[2] Lipovac, K., 2008. - Safety of Traffic, Public Enterprise Official Gazette of FRY Belgrade
[3] Law on Traffic Safety on the Roads of Republika Srpska, "Official Gazette of Republika Srpska", no. 121/12
[4] Law on the Basic Safety of Traffic on Roads in BiH, "Official Gazette of BiH", no. 6/06
[5] Law on the Safety of Road Traffic in Serbia, "Sl. glasnik RS ", no. 41/2009, 53/2010 and 101/2011
[6] Internal Annual Report of Republika Srpska MUP on Road Traffic Safety on Republika Srpska Roads for the period 2009-2013.
[7] Data from the Police Station for Traffic Safety Šamac for the period from 01.01.2009. until 31.12.2013. years
[8] Farmer, C., Braithman, K., & Lund, A. (2010). Cell phone use while driving and attributable crash risk.
[9] Violanti, J. M., Marshall, J.R., Cellular phones and traffic accidents: An epidemiological approach, 1999, Accident Analysis and Prevention.
[10] U.S. Department of Transportation. (2010). Statistics and Facts about Distracted
Driving.
[11] Rothe, P., Beyond Traffic Safety, Transaction Publishers, New Brunswick and London, 1994.
[12] Internet Addresses:
http://www.fvv.um.si/dv2013/zbornik/policijska_dejavnost/Obradovic_Magusic.pdf
http://blog.telekom.rs/internet/drustvene-mreze/kada-vozis-parkiraj-telefon-od-ideje-doviralne-
campaigns /
http://www.ams-rs.com/images/pdf/zakoni/Strategije_bezbj._saob._na_putevima_RS.pdf
http://www.abs.gov.rs/kampanje.html
http://www.mup.vladars.net/statistike_pdf/lat/2802042256377985.pdf

INNOVATIVE TECHNOLOGIES IN FUNCTION OF IMPROVEMENT OF ROAD SAFETY

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***Abstract**: The purpose of this paper is to show the importance of new innovative technologies and new technological systems of active safety of vehicles, in contribution to improving road safety and sustainable mobility. Data at indicators point to an increase in mortality and deterioration of road safety. Current measures applied have not contributed to the expected improvement and reducing the number of deaths in traffic accidents. After making inquiries, among 50 potential measures of application of innovative technologies, the most effective measures can contribute to a significant reduction in the number of road accidents and the number of those killed in these accidents. Given the expected effect, reducing the mortality individual use from 7 % to 30 %, the best prospects for the application of intelligent systems have to adapt speed, automated emergency braking, warning in case of leaving the lane, Alcoholic switch and a reminder to use the safety belt. The results of application indicate the potential for improving road safety and sustainable mobility. Implementation of new technological systems of active safety of vehicles requires the adoption of legislation and establishing minimum common standards of installation in all Member States.*

***Keywords:** innovative technological systems, traffic accidents, measures to improve.*

1. INTRODUCTION

The World Health Organization (WHO) announced the latest Global Status Report on Road Safety 2015, based on a road safety survey conducted in 2013 in 180 countries around the world. According to the report, it is estimated that 1.25 million people around the world annually, and millions have suffered long-term consequences for health (1).

Global, traffic accidents are the main cause of death among young people aged 15-29 years.
The estimation is that injuries in road traffic are currently the leading cause of death in all age groups, and are predicted to become the seventh leading cause of death by 2030. The relative indicators of road transport safety in low and middle-developed countries of the world are twice as high as in developed countries (24.1 / 18.4 and 9.2 dead persons per hundred thousand citizen). According to the indicators, the worst situation is in the countries of Africa (on average 26.6 killed by hundreds of thousands of inhabitants), while the European Union has 5.15 deaths per hundred thousand inhabitants in 2015. In addition to road traffic accidents, up to 50 million people are severely injured each year in road accidents. Data from the report indicate that mortality and grave injuries in low- and middle-income countries cause economic losses to 5% of GDP.

