	2008	2009	2010
Tram	0	3	1	2	3
Bus	16	11	6	4	5
Total	16	14	7	6	8



Vehicle damage is shown in the table below for the period between 2006-2010:

Year	2006	2007	2008	2009	2010
Tram	3	32	11	3	7
Bus	46	52	48	49	57
Total	49	84	59	52	64



Damage and graffiti on bus station



Graffiti in the vehicles



Damage in the vehicles



Damage on display

3.1.2. Cameras-CCTV

Video Surveillance System, commonly known as CCTV, as a security tool in public transport is introduced in PT vehicles.

CCTV will always be a central tool for public transport security, but it does not in itself constitute a secure system: it is a tool which is there to help staff improve the security of public transport, which in turn makes public transport more attractive to passengers.

Cameras in vehicles

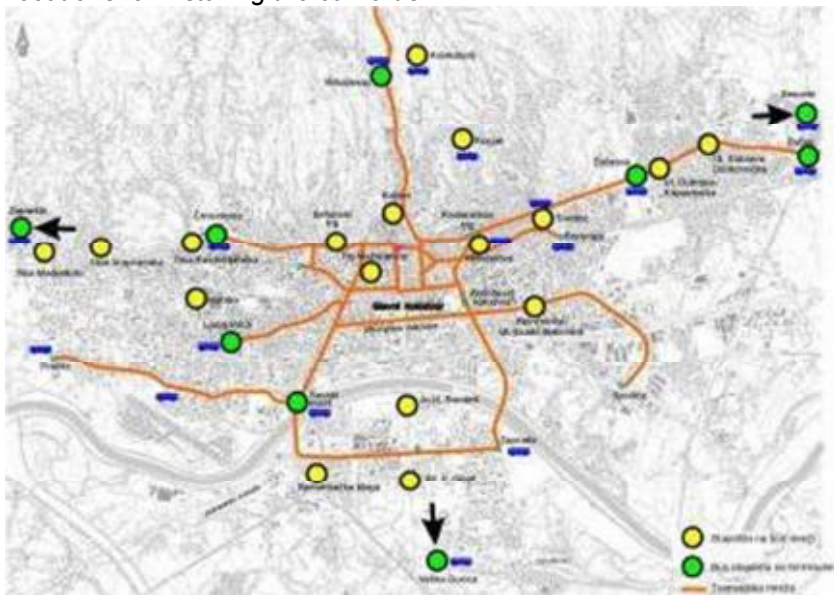




A competitive travel time, convenience and affordability are often the first tangible requirements. But this is not all modern public transport users expect, and not enough to encourage them out of their private cars: a good level of customer service is increasingly important, covering elements such as cleanliness, helpfulness of staff, real time information and so on. **On the top of this, feeling safe and secure is an important expectation.**

On the basis of statistical data presented is a picture of stops of public transport (tram and bus system) to which it is considered necessary to set up surveillance cameras. They have been selected because of the high frequency of passengers, the incident-occurrence of events at the stops and incidence-occurrence of traffic accidents at a particular site.

Locations for installing the cameras



The installation of the surveillance system at PT stops is postponed by decision of the Mayor until 2013:

- due to economic crises in Croatia and the City of Zagreb and the consequent lack of funding for the Surveillance Centre (transmission and data processing)
- missing legal requirements for installing cameras on specific locations.

3.1.3. Learning from European projects

AENEAS is a European project in the framework of the Intelligent Energy Europe (IEE) programme. Its acronym stands for "Attaining Energy-Efficient Mobility in an Ageing Society." The project's objective was to become the cornerstone for international reference projects in the field of urban mobility of older people.

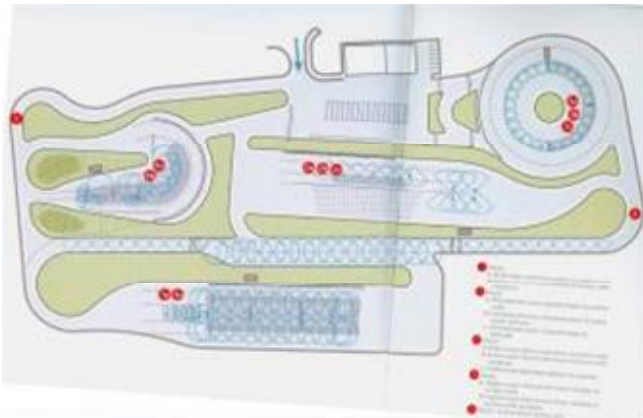
One of the main activities was to exchange good practices among European cities on energy-efficient mobility in ageing societies.

Thru our participation (ZET and ODRAZ) on Aeneas training we had an opportunity to learn how to work with older people (how to approach them, how to train them on how to use sustainable transport according to their needs and expectations). Gained knowledge helped that ZET put more effort in better understanding the needs of older passengers and improving their services and communication actions. Also, trainings for drivers on safety and security of seniors in public transport were held in better and more concrete manner.



3.2. *Training of drivers and maintenance personnel*

The education of drivers on how to drive the new tram which is long and heavy, with specific characteristics of acceleration and deceleration, is a key for safety and comfort of passengers. The goal of the training on how to drive and manage during the drive was to increase the safety of passengers in the tram, but also to decrease the risk of unexpected situations in traffic.



Besides all tram and buses drivers, the maintenance personnel were also trained. All together more than 2000 ZET drivers and maintenance personnel were trained since April 2008 till the end of January 2010.

They were also trained on how to use cameras in the vehicles, in order to obtain secure travel. Also, ODRAZ participated in the training to cover the topic of safety and security for older passengers (also connected with measure 5.3-ZAG).

4. Surveys on passengers' satisfaction

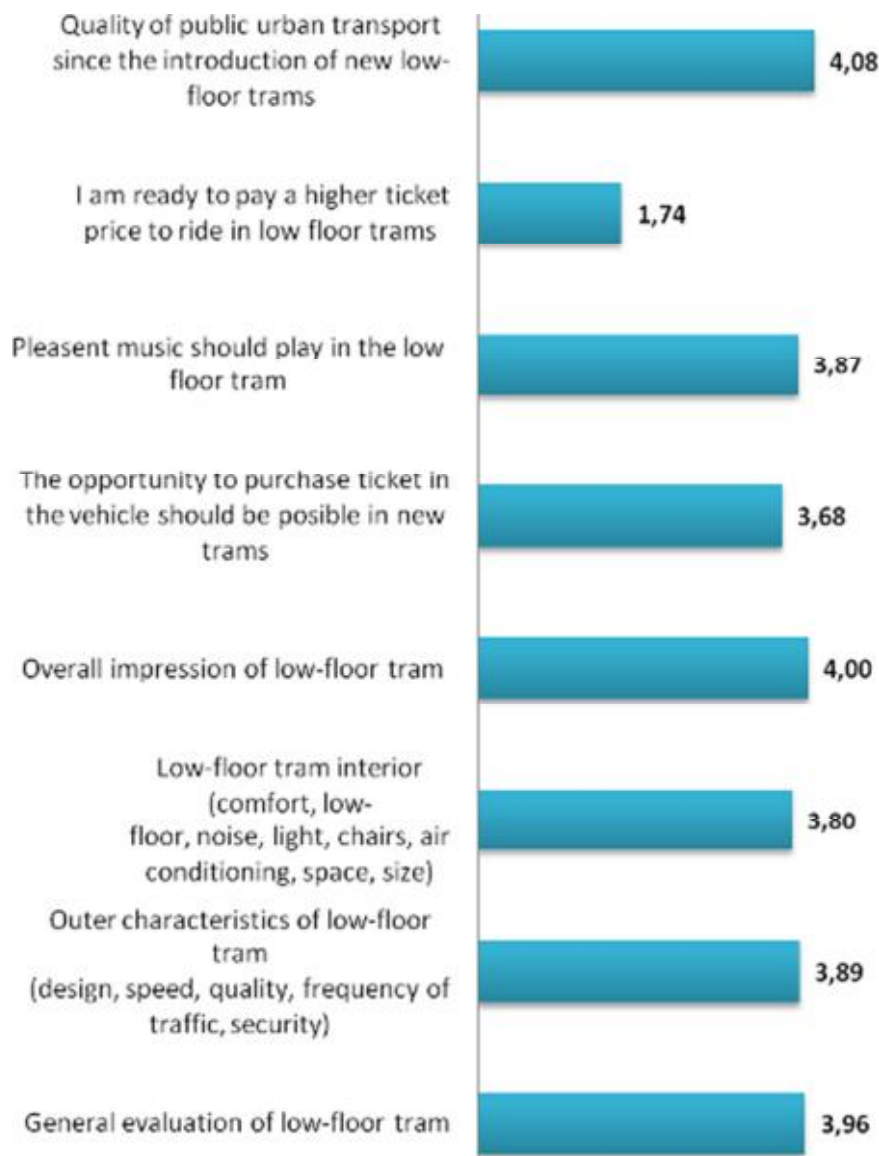
4.1. *ZET survey*

In order to find out the PT costumers' level of satisfaction, a survey was prepared and conducted by ZET. The questionnaire with seven questions was prepared with basic information about the respondents and their habits and opinions on PT.

All together 240 respondents filled in the questionnaire, out of which 25 was not filled in correctly. Therefore, the analysis was made based on 215 correctly questionnaires.

The survey showed that new trams are welcomed by PT users, as 102 of the respondents think that only new trams should be used; 86 of them think that more new trams should be introduced to PT, while 22 think that there is enough new trams. The most of the respondents (195) think that decision to buy new trams is good.

The satisfaction of PT users was obtained by answers given on 26 questions: the results show that respondents are very satisfied with low floor of the new tram, as it allows easier entering to tram. They are not very satisfied with number of seats. The average satisfaction with the new tram was very good. The results are grouped in several similar categories, e.g. based on characteristic of outer design (quality, safety etc.); inside (comfortable, light, air-condition, space, safety, sitting places etc.). The results show that high grades were given for improvement of PT since new trams were introduced. On the other hand, the respondents are not willing to pay more for the ride in the new low-floor trams.



4.2. ***EFFECT*** survey

The survey Status of transport possibilities, perception of PT and users habits in the corridor - Survey, step 2 was conducted within measure 2.5-ZAG. The survey started in January 2010 and was available to public by 1 March 2010.

The questionnaire was divided into three parts. In the second part, citizens were invited to evaluate PT in Zagreb by attributing 1-5 points to the listed PT features, separately for tram, bus and railway. Out of 441 collected questionnaires 430 were correctly fulfilled by the visitors of the CIVITAS-ELAN Info-point and urban railway users at two stations

In their written comments citizens were almost unanimous in judgment that the new low-floor trams and buses are the major recent PT improvement. New technology improvements, like displays in the vehicles were also highly praised.

4.3. **Comments of Info-point visitors**

ODRAZ analysed the comments made by Info-point visitors in the note-books posted in tram and prepared comprehensive report on findings, including those related to PT and new trams; the findings are available from the CIVITAS-ELAN Zagreb website.

4.4. **Promotion**

- A leaflet on CIVITAS ELAN and planned ZET activities was prepared at the beginning of the project.
- CIVITAS ELAN Tram line No.20 run along the project corridor (Sava bridge - Savska street - Main square) from 20 – 25 April 2009 – promotional activity marking new trams on the occasion of PMG meeting CIVITAS ELAN signs on and in tram, leaflets on project, ZET and Čistoća



- A leaflet “Did you know?” for the CIVITAS day was prepared by ODRAZ in cooperation with ZET, explaining PT in Zagreb from its beginning until today.
- Each time when a new vehicle was introduced it was done by Zagreb Mayor. Those events were regularly covered by media, so the public was informed on increasing No. of new trams.
- ZET also made an interesting promotion, by forming a “caterpillar” of new trams, driving through Zagreb. This event received widespread interest from the media.
- several articles were published in newspapers and on media websites.

5. Conclusion

It is evident that the number of traffic accidents in 2010, when compared to 2009, is decreasing in both absolute (12,08%) and relative (13,56%) numbers. If an increase of mileage in public transport is added to this, it can be stated that a high degree of safety was achieved, which was, to a large extent, the result of the renovation of the rolling stock, driver trainings, up-to-date and continuous repairing of critical sites and sections, reconstructions of certain rail facilities and pavement surfaces, quality and meaningful communication and cooperation with transport personnel, better coordination of traffic lights, etc.

Within its jurisdiction, as an organizer and coordinator of public transport in Zagreb, ZET will continue to monitor the occurrence of traffic accidents on certain sites and sections and will analyse them by types continuously. In case of significant disturbances, ZET will deal with the problem promptly with the aim of increasing the level of security in public transport.

The measures undertaken within the CIVITAS-ELAN – purchasing new vehicles, trams and buses, investing in infrastructure and education of staff and users of public transport – had a significant impact on the safety results in public transport, especially on the reduction of incidents with passengers who use public transport, attacks on drivers and increasing the sense of safety in public transport vehicles, and therefore greater confidence of passengers in public transport, which resulted it a more frequent usage.

6. Annex - ZET Security Report for 2010

1. ENGLISH SUMMARY

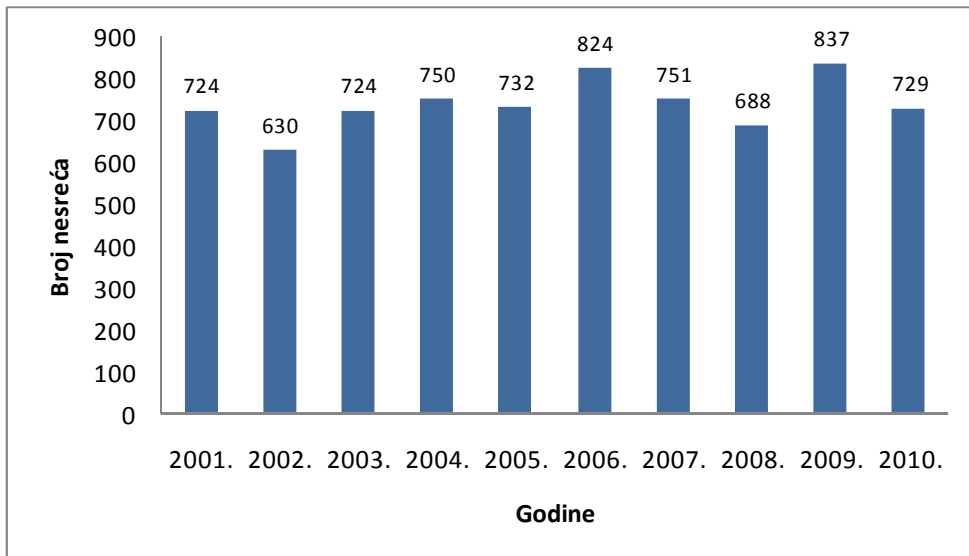
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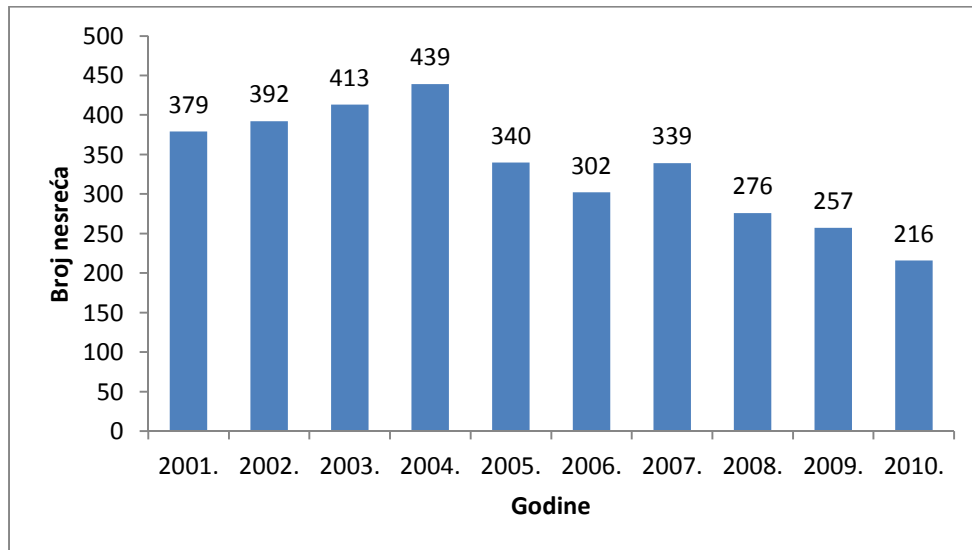
In 2010 a total of 182 persons were injured in traffic accidents, which is **25,41 % less** when compared to 2009, when 244 persons were injured.

The number of traffic accidents in the past 10 years



2. TRAFFIC ACCIDENTS IN TRAM TRAFFIC

Diagram 1. Number of traffic accidents in the period between 2001 and 2010



Tijekom 2010. godine dogodilo se 216 prometnih nesreća što je u odnosu na prethodnu godinu, kada se dogodilo 257 nesreća, smanjenje za 15,95 %.

Dnevno je prosječno ostvareno 36 175 km a dogodilo se 0,6 prometnih nesreća.

Tijekom 2010. godine prosječno po vozaču dogodilo se 0,27 nesreća.

Broj prometnih nesreća na 100.000 ostvarenih kilometara je u smanjenju sa 1,93 na 1,63 događaja.

Table 1. Number of traffic accidents on 100.000 km and number of traffic accidents on an average number of trams participating in the traffic

Vrsta nesreće	Broj nesreća					Broj nesreća na 100 000 km					Broj nesreća na prosječan broj tramvaja u prometu				
	###	###	###	###	2010	###	###	###	###	###	###	###	###	###	2010
Sudar tramvaja i tramvaja	3	4	6	4	6	0,02	0,03	0,05	0,03	0,05	0,02	0,03	0,04	0,02	0,04
Sudar tramvaja i mot.vozila	158	143	118	108	103	1,19	1,13	0,90	0,81	0,78	0,98	0,89	0,72	0,66	0,65
Sudar tramvaja i bus ZET	0	0	0	0	0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Sudar tramvaja i motoc./bicikla	4	3	3	6	3	0,03	0,02	0,02	0,05	0,02	0,02	0,02	0,02	0,04	0,02
Ukupno	165	150	127	118	112	1,24	1,19	0,97	0,89	0,85	1,02	0,94	0,77	0,72	0,70
Okrz. tramvaja i tramvaja	0	1	1	2	2	0,00	0,01	0,01	0,02	0,02	0,00	0,01	0,01	0,01	0,01
Okrz. tramvaja i bus. ZET	0	1	1	0	1	0,00	0,01	0,01	0,00	0,01	0,00	0,01	0,01	0,00	0,01
Okrz. tramvaja i mot.vozila	63	117	65	80	56	0,47	0,93	0,50	0,60	0,42	0,39	0,73	0,40	0,49	0,35
Ukupno	63	119	67	82	59	0,47	0,94	0,51	0,62	0,45	0,39	0,74	0,41	0,50	0,37
Iskliznuće tramvaja	13	8	12	8	7	0,10	0,06	0,09	0,06	0,05	0,08	0,05	0,07	0,05	0,04
Prevrnuće tramvaja	1	0	0	0	0	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00
Nalet na pješaka	25	19	28	21	19	0,19	0,15	0,21	0,16	0,14	0,16	0,12	0,17	0,13	0,12
Pad tramvajskih putnika	27	39	41	24	14	0,20	0,31	0,31	0,18	0,11	0,17	0,24	0,25	0,15	0,09
Nesvrstane nesreće	8	4	1	4	5	0,06	0,03	0,01	0,03	0,04	0,05	0,03	0,01	0,02	0,03
Ukupno	74	70	82	57	45	0,56	0,55	0,63	0,43	0,34	0,46	0,44	0,50	0,35	0,28
Sveukupno	302	339	276	257	216	2,27	2,68	2,11	1,93	1,63	1,88	2,12	1,68	1,57	1,54
OZLIJEĐENE OSOBE															
Lakše ozljede	97	85	110	108	65	0,73	0,67	0,84	0,81	0,49	0,60	0,37	0,67	0,66	0,41
Teže ozljede	19	10	24	13	6	0,14	0,08	0,18	0,10	0,05	0,12	0,04	0,15	0,08	0,04
Smrtni slučaj	0	1	0	2	2	0,00	0,01	0,00	0,02	0,02	0,00	0,00	0,00	0,01	0,01
UKUPNO	116	96	134	123	73	0,87	0,76	1,03	0,93	0,55	0,72	0,42	0,82	0,75	0,46

Ako se stavi u odnos broj pojedinih vrsta prometnih nesreća s brojem istih iz 2009. godine, dobivaju se slijedeće vrijednosti:

VRSTA PROMETNE NESREĆE	Smanjenje (porast) broja prometnih nesreća
Sudar tramvaja s tramvajem	<i>povećanje sa 4 na 6</i>
Sudar tramvaja s motornim vozilom	<i>smanjenje sa 108 na 103</i>
Okrznuće tramvaja s motornim vozilom	<i>smanjenje sa 80 na 56</i>
Iskliznuće tramvaja	<i>smanjenje sa 8 na 7</i>
Nalet tramvaja na pješaka	<i>smanjenje sa 21 na 19</i>
Pad tramvajskih putnika	<i>smanjenje sa 24 na 14</i>

Stvarno stanje stupnja sigurnosti dobiva se preko relativnih vrijednosti, stavljajući u odnos broj prometnih nesreća i 100 000 prijeđenih kilometara te broja prometnih nesreća na prosječan broj tramvaja u prometu. Iz podataka prikazanih u tablici 1. dobivaju se vrijednosti na temelju kojih je vidljivo da se tijekom 2010. godine dogodilo 1,63 prometnih nesreća na 100 000 prijeđenih kilometara, što u odnosu na 2009. godinu predstavlja smanjenje za 15,54 %._Također se bilježi smanjenje broja prometnih nesreća na prosječan broj tramvaja u prometu za 1,91%.

2.1. Traffic accidents by type

Table 2. Number of traffic accidents by type and tramway drive in 2009 and 2010

POGON	TP TREŠNJEVKA		TP DUBRAVA		UKUPNO		INDEX
	2009.	2010.	2009.	2010.	2009.	2010.	
VRSTE NESREĆA							
Sudari:							
Sudar tramvaja i tramvaja	3	2	1	4	4	6	150,00
Sudar tramvaja i mot.vozila	50	52	58	51	108	103	95,37
Sudar tramvaja i bus ZET - a	0	0	0	0	0	0	-
Sudar tramvaja i motoc. /bic.	4	1	2	2	6	3	50,00
UKUPNO	57	55	61	57	118	112	94,92
Okrznuća:							
Okrz.tramvaja i tramvaja	2	1	0	1	2	2	100,00
Okrz.tramvaja i bus. ZET-a	0	0	0	1	0	1	-
Okrz.tramvaja i mot. vozila	52	23	28	33	80	56	70,00
UKUPNO	54	24	28	35	82	59	71,95
Ostale nesreće:							
Iskliznuće tramvaja	5	2	3	5	8	7	87,50
Prevrnuće tramvaja	0	0	0	0	0	0	-
Nalet tramvaja na pješaka	12	11	9	8	21	19	90,48
Pad tramvajskih putnika	5	5	19	9	24	14	58,33
Nesvrstane nesreće	2	2	2	3	4	5	125,00
UKUPNO	24	20	33	25	57	45	78,95
SVEUKUPNO	135	99	122	117	257	216	84,05
INDEX	73,33		95,90		84,05		

2.1.1. Collisions of trams with other vehicles

Broj sudara tramvaja s ostalim sudionicima je u smanjenju sa 118 na 112 događaja ili za 5,08%. Broj sudara tramvaja s tramvajem je u povećanju s 4 na 6 događaja.