The estimate is that at the global level, the cost of mortality and injuries in road accidents is 3% of GDP (2). In response to this growing epidemic, the United Nations General Assembly adopted in 2010 Resolution 64/255 defining Decade Action for Road Safety (2011-2020), with the overall objective of reducing the number of road deaths by 50% worldwide to On the basis of this resolution, the European Commission adopted the 2011 White Paper, the Single European Space Plan - A Road to a Competitive Transport System within which to manage resources effectively (3). For the period up to 2020, the EU has set a very ambitious goal, reducing the number of road deaths by 50% starting from 2011. In the EU Member States, 500 people per week die in road accidents, of which the largest number of drivers, 105 pedestrians and 38 cyclists, and about 2600 people are seriously injured (4). According to the lowest number of people killed in road accidents, Sweden is ahead of 2.8 and Britain with 2.9 deaths per one hundred thousand inhabitants. On the European Union's assessment of the overall costs generated by the death of a person in a car accident is estimated at EUR 1.1 to 1.3 million. It is estimated that social costs (rehabilitation, health care, pecuniary damage, etc.) arising from fatalities and injuries on roads amount to at least 100 billion euros. The current stagnation of road traffic safety in relation to previous years is the reason for increased efforts and taking additional measures that will contribute to improving traffic safety.
Innovative technologies and technological advances are increasingly taking on the impact on road safety, with significant potential for future improvements in road safety, in particular in the area of active vehicle safety and automated and networked driving.

2. STATE OF ROAD TRAFFIC SAFETY

In order to improve the safety of road transport in the EU, the scope of activities is defined through seven strategic objectives: improving education, training and training of road users, enhancing incentives to respect traffic regulations, secure road infrastructure, safer vehicles, encourage the use of inventive technologies for increased traffic safety, improve emergency services for better care after a car accident and subsequent care and

increased protection of the most vulnerable road users, pedestrians, cyclists and motorcyclists.

2.1. Statistical indicators of road traffic safety in the European Union

According to the published statistical data (4), the number of deaths on EU roads in 2015 increased by 1% compared to 2014. These data confirm that European roads are still the safest in the world despite the current stalemate in reducing the number of fatalities. On the EU roads last year, 26,000 people lost their lives, 5,500 fewer than in 2010, and 135,000 were seriously injured, Figure 1.

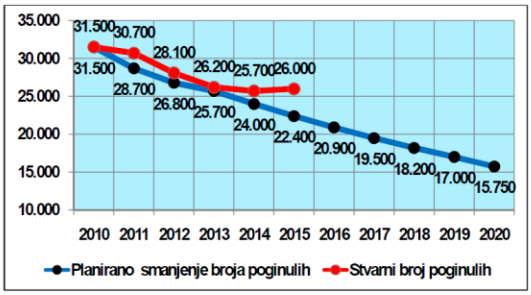

Figure 1. Planned and actual number of those killed on the EU roads 2011-2020. Source: (4).

The average mortality rate in the EU in 2015 was 5.15 killed in traffic accidents per 100,000 inhabitants. Tom's slowdown, which followed a significant reduction of 8% in 2012 and 2013, has contributed several factors, such as greater interaction between unprotected and motorized traffic participants in cities. Endangered traffic participants Pedestrians, cyclists and motorcyclists make up a large share of 135,000 people, according to estimates in traffic accidents. Statistics on the number of people killed in road accidents by EU Member States, Figure 2, show that there are still large differences between individual countries, although this difference is decreasing every year. Some countries that traditionally have a good effect have made weaker progress, and in the three Member States where most deaths have been reported, road safety has improved. The average mortality rate in road accidents in 2010 was 6.3 deaths per 100,000 inhabitants, while in 2014, Amounts 5.1, or 51 killed a person per million inhabitants, which is the best situation so far.

Countries with the lowest mortality rates in road accidents are Sweden with 2.7 deaths per 100,000 inhabitants; Netherlands with 2.8; Great Britain with 2.9; Denmark with 3.0; Malta with 2.6; Ireland with 3.6; Spain with 3.6; Germany with 4.3. Countries with the highest death rates in road accidents are Romania with 9.5 killed per 100,000 inhabitants, Bulgaria with 9.5; Latvia with 9.4, etc.

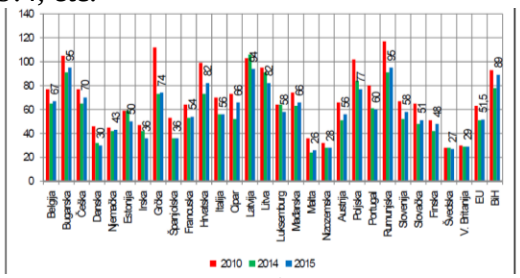

Figure 2. Number of deaths per 100,000 inhabitants in certain EU countries in 2010, 2014. and 2015.[14] Source: (4).