2.1.2 Grazes of trams with other vehicles

Ukupan broj okrznuća tramvaja s motornim vozilima je u smanjenju s 82 na 59 događaja ili za 28,05%.

2.1.3. Other accidents

Ukupan broj prometnih nesreća pod nazivom "ostale nesreće" je u smanjenju sa 57 na 45 događaja ili za 21,05 %. Zabilježen je porast jedino u podgrupi „nesvrstane nesreće“ u koju se svrstavaju izvanredni događaji u prometu koje ne možemo svrstati u postojeću kategorizaciju prometnih nesreća (sudar i okrznuće sa specijalnim vozilima, oštećenja tramvaja od strane nepoznatog počinitelja i ost.) i to s 4 na 5 događaja ili za 25,00 %.

2.2 Spatial analysis of traffic accidents

Tramvajska mreža prostire se na duljini od 116 km, od kojih je 62 km ili 53,45 % pruge odvojeno od ostalog prometa, 54 km ili 46,55 % pruge nalazi na zajedničkom tijelu. Od ukupne duljine tramvajske mreže 38 km ili 32,75 % odvojeno je trakama rezerviranim za promet JPP (žute trake).

Na prometnim površinama gdje se tramvajski i ostali promet odvijaju na zajedničkom tijelu dogodilo se 147 prometne nesreće ili 68,05% dok se na tramvajskim pravicima odvojenim od ostalog prometa

dogodilo 32 ili 14,81 %, u pješačkoj zoni 3 ili 1,39 %, a na trakama rezerviranim za promet JPP-a (žute trake) 34 ili 15,75 %.

Na trakama rezerviranim za promet JPP (žute trake) dogodilo se: 16 okrznuća tramvaja s motornim vozilom, 9 čeonih sudara, 5 bočnih sudara, 2 naleta na pješaka i 2 pada putnika.

2.2.1. Traffic accidents by tram routes, squares and intersections

Obzirom na veliku disperziju prometnih nesreća u tramvajskom prometu navesti će se samo one prometne dionice gdje se dogodilo 5 i više prometnih nesreća, odnosno raskrižja i trgova s 3 i više prometnih nesreća.

<u>Prometnice</u>	
Ilica	15 nesreća
Savska	13 nesreća
Maksimirska	12 nesreća
Kneza Mislava	5 nesreća
Draškovićeve	5 nesreća
Divka Budaka	5 nesreća
<u>Raskrižja</u>	
Branimirova - Trpimirova	4 nesreća
Vlaška - Vončinina	3 nesreće
Ilica – Čanićeve	3 nesreće
<u>Trgovi</u>	
Roosveltov trg	3 nesreće

Prometne nesreće koje su se dogodile na Ilici, Savskoj i Maksimirskoj, disperzirane su po cijeloj duljini prometnica, a niti na jednom mjestu nije se dogodilo više od 3 prometne nesreće. Veći broj nesreća na tim pravcima se dogodio zbog: velike frekvencije tramvajskog i ostalog prometa, odvijanja prometa na zajedničkom tijelu, neopreznosti vozača motornih vozila prilikom uključivanja u promet s parkirališnih mjesta te promjene vozne trake.

Najviše prometnih nesreća, osam, dogodilo se na raskrižju Branimirove i Trpimirove ulice. Sve nesreće su se dogodile na skoro identičan način, prilikom neopreznog uključivanja vozača osobnih vozila iz Trpimirove u Branimirovu ulicu, pri čemu je došlo do sudara ili okrznuća s tramvajskim vlakom.

2. 2. 2. Traffic accidents by tram lines on 100 000 realized kilometers

Table 3. Number of traffic accidents by tram lines on 100.000 realized kilometers

LINIJA	Broj nesreća TP Trešnjevka	Broj nesreća TP Dubrava	Ukupno	Ukupno nesreća na 100 000 km
1	10	0	10	2,88
2	9	0	9	1,01
3	7	0	7	1,93
4	0	21	21	2,03
5	10	0	10	1,10
6	1	36	37	3,11
7	0	10	10	0,84
8	0	6	6	1,00
9	15	0	15	2,42
11	13	7	20	1,47
12	14	0	14	1,52
13	0	15	15	1,94
14	0	20	20	1,68
17	20	0	20	1,54
31	0	2	2	2,80
32	0	0	0	0,00
33	0	0	0	0,00
34	0	0	0	0,00
UKUPNO	99	117	216	1,63

U tablici 4 prikazan je broj prometnih nesreća po linijama na 100 000 ostvarenih kilometara. Najviše nesreća se dogodilo u apsolutnom iznosu na linijama br. 6, 4, 11, 14 i 17, a u relativnom iznosu na liniji br. 6 - 3,11 prometnih nesreća. Navedene linije prometuju kroz uži centar grada gdje se tramvajski i ostali promet odvijaju na zajedničkom tijelu uslijed čega je povećana vjerojatnost događanja prometnih nesreća.

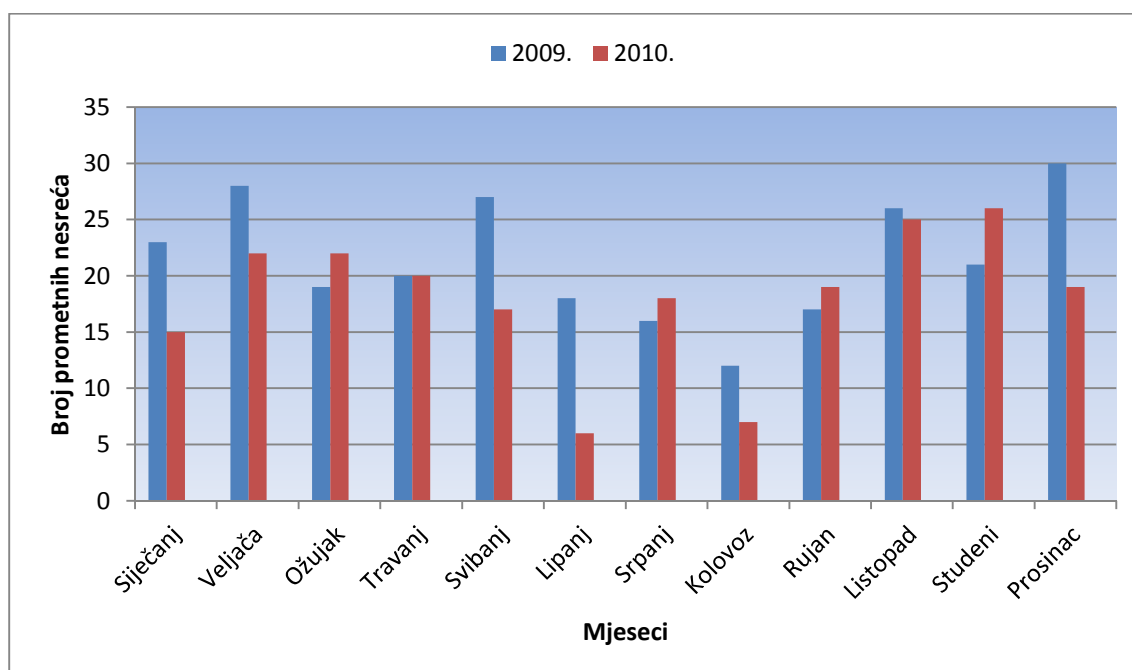
2.3 Temporal analysis of traffic accidents

2.3.1 Traffic accidents by months of the year

Table 4. Number of traffic accidents by months for 2009 and 2010

MJESECI	GODINA	
	2009.	2010.
Siječanj	23	15
Veljača	28	22
Ožujak	19	22
Travanj	20	20
Svibanj	27	17
Lipanj	18	6
Srpanj	16	18
Kolovoz	12	7
Rujan	17	19
Listopad	26	25
Studenj	21	26
Prosinac	30	19
UKUPNO	257	216

Diagram 2. An overview of the number of accidents per month by months for 2009 and 2010.



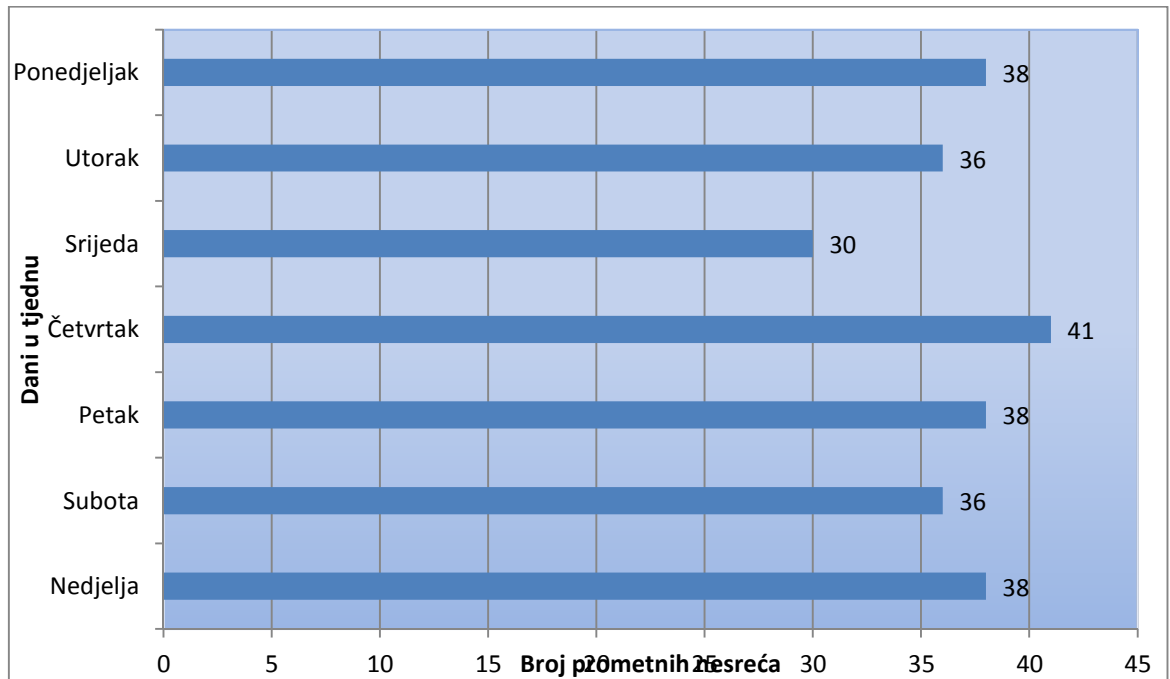
U tablici 5 i dijagramu 4 prikazan je broj prometnih nesreća po mjesecima u godini. Analizom broja prometnih nesreća po mjesecima, proizlazi da se najviše nesreća dogodilo u studenom - 26 ili 12,04 %, a najmanje u lipnju - 6 ili 2,78 %.

2. 3.2. Traffic accidents by days of the week

Table 5. Number of traffic accidents by days of the week

DAN	GOD INA	
	2009.	2010.
Ponedjeljak	43	38
Utorak	57	36
Srijeda	41	38
Četvrtak	45	41
Petak	29	30
Subota	32	23
Nedjelja	10	10
UKUPNO	257	216

Diagram 3. An overview of the number of traffic accidents by days of the week for 2010



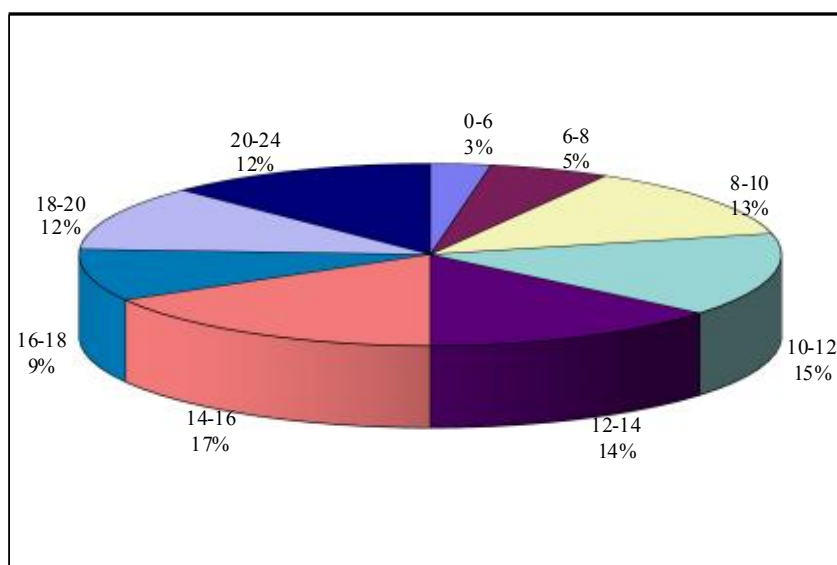
Broj prometnih nesreća po danima u tjednu prikazan je u tablici 5 i dijagramu 3. Tijekom 2010.godine najviše se nesreća događalo četvrtkom - 41 ili 19,00 % od ukupnog broja prometnih nesreća.

2.3.3. Traffic accident by hours of the day

Table 6. Number of traffic accidents by hours of the day

GODINA	2009.	2010.
NESREĆA U SATU		
0-2	4	1
2-4	2	0
4-6	3	5
6-8	21	12
8-10	29	28
10-12	32	32
12-14	44	30
14-16	32	36
16-18	35	20
18-20	27	25
20-22	17	15
22-24	11	12
UKUPNO	257	216

Diagram 4. An overview of traffic accidents by hours of the day for 2010



Temeljem dobivenih podataka u tablici 7 i dijagramu 3 najviše prometnih nesreća - 36 ili 16,67 % dogodilo se u periodu između 14.00 - 16.00 sati. Taj podatak je očekivan jer se radi o vršnom prometnom opterećenju kada se na cijelom području grada stvaraju velike prometne gužve i istodobno je smanjen stupanj prometne sigurnosti te nepoštivanje prednosti vozila JPP pri prometovanju po žutim trakama.

U doba dnevnog svjetla dogodilo se 158 nesreća ili 73,15 % dok je u noćnom razdoblju bilo 58 nesreće ili 26,85 %.

2. 4. Number of participants hurt in traffic accidents

Table 7. Number of people hurt in traffic accidents

Vrste ozlijeđenih osoba	Lakše ozlijeđeni		Teže ozlijeđeni		Smrtno stradali		UKUPNO		INDEKS
	2009.	2010.	2009.	2010.	2009.	2010.	2009.	2010.	
Prometno osoblje	5	4	0	0	0	0	5	4	80,00
Tramvajski putnici	73	35	0	0	0	0	73	35	47,94
Putnici u drugom vozilu	19	14	4	0	0	0	23	14	60,87
Pješaci	11	12	9	6	2	2	22	20	90,90
UKUPNO	108	65	13	6	2	2	123	73	59,35
INDEX		60,18		46,15		100,00		59,35	

Ukupan broj ozlijeđenih osoba u tramvajskom prometu je u padu za 40,65% (sa 123 na 73). Temeljem podataka iz tablice 7 bilježi se smanjenje broja lakše ozlijeđenih osoba za 39,82% (sa 108 na 65) i teško ozlijeđenih osoba za 53,85 % (sa 13 na 6). Broj smrtno stradalih osoba jednak je u promatranim periodima.

U 20 nesreća došlo je do naleta tramvaja na pješaka i obrnuto; u pet slučajeva pješak je neoprezno naletio na tramvaj; u 12 slučajeva tramvaj je okrnio pješaka, a u tri slučaja tramvaj je naletio na

pješaka. Sve nesreće su se dogodile na različitim mjestima tramvajske mreže, a prosječno vrijeme zastoja po jednoj nesreći je bilo 46 minuta.

U tramvaju i na tramvajskom stajalištu dogodilo se 14 nesreća s ozlijeđenim putnicima u kojima je ozlijeđeno 35 putnika ili 2,5 po jednoj nesreći. U osam nesreća do pada putnika je došlo uslijed naglog kočenja tramvaja i nepridržavanja putnika za rukohvat, u 3 slučaja uzrok je bio aktiviranje kočnice za opasnost od strane nepoznatih osoba, u 3 slučaja putnici su pali pri ulasku - izlasku iz tramvaja.

Uslijed naleta tramvaja na tramvaj, 24.09.2010. na raskrižju ul. Grada Gospića i M. Čavića ozlijeđeno je 7 putnika i dva vozača tramvaja.

Dva pješaka su smrtno stradala; na raskrižju Draškovićeve i Đorđićeve i na Aveniji Dubrovnik kod kbr. 16.

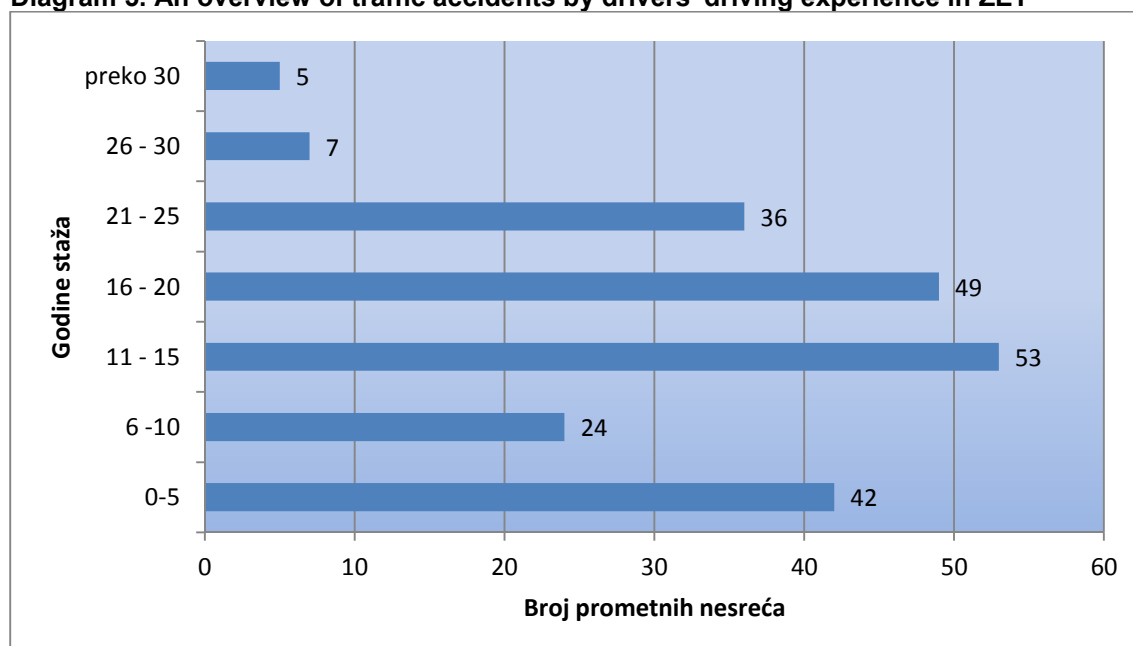
2.5. The impact of driving experience and working hours on the occurrence of traffic accidents

2.5.1. Traffic accidents by drivers' driving experience in ZET

Table 8. Number of traffic accidents by drivers' driving experience in ZET

STAŽ	BROJ NESREĆA	BROJ VOZAČA	BROJ NESREĆA PO VOZAČU
0 - 5	42	22	1,91
6 - 10	24	64	0,38
11 - 15	53	145	0,37
16 - 20	49	160	0,31
21 - 25	36	207	0,17
26 - 30	7	107	0,07
preko 30	5	81	0,06
UKUPNO	216	786	0,27

Diagram 5. An overview of traffic accidents by drivers' driving experience in ZET



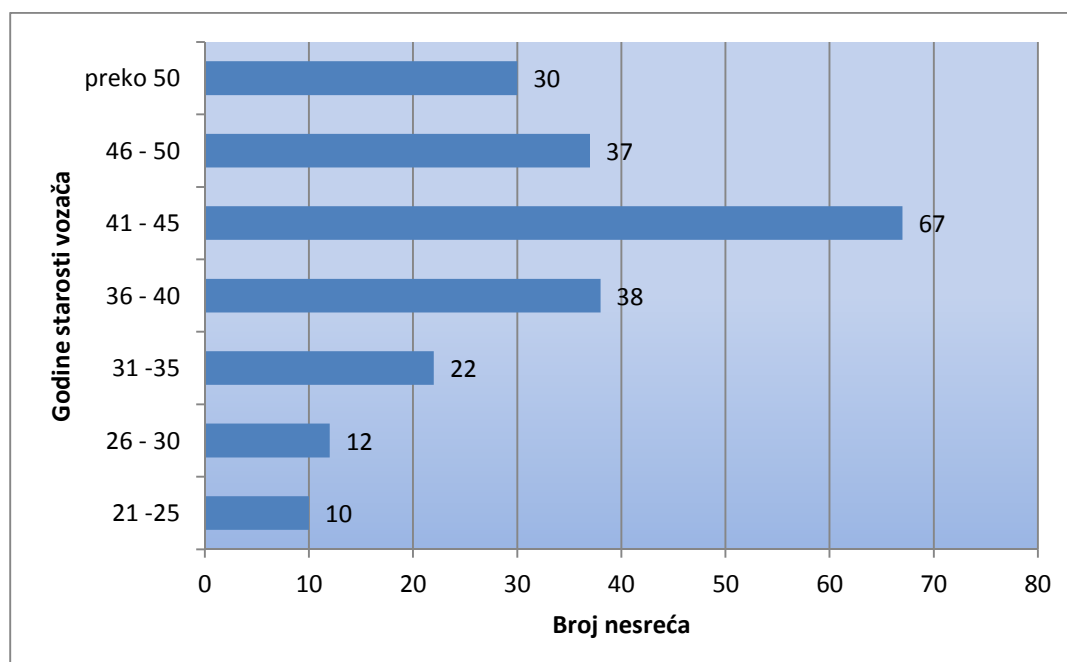
Temeljem podataka iz tablice 8 i dijagrama 5 vidi se da su u najviše nesreća - 53 ili 24,54 % sudjelovali vozači od 11 - 15 godina vozačkog staža u ZET-u, dok su vozači preko 30 godina vozačkoga staža sudjelovali u najmanje prometnih nesreća. Ako stavimo u odnos broj nesreća i broj vozača prema godinama staža proizlazi da su vozači do 5 godina vozačkog staža sudjelovali u najviše prometnih nesreća (1,91 nesreća po vozaču).