Comparing indicators of the current state of road traffic safety with indicators for the past decade, as well as indicators for 2010, shows that significant results have been achieved in reducing the number of people killed in road accidents on EU roads. However, the current stagnation of road traffic safety in relation to 2014 is the reason for additional measures. In order for the EU to achieve its goal and halve the number of people killed on the roads by 2020, it is necessary to continue to operate in areas where visible improvement can be achieved. Innovative technologies and

[14] Data for 2015 are based on preliminary data. There may be minor changes in the final data for individual EU Member States.

technological advances have increasingly taken on the impact on road safety, with significant potential for future improvements road traffic safety.

2.2. Statistical indicators of road traffic safety in Bosnia and Herzegovina

According to the available and collected statistical data on the road network of Bosnia and Herzegovina (BiH) in 2015, a total of 38,677 traffic accidents happened, which is an increase of 1.7%, (5.6.7.20) in relation to 2014. The trend of increasing the total number of accidents since 2013 continued in 2015, Figure 3. In the area of the larger entity in 2015, 28,978 traffic accidents happened, which is an increase of 6.5% compared to 2014 (5). The increase in the number of traffic accidents in 2013 continued in 2015. In the area of the smaller entity in 2015, 9,295 traffic accidents happened, which is an increase of 8.3% compared to 2014 (6). In road traffic accidents on the BiH road network in 2015 341 people died, which is an increase of 14.8%, or more killed for 44 people, Figure 4 (5.6.7).

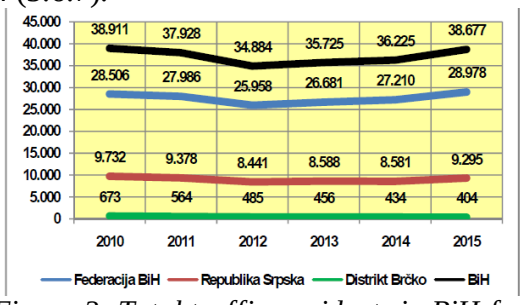

Figure 3. Total traffic accidents in BiH from 2010 to 2015 Source: (5,6,7)

In the area of the larger entity in 2015, 185 people died in road accidents, which is an increase of 14.9% and more deaths for 24 people in relation to 2014. (5). In the area of the smaller entity, in traffic accidents, 150 people died, which is an increase of 14.5% and more deaths by 19 persons compared to 2014 (6). In the Brčko District, six people died last year, an increase of 20% compared to 2014. (7).

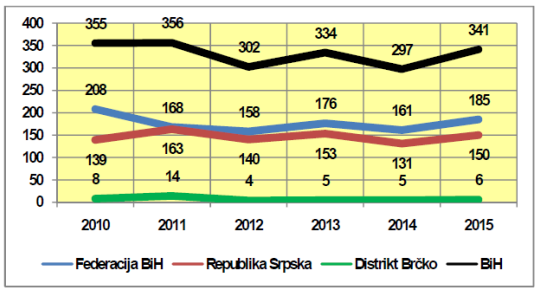

Figure 4. Number of persons killed in road accidents in BiH from 2010 to 2015 Source: (5,6,7)

In the area of the larger entity in 2015, 185 people died in road accidents, which is an increase of 14.9% and more deaths for 24 people in relation to 2014. (5). In the area of the smaller entity, in traffic accidents, 150 people died, which is an increase of 14.5% and more deaths by 19 persons compared to 2014 (6). In the Brčko District, six people died last year, an increase of 20% compared to 2014. (7).

In 2015, in BiH, in traffic accidents per 100,000 people were killed by 8.9 persons or 89 people per million inhabitants, Figure 5, and 2014 by 7.8 or 78 persons per million inhabitants. Compared to the EU average (5,15), this is in the ranking of Member States that have a high mortality rate in road traffic.

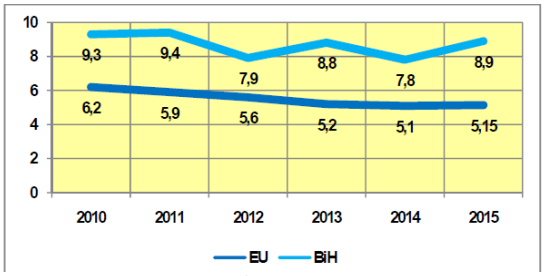

Figure 5. Number of deaths in the EU and BiH per 100,000 inhabitants from 2010 to 2015 Source: (5,6,7)