2.5.2 Traffic accidents by drivers' age

Table 9. Traffic accidents by drivers' age

GODINE STAROSTI	BROJ NESREĆA	BROJ VOZAČA	BROJ NESREĆA PO VOZAČU
21 - 25	10	10	1
26 - 30	12	32	0,38
31 - 35	22	81	0,27
36 - 40	38	161	0,24
41 - 45	67	206	0,33
46 - 50	37	172	0,22
preko 50	30	124	0,24
UKUPNO	216	786	0,27

Diagram 6. An overview of traffic accidents by drivers' age



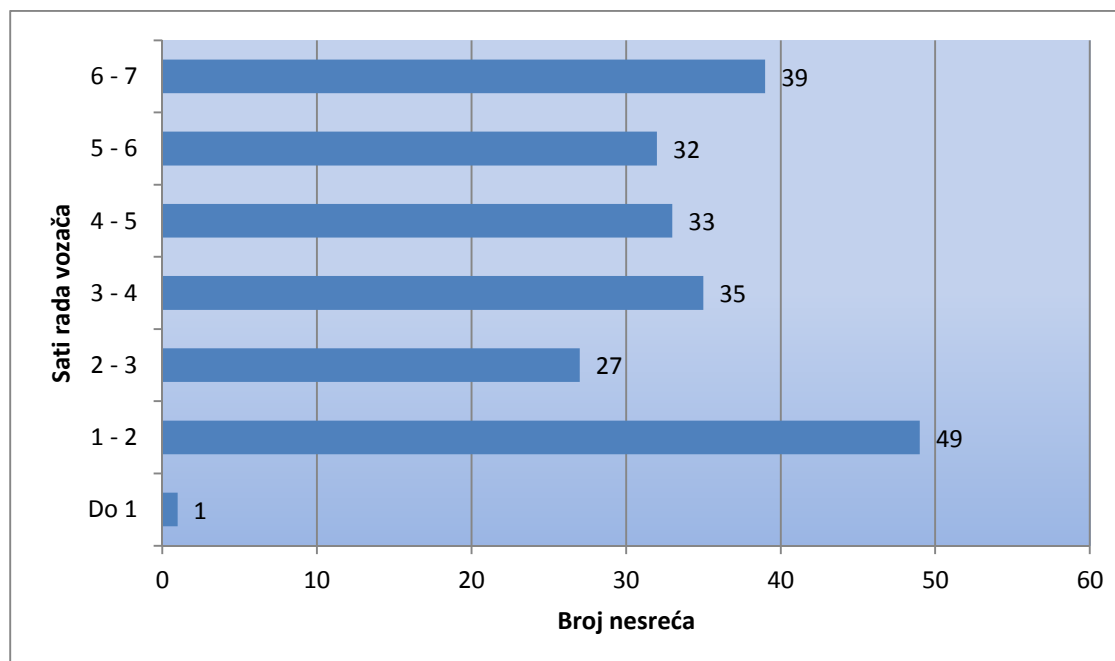
U najviše nesreća, 67 ili 31,02 %, sudjelovali su vozači starosne dobi od 41 - 45 godina, dok je u najmanje prometnih nesreća 10 ili 4,63 % sudjelovala skupina vozača od 21 - 25 godina starosti. Ako stavimo u odnos broj prometnih nesreća i broj vozača po određenoj starosnoj kategoriji proizlazi da je skupina vozača do 25 godina starosti sudjelovala u najviše prometnih nesreća odnosno svaki vozač u 1 nesreći.

2.5.3. Hours of work until the occurrence of a traffic accident and drivers' age

Table 10. Relation between hours of work until the occurrence of a traffic accident and age of drivers

Sati rada	GODINE STAROSTI							Ukupno	%
	21 - 25	26 - 30	31 - 35	36 - 40	41 - 45	46 - 50	> 50		
Do 1	0	0	0	1	0	0	0	1	0,46
1 - 2	1	5	3	11	12	9	8	49	22,69
2 - 3	1	1	6	6	7	3	3	27	12,50
3 - 4	4	1	5	6	6	7	6	35	16,20
4 - 5	1	1	2	5	17	4	3	33	15,28
5 - 6	1	0	5	4	11	7	4	32	14,81
6 - 7	2	4	1	5	14	7	6	39	18,06
Ukupno	10	12	22	38	67	37	30	216	100,00
%	4,63	5,55	10,18	17,59	31,02	17,13	13,89	100,00	

Diagram 7. An overview of traffic accidents by the hours of work until the occurrence of a traffic accident



S obzirom na sate rada do nesreće evidentno je da se **najviše prometnih nesreća događa u razdoblju od 1. – 2. sata rada vozača, 49 ili 22,69%**. Za vrijeme prvog sata rada dogodilo se najmanje prometnih nesreća - 1 ili 0,46 %.

2.6. Traffic accidents by drivers' shifts

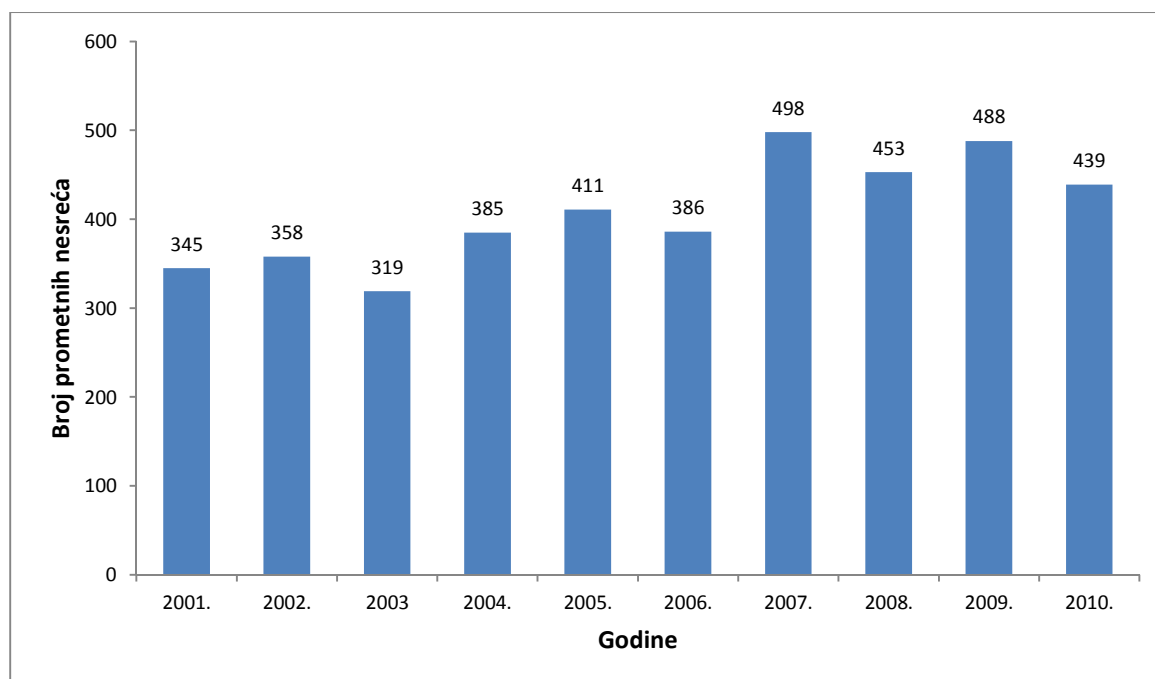
Table 11. Number of traffic accidents by drivers' shifts and tramway drives

POGON SLUŽBA	BROJ PROMETNIH NESREĆA		UKUPNO	%
	Trešnjevka	Dubrava		
RANA od 4 – 11 sati	16	23	39	18,05
DVOKRATNA RANA od 6 – 9 i 12 – 17 sati	0	0	0	0
ČINOVNIČKA od 7 – 14 sati	18	13	31	14,36
SREDNJA od 11 – 18 sati	29	35	64	29,62
POLUKASNA od 14 – 21 sati	19	23	42	19,45
KASNA od 17 – 24 sata	17	22	39	18,06
NOĆNA od 23 – 5 sati	0	1	1	0,46
UKUPNO	99	117	216	100,00

Evidencija broja prometnih nesreća po službama pokazala je da se najviše nesreća dogodilo za vrijeme trajanja srednje službe - 64 ili 29,62%, a zatim u polukasnoj - 42 ili 19,45 %. **Popodnevno vršno opterećenje je glavnim razlogom pojave najvećeg broja prometnih nesreća za vrijeme trajanja srednje službe.**

3. TRAFFIC ACCIDENTS IN BUS TRAFFIC

Diagram 8. An overview of traffic accidents in bus traffic in the period between 2001 and 2010



Tijekom 2010. godine dogodilo se 439 prometnih nesreća što je u odnosu na prethodnu godinu kada se dogodilo 488 nesreća, smanjenje za 10,04 %.

Dnevno je prosječno ostvareno 80 931 km, a dogodilo se 1,2 prometne nesreće.

Tijekom 2010. godine prosječno po vozaču dogodilo se 0,37 nesreće.

Broj prometnih nesreća na 100 000 ostvarenih kilometara je u smanjenju sa 1,70 na 1,49 događaja.

Table 12. Number of traffic accidents on 100.000 km and number of traffic accidents on an average number of buses participating in the traffic in the period between 2006 and 2010

GODINA	Broj prometnih nesreća					Broj prometnih nesreća na 100 000 kilometara					Broj prometnih nesreća na prosječan broj autobusa				
	06.	07.	08.	09.	10.	06.	07.	08.	09.	10.	06.	07.	08.	09.	10.
Sud. busa i bus ZET	3	5	3	3	1	0	0	0	0,01	0,00	0	0	0	0,01	0,00
Sud. busa i mot.vozila	114	130	108	102	98	0,5	0,5	0,40	0,36	0,33	0,5	0,6	0,5	0,44	0,42
Sud. busa i tramvaja	0	0	0	0	0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Sud. busa i motoc./bic.	3	2	6	10	5	0	0	0	0,03	0,02	0	0	0	0,04	0,02
Okrz. busa i bus. ZET-	8	7	8	11	10	0	0	0	0,04	0,03	0	0	0	0,05	0,04
Okrz. busa i tram.	1	0	1	0	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Okrz. busa i mot. voz.	198	240	208	241	206	0,8	0,9	0,8	0,84	0,70	0,9	1	0,9	1,04	0,89
Okrz. busa u nepok. ob.	2	13	23	24	39	0	0,1	0,9	0,08	0,13	0	0,1	0,1	0,10	0,17
Iskliznuće autobusa	3	3	2	6	6	0	0	0	0,02	0,02	0	0	0	0,03	0,03
Prevrnuće autobusa	0	0	0	0	0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Nalet na pješaka	3	1	6	3	7	0	0,00	0	0,01	0,02	0	0	0	0,01	0,03
Pad autobusnih	32	51	49	42	36	0,1	0,2	0,2	0,15	0,12	0,1	0,2	0,2	0,18	0,16
Udar busa u nep.	6	21	17	13	14	0	0,1	0,1	0,05	0,05	0	0,1	0,1	0,06	0,06
Nesvrstane nesreće	13	25	22	33	16	0,1	0,1	0,1	0,12	0,05	0,1	0,1	0,1	0,14	0,07
SVEUKUPNO	386	498	453	488	439	1,5	1,9	1,67	1,70	1,49	1,7	2,2	2	2,10	1,89

OZLIJEĐ. OSOBE

Lakše ozlijeđe	91	90	113	114	101	0,4	0,3	0,4	0,40	0,34	0,4	0,4	0,51	0,49	0,44
Teže ozlijeđe	9	8	5	5	8	0	0	0	0,02	0,03	0	0	0,02	0,02	0,03
Smrtni slučaj	0	0	1	2	0	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00
UKUPNO	100	98	119	121	109	0,4	0,4	0,4	0,42	0,37	0,5	0,4	0,54	0,52	0,47

Ako se stavi u odnos broj pojedinih vrsta prometnih nesreća sa brojem istih iz 2009. godine, dobivaju se slijedeće vrijednosti:

VRSTA PROMETNE NESREĆE	Smanjenje (porast) prometnih nesreća
Sudar autobusa sa motornim vozilom	smanjenje sa 102 na 98
Udar autobusa u nepokretan objekt	povećanje sa 13 na 14
Sudar autobusa i motoc./bic.	smanjenje sa 10 na 5
Okrznuće autobusa i mot.voz.	smanjenje sa 241 na 206
Nalet na pješaka	povećanje sa 3 na 7
Pad autobusnih putnika	smanjenje sa 42 na 36
Okrznuće autobusa s autobusom ZET-a	smanjenje sa 11 na 10

Stvarno stanje sigurnosti autobusnog prometa dobiva se preko relativnih vrijednosti stavljanjem u odnos broja prometnih nesreća i 100 000 prijeđenih kilometara vozila te broja prometnih nesreća na prosječan broj autobusa u prometu.

Iz podataka prikazanih u tablici 12. dobivaju se vrijednosti na temelju kojih je vidljivo da se tijekom 2010. godine dogodilo 1,49 prometnih nesreća na 100 000 prijeđenih kilometara, što u odnosu na 2009. godinu predstavlja smanjenje za 12,35 %. Broj prometnih nesreća na prosječan broj autobusa u prometu se smanjio za 10%.

3.1. Traffic accidents by type

Table 13. Number of traffic accidents by bus drives in 2009 and 2010

VRSTE PROMETNIH NESREĆA	PODSUSED		DUBRAVA		V.GORICA		UKUPNO		INDEX
	2009.	2010.	2009.	2010.	2009.	2010.	2009.	2010.	
Sudari									
Autobus i autobus ZET-a	1	1	1	0	1	0	3	1	33,33
Autobus i motorno vozilo	46	47	48	39	8	12	102	98	96,08
Autobus i tramvaj	0	0	0	0	0	0	0	0	0
Autobus i motoc./bicikl	5	3	5	2	0	0	10	5	50,00
UKUPNO:	54	51	57	41	9	12	115	104	90,43
Okrznuća									
Autobus i autobus ZET-a	6	4	5	6	0	0	11	10	90,91
Autobus i tramvaj	0	1	0	0	0	0	0	1	-
Autobus i motorno vozilo	118	102	106	96	17	8	241	206	85,48
Autobus i nepokretan objekt	16	20	8	18	0	1	24	39	162,50
UKUPNO:	140	127	119	120	17	9	276	256	92,75
Ostale nesreće									
Iskliznuće autobusa	3	4	1	1	2	1	6	6	100,00
Prevrnuće autobusa	0	0	0	0	0	0	0	0	0
Nalet autobusa na pješaka	2	4	1	2	0	1	3	7	233,33
Pad autobusnih putnika	22	18	19	18	1	0	42	36	85,71
Udar u nepokretan objekt	5	10	7	2	1	2	13	14	107,69
Nesvrstane nesreće	21	9	11	4	1	3	33	16	48,48
UKUPNO	53	45	39	27	5	7	97	79	81,44
SVEUKUPNO	245	223	212	188	31	28	488	439	89,96
INDEX		91,02		88,67		90,32			

3.1.1. Collisions of buses with other vehicles

Promatrajući prometne nesreće po vrstama (tablica 13) evidentno je da su sudari zastupljeni sa 104 prometnih nesreća što je u odnosu na 2009. godinu smanjenje za 9,57 %.

3.1.2. Grazes of buses with other vehicles

Tijekom 2010. godine u kategoriji okrznuća autobusa dogodilo su ukupno 256 nesreća ili 7,25 % manje nego u istom razdoblju 2009. godine (276 nesreća).

Prema tipizaciji nesreća, okrznuća autobusa svrstavaju se u nesreće sa manjom materijalnom štetom, a uzrok nastanka je uglavnom nepoštivanje propisa od strane drugih sudionika u prometu.

Porast broja okrznuća bilježimo u kategoriji „autobus u nepokretan objekt“ sa 24 na 39 događaja ili za 62,50%.

3. 1. 3. Other accidents

Ukupan broj prometnih nesreća pod nazivom "ostale nesreće" je u smanjenju u odnosu na prošlu godinu sa 97 na 79 događaja ili za 18,56 %. Zabilježen je porast broja nesreća u kategorijama: „nalet autobusa na pješaka“ sa 3 na 7 događaja ili za 133,33 % i u kategoriji „udar u nepokretan objekt“ s 13 na 14 događaja ili za 7,69%. U ostalim kategorijama bilježimo smanjenje broja prometnih nesreća.

U podgrupu "nesvrstane nesreće" svrstavaju se izvanredni događaji u prometu koje ne možemo svrstati u postojeću kategorizaciju prometnih nesreća (naleti biciklista na autobus, oštećenje guma, puknuće stakala na autobusu, oštećenja autobusa od strane nepoznatih osoba, nalet na predmete koji ispadnu sa drugih vozila i sl.).

3. 2. Spatial analysis of traffic accidents

3.2.1. Traffic accidents by bus routes

U razmatranje su uzete prometnice i raskrižja gdje se dogodilo više prometnih nesreća tijekom 2010. godine.

Tijekom 2010. godine najveći broj nesreća (u apsolutnom iznosu) dogodio se na Ilici (21 prometna nesreća). Prometne nesreće na Ilici disperzirane su po cijeloj dužini prometnice od Črnomerca do Vrapčanske aleje, a ni na jednom mjestu nije se dogodilo više od dvije prometne nesreće. Višegodišnjim praćenjem događanja prometnih nesreća pokazalo se kako je Ilica najkritičnija prometnica u Gradu Zagrebu zbog velike frekvencije kako autobusnog tako i ostalog prometa, te zbog neadekvatne dužine odvojenog prometnog traka za vozila JPP-a - "žuta traka" (postoji samo na južnom kolničkom traku Ilice u smjeru istoka od benzinske postaje INA kod raskrižja Ilice sa Vrapčanskom ulicom do raskrižja sa Skladišnom ulicom).

Prometnice s najvećim brojem prometnih nesreća mogu se vidjeti iz slijedećeg preglda:

<u>Prometnice:</u>	
Ilica	21 nesreća
Selska	9 nesreća
Zagrebačka (Sesvete)	7 nesreća
Remetničkacka c.	6 nesreća
Zagrebačka (V.Gorica)	5 nesreća
 <u>Raskrižja:</u>	
Rotor Remetinec	5 nesreća
 <u>Terminali:</u>	
Terminal Črnomerec	9 nesreća

Rotor u Remetincu na kojemu su se protekle godine dogodilo 5 prometnih nesreća pokazao se kao najkritičnije raskrižje, dok je najkritičniji terminal Črnomerec sa 9 nesreća. Ovakvo stanje na terminalu Črnomerec je uzrokovano velikom frekvencijom autobusa ZET-a i ostalih prijevoznika i prisutnošću nepropisno parkiranih vozila te kretanjem osobnih vozila preko prostora terminala.

Potrebno je napomenuti da na postojeći broj prometnih nesreća znatan utjecaj ima stanje kolnika odnosno cjelokupne prateće prometne infrastrukture. Za pretpostaviti je da bi se popravkom i proširenjem pojedinih prometnica, novom regulacijom prometa na pojedinim lokacijama, redovitim održavanjem i kontrolom poštivanja žutih traka i izgradnjom parkirališnih mjesta za vozila ostalog prometa znatno povećao stupanj sigurnosti.

3.2.2. Traffic accidents by bus lines

Table 14. An overview of bus lines with 10 or more traffic accidents in 2010

LINIJA	NAZIV LINIJE	BROJ PROM. NESREĆA	POGON	NESREĆA NA 100 000 KM
109	ČRNOMEREC - DUGAVE	23	PODSUSED	2,80
215	KVATERNIKOV TRG - TRNAVA	16	DUBRAVA	3,48
128	ČRNOMEREC – LUKŠIĆ	13	PODSUSED	4,79
127	ČRNOMEREC - MIKULIČI	13	PODSUSED	6,45
118	MAŽURANIĆEV TRG - VOLTINO	13	PODSUSED	3,04
268	ZAGREB – V.GORICA	12	DUBRAVA	0,91
120	ČRNOMEREC - GAJNICE	11	PODSUSED	4,44
121	ČRNOMEREC- KARAŽNIK	11	PODSUSED	3,75

Slijedom prikazanog u tablici 14 vidljivo je da se najviše prometnih nesreća – 23 (apsolutni broj) dogodilo na autobusnoj liniji 109 Črnomerec – Dugave. Ako se promatra broj prometnih nesreća na prijeđenih 100 000 km (relativan broj) najviše prometnih nesreća – 6,45 dogodilo se na liniji 127 Črnomerec - Mikulići.

Analizom (pregledom) događanja prometnih nesreća po linijama vidljivo je da se iste događaju na područjima i prometnicama gdje se odvija intenzivan promet te na prometnicama gdje su zbog prometne situacije, zahtjevni i složeni uvjeti za siguran i redovit promet.

Na brdskim linijama 127 i 128, smanjena je sigurnost prometa na pojedinim dijelovima uslijed: nemogućnosti sigurnog mimoilažena autobusa s ostalim vozilima zbog neadekvatne širine kolničkog traka; smanjene preglednost u krivinama; nepropisno parkiranih vozila.

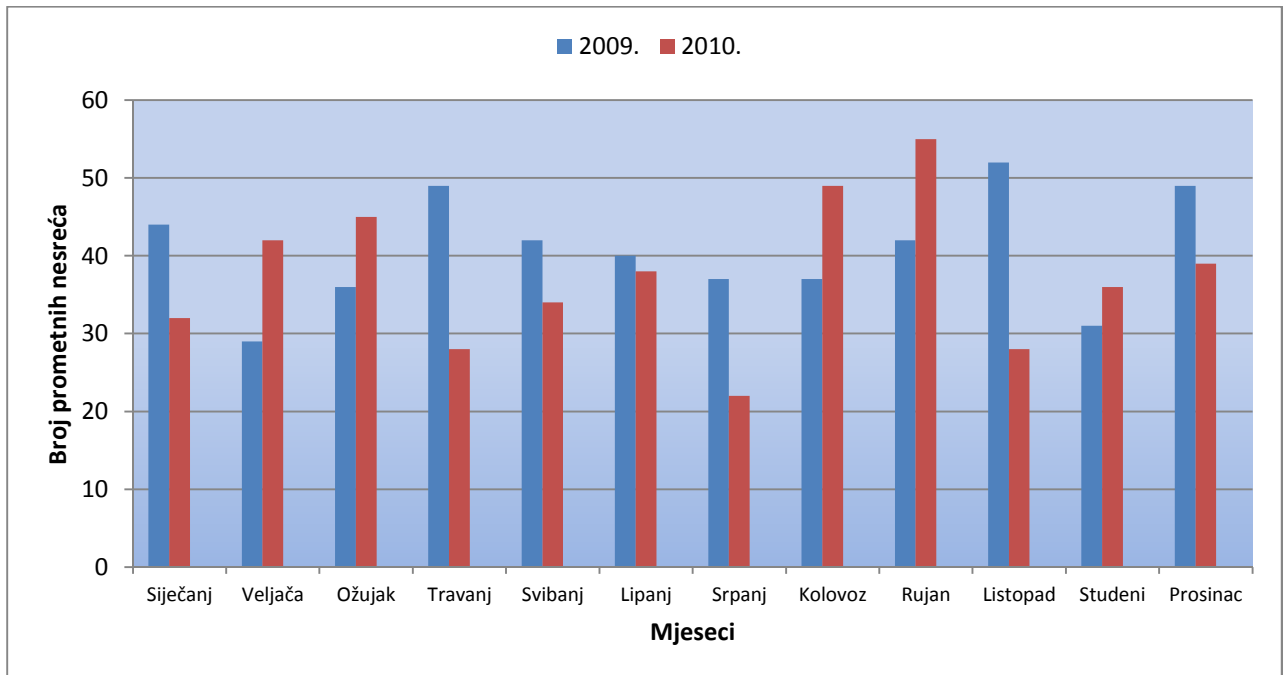
3. 3. Temporal analysis of traffic accidents