2.3. Features of the state of road traffic safety in Bosnia and Herzegovina

The comparison and analysis of data on traffic accidents and road traffic offenses 2015/2014 points to the following conclusions:

· There is a trend to increase the total number of traffic accidents, increase traffic accidents with heavier and more easily injured persons, increase traffic accidents with material
damage and an increase in the number of people killed,

· In relation to traffic accident participants, the most striking drivers are (2014 - 55.22%;
2015-53,37%), passengers (2014 - 19,53%, 2015 - 22,58%) and pedestrians (2014 - 25,25%; 2015 - 24,05%),

• in comparison with the age structure of the dead, two risk groups of persons who are the most dying, young / new drivers and persons aged 60 and over who are on average over one third of the total number of those killed are worrying,

· The most common causes of traffic accidents are unadjusted speed, improper performance of vehicle traffic, disregard of leakage rules and the advantages of passing and driving at insufficient distance, driving under the influence of alcohol,

· The most common offenses established by traffic control committed by drivers in traffic are disregard for speed limits, driving without the use of a seat belt, use of a mobile phone while driving, driving a vehicle under the influence of alcohol, driving an unregistered motor vehicle, driving a vehicle under the imposed protection measure and driving a vehicle without passed a driving test.

Based on the existing methodology of collecting and recording data on traffic accidents, it is not possible to seriously and thoroughly analyze and investigate particular features of traffic accidents, and participants in these disasters, nor to make comprehensive conclusions, in order to really determine possible causes and relationships among relevant variables, based on which could be proposed appropriate measures to improve the safety of road transport. Therefore, it is necessary to harmonize the methodology of collecting and recording data on traffic accidents with the EU methodology and the database on traffic accidents.

3. USE OF INNOVATIVE TECHNOLOGIES FOR ROAD SAFETY IMPROVEMENT

The increase in mortality on EU roads as well as on the BiH road network requires the implementation of new measures to stop the negative trend, since the measures currently in use did not contribute to the expected improvement in road safety. It is therefore necessary to review the impact of existing measures to improve road safety. Pursuant to the EU road safety policy guidelines for the period 2011-2020 and the General Safety Regulation (8), innovative technologies and research have a primary role to play in improving road safety in the future. There are over 50 potential measures that could be implemented, which depends on the cost-benefit assessment of individual measures and implementation possibilities. The most effective inventive technologies for improving road safety in the area of active vehicle safety can bring significant benefits, including Intelligent Speed Assistance (ISA), Autonomous Emergency Braking (AEB), a warning in case of abandoning the traffic lane (Lane departure Warning-LDW / LCA), Alcohol Interlocks, engine blocking devices if the driver is under the influence of alcohol and seat belt tie reminders system, which are needed as necessary technologies and already available on the market under effective conditions of use (9) The feasibility assessment includes two aspects:

technical and legislative: technical feasibility is not a problem, because technological solutions are available and depend on the degree of technical development.The legislative framework of feasibility is a problem because the test procedures and performance requirements are not legal
prescribed in order to encourage the identification and choice of solutions that effectively address security issues.

3.1. Intelligent speed adjustment

According to a new study[15] on the effects and feasibility of a range of new technologies and unregulated measures in the area of passenger safety and the protection of endangered road users (9), it is possible to use them in the function of improving the safety of road traffic. A special significance for use would be the ISA, whose application could have the effect of reducing road mortality by a fifth. Speed (improper and unfavorable conditions) is the primary cause of the events of about one-third of all traffic accidents, and over 50% of all traffic accidents with deaths and seriously injured persons (5,6,7,10,11,20). The appearance that drivers do not respect the speed limit is a very frequent traffic violation. According to the available data, between 10 and 50% of drivers do not respect the speed limit on motorways, between 10 and 60% on local roads and between 30 and 60% on roads in the settlement (12).