3.3.1. Traffic accidents by months of the year

Table 15. Number of traffic accidents by months

GODINA	2009.	2010.
MJESECI		
Siječanj	44	32
Veljača	29	42
Ožujak	36	45
Travanj	49	28
Svibanj	42	34
Lipanj	40	38
Srpanj	37	22
Kolovoz	37	40
Rujan	42	55
Listopad	52	28
Studenj	31	36
Prosinac	49	39
UKUPNO	488	439

Diagram 9. An overview of traffic accidents by months



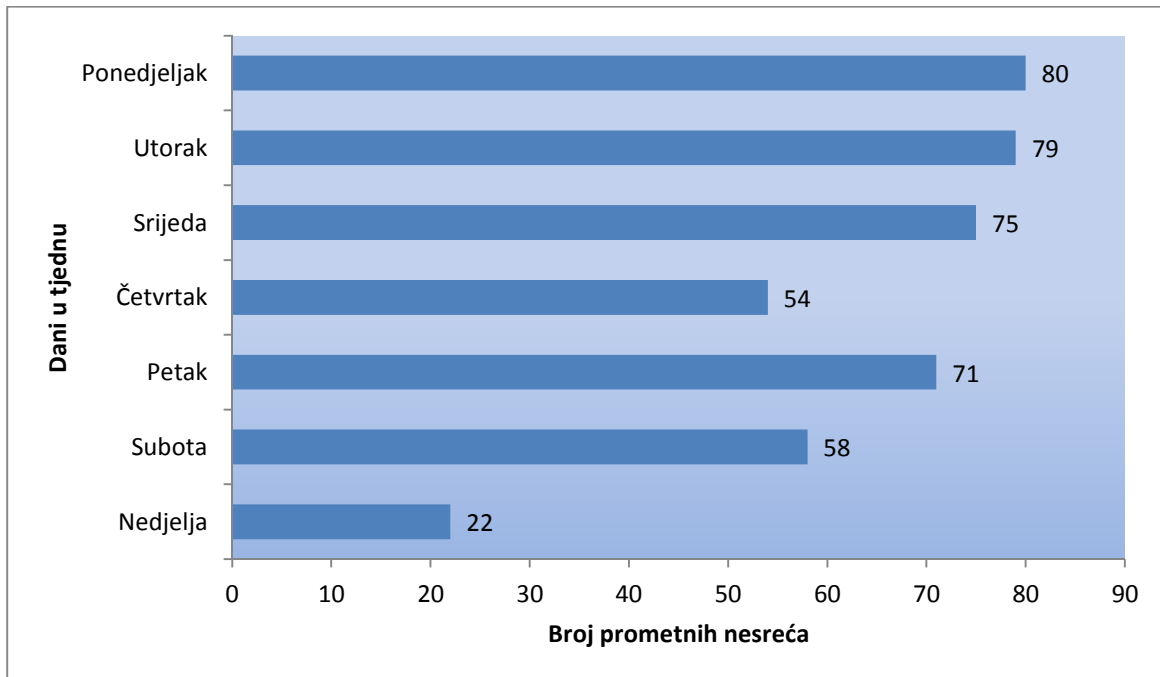
Promatra li se pojavljivanje prometnih nesreća po mjesecima u 2010. godini proizlazi da se najviše nesreća – 55 ili 12,52 % **dogodio u rujnu**, a **najmanji broj nesreća -22 ili 5,01 % dogodio se u srpnju**.

3.3.2. Traffic accidents by days of the week

Table 16. Number of traffic accidents by days of the week

DANI	GODINA	
	2009.	2010.
Ponedjeljak	71	80
Utorak	84	79
Srijeda	69	75
Četvrtak	84	54
Petak	85	71
Subota	70	58
Nedjelja	25	22
UKUPNO	488	439

Diagram 10. An overview of traffic accidents by days of the week



Analiziramo li pojavljivanje prometnih nesreća po danima u tjednu dobivamo podatak da se tijekom 2010. godine najviše nesreća - 80 ili 18,22 % od ukupnog broja nesreća dogodilo ponedjeljkom (tablica 16 i dijagram 10).

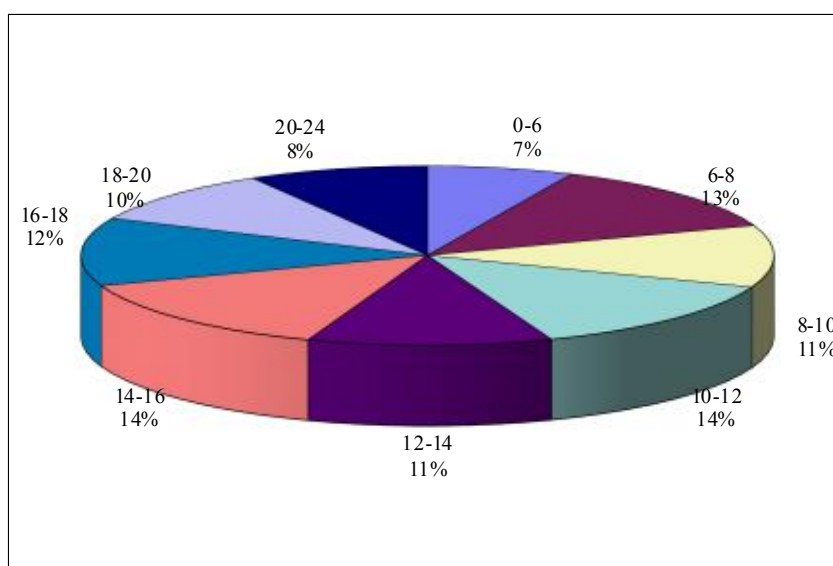
Najmanje nesreća - 22 ili 5,01 % dogodilo se nedjeljom. Ovakva situacija nedjeljom je i očekivana jer je intenzitet javnog i individualnog prometa znatno manji s obzirom na ostale dane u tjednu.

3.3.3. Traffic accidents by hours of the day

Table 17. Number of traffic accidents by hours of the day

GODINA	2009.	2010.
NESREĆA U SATU		
0-2	4	3
2-4	10	3
4-6	19	24
6-8	48	56
8-10	53	49
10-12	64	59
12-14	57	50
14-16	86	61
16-18	55	54
18-20	38	43
20-22	32	22
22-24	22	15
UKUPNO	488	439

Diagram 11. An overview of traffic accidents by hours of the day



Pojavljivanje nesreća po satima tijekom dana kao i prošlih godina pokazuje zakonitost da su vršni sati prometnog opterećenja ujedno i najkritičniji sati, odnosno razdoblja kada je broj nesreća maksimalan u odnosu na druga razdoblja tijekom dana. To potvrđuje činjenicu da je broj sudionika u prometu proporcionalan sa brojem nesreća.

Problematično razdoblje je, što se može vidjeti i iz tablice 17 i dijagrama 11, od 12 - 18 sati unutar kojeg se u vremenu od 14 - 16 sati broj nesreća intenzivira i dostiže svoj maksimum od 61 nesreću ili 13,89 % od ukupnog broja prometnih nesreća. **Razlog je uglavnom intenzivan (pojačan) promet u tom vremenskom razdoblju obzirom na vršno poslijepodnevno razdoblje.**

U razdoblju dnevne svjetlosti od 6-18 sati dogodilo se 329 nesreća ili 74,94 % nesreća, a u noćnom periodu 110 ili 25,06 % nesreća.

3. 4. Participants hurt in traffic accidents

Table 18. Number of people hurt in traffic accidents

Vrste ozlijeđenih osoba	Lakše ozlijeđeni		Teže ozlijeđeni		Smrtno stradali		Ukupno		INDEX
	2009.	2010.	2009.	2010.	2009.	2010.	2009.	2010.	
Putnici u autobusu	88	71	0	2	0	0	88	73	82,95
Putnici u ost. voz.	19	23	5	4	2	0	26	27	103,85
Prometno osoblje	3	2	0	0	0	0	3	2	66,67
Pješaci	4	5	0	2	0	0	4	7	175,00
UKUPNO	114	101	5	8	2	0	121	109	90,10
INDEX		88,60		160,00		-			

Prema podacima iz tablice 18 vidimo da je došlo do smanjenja broja ozlijeđenih osoba u komparativnom razdoblju za 9,90% (sa 121 na 109). Povećanje broja ozlijeđenih osoba bilježimo kod teže ozlijeđenih za 60,00%. Tijekom 2010. godine dogodilo se 74 nesreća sa ozlijeđenim osobama, što znači da je svaka šesta nesreća (5,93 nesreća) imala za posljedicu ozljede sudionika u prometu.

Ako se promatra struktura ozlijeđenih osoba može se uočiti da je povećanje prisutno u slijedećim kategorijama i to: „putnici u ostalim vozilima“ za 3,85 %, „pješaci“ za 175,00%. Od sedam nesreća u kojima su ozlijeđeni pješaci u tri slučaja autobus je naletio na pješake, u dva slučaja autobus je okrnio pješake, a u jednom slučaju pješak je naletio na autobus.

Najveći broj putnika povrijeđen je uslijed naglog kočenja autobusa izazvanog nepredviđenim radnjama i ponašanjem ostalih sudionika u prometu, u 8 slučajeva putnici su povrijeđeni zbog nepridržavanja za rukohvat, a tri putnika su pala prilikom ulaza-izlaza iz autobusa.

Događanje nesreća sa ozlijeđenim osobama u autobusnom prometu podjednako je zastupljeno na cijeloj autobusnoj mreži: Ilica - 3 nesreće, Zagrebačka cesta (V.Gorica) - 2 nesreće, terminal Črnomerec - 3 nesreće, raskrižje Heinzelove i N.Branimirove - 2 nesreće.

Najviše nesreća sa stradalim osobama dogodilo se na trasama linija broj 215 Kvaternikov trg - Trnava - 3 nesreće.

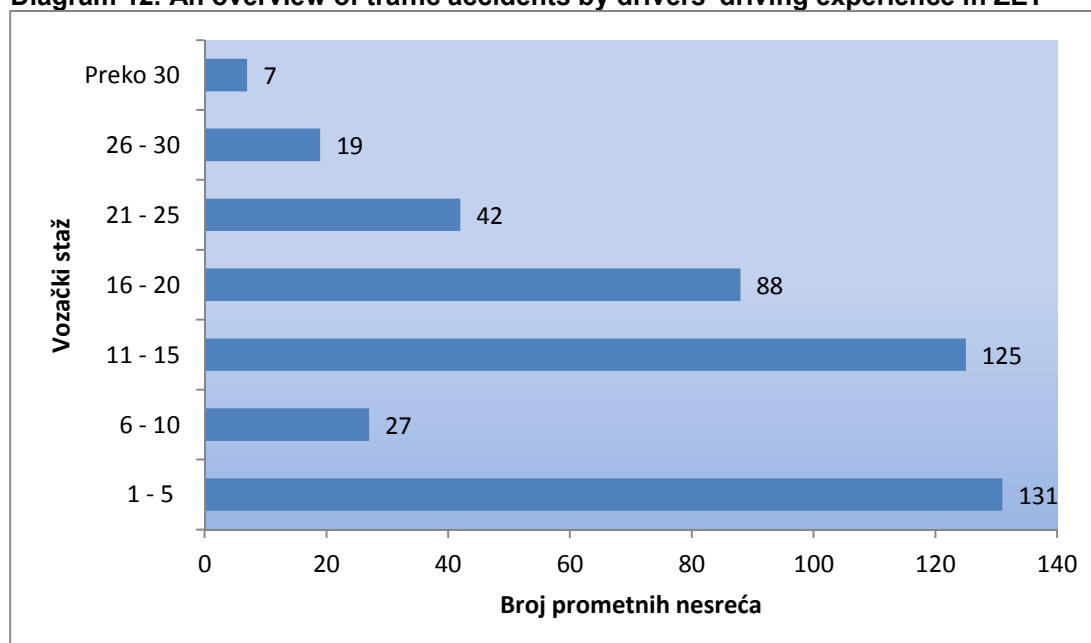
3. 5. The impact of driving experience and working hours on the occurrence of traffic accidents

3.5.1. Traffic accidents by drivers' driving experience in ZET

Table 19. Number of traffic accidents by drivers' driving experience in ZET

STAŽ VOZAČA	BROJ NESREĆA	BROJ VOZAČA	BROJ NESREĆA PO VOZAČU
do 5	131	23	5,70
6 - 10	27	75	0,36
11 - 15	125	150	0,83
16 - 20	88	182	0,48
21 - 25	42	204	0,21
26 - 30	19	232	0,08
preko 30	7	307	0,02
UKUPNO	439	1173	0,37

Diagram 12. An overview of traffic accidents by drivers' driving experience in ZET



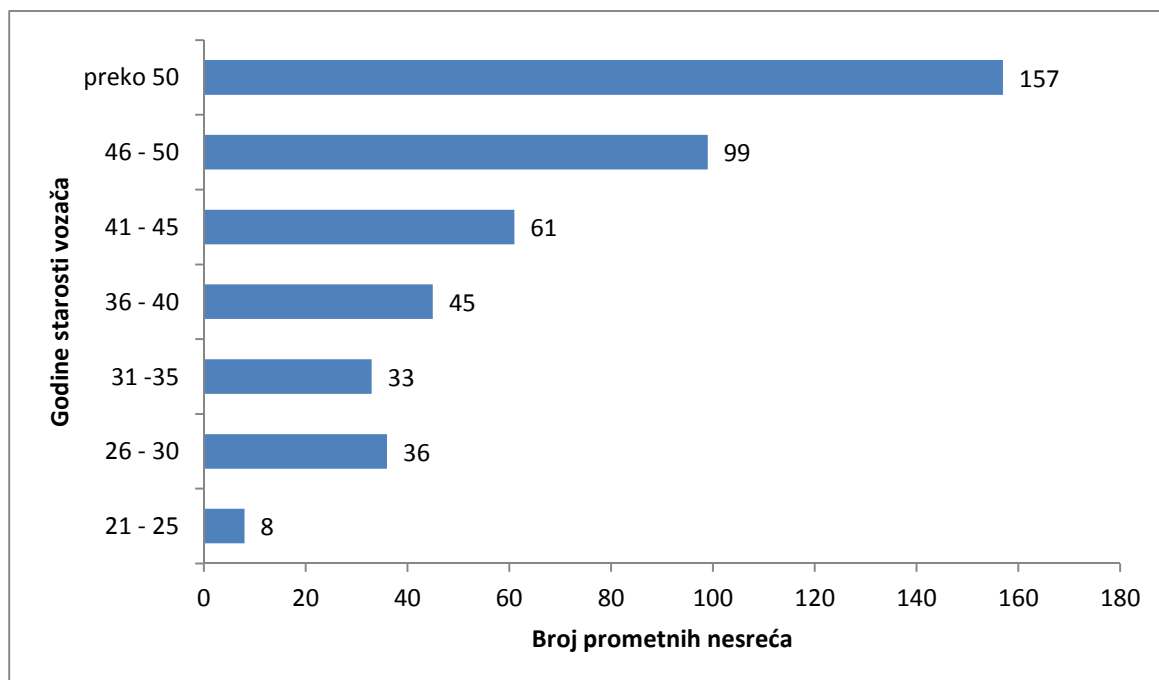
Pregledom podataka evidentno je da je najviše nesreća imala skupina vozača do 5 godina staža u ZET-u - 131 nesreća ili 29.84 %, te skupina vozača od 11-15 godina staža sa 125 nesreća ili 28,47% od ukupnog broja nesreća. Prema broju nesreća u odnosu na broj vozača proizlazi da su u najviše nesreća sudjelovali vozači do 5 godina staža (5,70 nesreća po vozaču), a slijede vozači 11-15 godina staža (0,83 nesreća po vozaču).

3.5.2. Traffic accidents by drivers' age

Table 20. Number of traffic accidents by drivers' age

GODINE STAROSTI	BROJ NESREĆA	BROJ VOZAČA	BROJ NESREĆA PO VOZAČU
do 25	8	13	0,62
26 - 30	36	46	0,78
31 - 35	33	76	0,43
36 - 40	45	147	0,31
41 - 45	61	231	0,26
46 - 50	99	269	0,37
preko 50	157	391	0,40
UKUPNO	439	1173	0,37

Diagram 13. An overview of traffic accidents by drivers' age



Iz podataka u tablici 20 vidljivo je da je s obzirom na godine starosti najviše nesreća imala dobna skupina vozača iznad 50 godina, 157 nesreća ili 35,76 %, te potom dobna skupina vozača od 46 - 50 godina sa 99 nesreća ili 22,55 %, a u najmanje prometnih nesreća sudjelovala je skupina vozača od 21 do 25 godina starosti, u 8 nesreća ili 1,82 % (dijagram 13). Ako usporedimo broj nesreća i broj

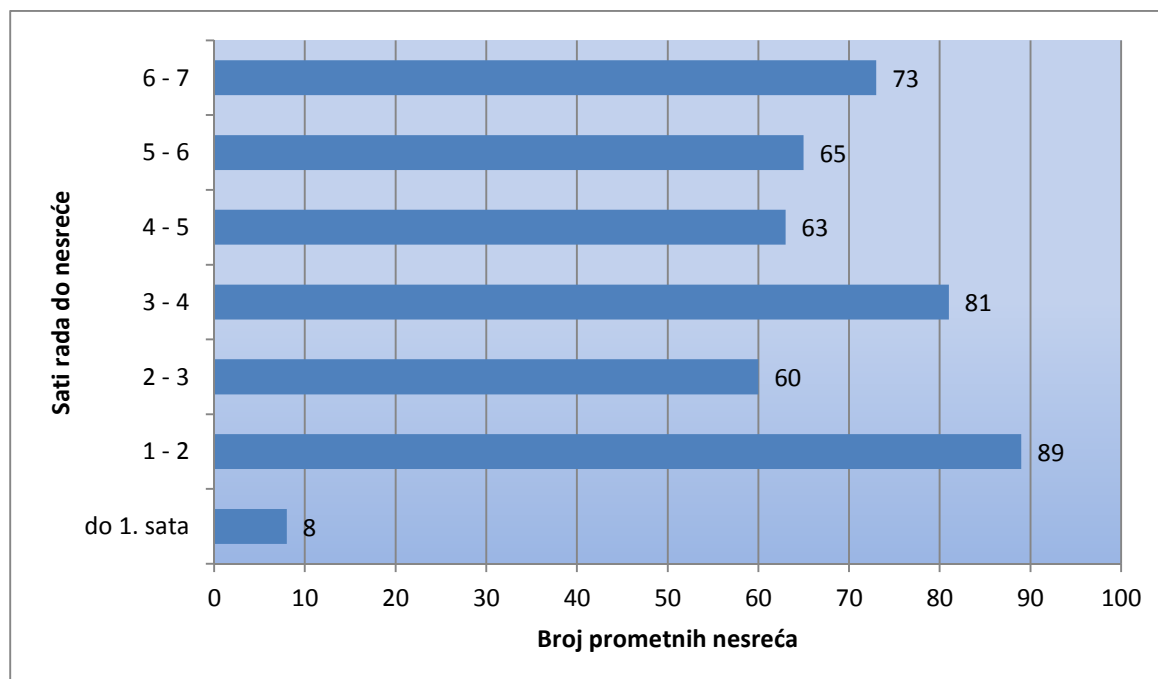
vozača proizlazi da su vozači od 26 – 30 godina starosti sudjelovali u najviše nesreća (0,78 nesreća po vozaču).

3.5.3. Hours of work until the occurrence of a traffic accident and drivers' age

Table 21. Relation between hours of work until the occurrence of a traffic accident and drivers' age

Sati rada	GODINE STAROSTI							Ukupno	%
	do 25	26 - 30	31 - 35	36 - 40	41 - 45	46 - 50	više 50		
Do 1	0	0	0	1	1	1	5	8	1,82
1-2	1	5	10	5	12	23	33	89	20,27
2-3	2	6	6	7	9	5	25	60	13,67
3-4	2	5	8	10	14	14	28	81	18,45
4-5	0	3	6	9	8	15	22	63	14,35
5-6	1	7	0	7	11	20	19	65	14,81
6-7	2	10	3	6	6	21	25	73	16,63
Ukupno	8	36	33	45	61	99	157	439	100,00
%	1,82	8,20	7,52	10,25	13,90	22,55	35,76	100,00	

Diagram 14. An overview of traffic accidents by hours of work until the occurrence of a traffic accident



S obzirom na sate rada do nesreće evidentno je da se najviše prometnih nesreća događa u razdoblju od 1.-2. sata rada - 89 nesreća ili 20,27 %, te od 3.- 4. sata rada kada se dogodilo 81 nesreća ili 18,45 %, što je i vidljivo iz tablice 21. i dijagrama 14.

Iz prikazanih podataka može se zaključiti da se najmanji broj nesreća događa u prvom satu rada - 8 nesreća ili 1,82%.

3. 6. Traffic accidents by drivers' shifts

Table 22. Number of traffic accidents by drivers' shifts

Pogon	Broj prometnih nesreća				
	PODSUSED	DUBRAVA	V.GORICA	U K U P N O	%
RANA od 4 – 11 sati	69	62	6	137	31,21
DVOKRATNA RANA od 6 – 9 i 12 – 17 sati	19	23	9	51	11,62
ČINOVNIČKA od 7 – 14 sati	3	4	0	7	1,59
SREDNJA od 11 – 18 sati	85	59	5	149	33,94
POLUKASNA od 14 – 21 sati	10	9	2	21	4,78
KASNA od 17 – 24 sata	33	27	5	65	14,81
NOĆNA od 23 – 5 sati	4	4	1	9	2,05
UKUPNO	223	188	28	439	100,00

Promatraju li se događanja nesreća prikazanih u tablici 22 s obzirom na vrstu službe vidljivo je da se srednja služba pojavljuje kao kritična s najvećim brojem nesreća – 149 nesreća ili 33,94%. Kako je najveći obim prometa tijekom trajanja srednje službe (vršno prometno opterećenje) sukladno tome veća je vjerojatnost pojave prometnih nesreća.

Vremenska raspodjela službi u danu također je bitno utjecala na broj prometnih nesreća, ponajprije u srednjoj službi, koja vremenskim trajanjem obuhvaća popodneвно vršno opterećenje, a i najzastupljenija je u odnosu na ostale službe.

Rana služba se nalazi po broju nesreća iza srednje sa 137 nesreća ili 31,21% zbog povećanog intenziteta prometa u jutarnjem vršnom opterećenju.

Najmanje nesreća se dogodilo za vrijeme noćne službe - 9 nesreća ili 2,05 % i činovničke službe - 7 nesreća ili 1,59 % što je i razumljivo s obzirom na minimalnu zastupljenost istih u odnosu na ostale službe.