The ISA is a term that includes a range of devices that help drivers in selecting the appropriate speed and respecting the limitations. It is a technology that delivers speed limitation information to the driver's vehicle, which is being informed. Drivers receive information about the speed limit by a traffic sign via the communication system on the display, helping to monitor the speed limit for a given share. The information related to the speed limit for a particular location is identified on the digital map shown in the display. The information comes to the driver in one of the following three ways: informing the speed limiter driver (advisory), warning them when the speed is higher than the limit (warning) or actively helping the driver to respect the speed limit (help). The introduction of intelligent speed adjusting assistance will help to achieve a high level of compliance with speed limits, thereby significantly reducing road traffic deaths. Assessments by individual experts (13) show that using the ISA system, the risk of traffic accidents can be reduced in road traffic by 28.9% (33% in the urban area and 18.1% on motorways). In doing so, mortality can be reduced by 21%, and with constant use up to 46%. Analysis of the costs and benefits of using the ISA showed a ratio of 7.9 to 15.4 depending on the type of ISA system (14). In November 2013, the European Commission published a study [16]focusing on the effects of speed limitation on safety and the application of ISA. It also includes the results of the research in order to evaluate the tests at the European level. Consequently, the recommendations are to make regulations for the installation of the ISA system in all new commercial vehicles in accordance with the evaluation recommendations of the Study conducted for the needs of the European Commission, the system should be limited to 100 km / h for buses and 90 km / h for commercial vehicles, in accordance with existing EU regulations and the adoption of regulations for the installation of the ISA system in all new passenger cars.

[15] Study conducted by Advisors Transport Research Laboratory (TRL), UK, England

[16] The study is available at: http://ec.europa.eu/transport/road_safety/pdf/vehicles/speed_limitation_evaluation_en.pdf

3.2. A device that blocks the starting of the engine in case of driver's alcoholism

The European Commission estimates that at least 20% of those killed in traffic accidents on EU roads are related to driving under the influence of alcohol. An effective technological measure to prevent driving under the influence of alcohol is a device that blocks the starting of the engine in case of alcoholism (Alcohol Interlocks). It is connected to the ignition system and requires the driver to test the breath for the engine to start. If the driver has alcohol in the blood above the allowable amount, the engine will not start. In many EU Member States, this technology is voluntarily incorporated in passenger and cargo vehicles. More and more Member States are introducing this technology, such as France and Finland into vehicles for transporting school children. In Belgium, France, the Netherlands, Sweden and Finland, recidivist drivers, driven by alcohol-dependent driving, must have this device installed in the vehicle. The device is used as a quality solution in accordance with the established policy of improving the safety of road traffic related to the prevention of driving under the influence of alcohol. Based on the Study on Alcohol-Prevention Studies (15), it has been concluded that this technology solution can offer an efficient and cost-effective improvement in road safety in the EU, especially for drivers of commercial vehicles. The report goes on
states that, in the future, the cost of purchasing devices will be economically viable and this one
technology is being further developed and incorporated into all personal cars, this could be a huge net benefit for society. The study (16) also includes recommendations calling for the adoption of a law that would extend compulsory use of the device within a five-year period as part of the rehabilitation program of the target group of users, and as a special preventive measure for drivers of commercial vehicles. Consequently, it is recommended to introduce uniform EU standards to provide vehicle interfaces for the use of an engine-locking device, to pass a law for a consistently high level of reliability of the device to block the start of the engine, and as a first step of expanding the use of the device engine start-up blocking, legally stipulates mandatory use by professional drivers.

3.3. Reminders for buckling up and safety belts

The estimate is that annually 900 deaths could be prevented if all vehicles were equipped with a safety belt reminder on all seats. The safety belt remains the only most effective element of passive safety in the vehicle. Regardless of the legal obligation to use the safety belt in all 28 EU Member States (17), it is estimated that
it uses only 88% on the front seats and 74% on the rear seats in the countries that monitor the use (18). These figures are of particular importance, as research has shown that drivers who do not use a seat belt are more often involved in road traffic accidents with fatal consequences. The increased use of the seat belt can be achieved using a seat belt reminder. The seat belt reminders will alert passengers to use the seat belt on all seats, and alert the alarm to the need for belt buckling. The recommendations are to expand the mandatory installation of advanced seat belt reminders as standard equipment for all seats in vehicles and to introduce tensioners and boundary seat belt loads.

3.4. Accelerated Braking (AEB)

The automated sudden braking system (AEB) can reduce mortality by 7%. It has the best ratio of benefits and costs as a driver support system (19). All new EU commercial vehicles are equipped with advanced brake technology from 2013. Thanks to the requirements of the 2009 General Safety Regulation, the recommendations are to extend the installation of the AEB system to passenger cars, light trucks and vans, and to introduce autonomous braking systems that operate at all speeds, as well as those that can detect pedestrians and cyclists.

3.5. A warning when leaving the traffic lane

Studies conducted in the United States show that the warning system when leaving the conveyor belt can reduce the abandonment by 37%, and this technology is mandatory for heavy-duty trucks. Recognizes the markings on the road and activates the audible and visual light signal on the screen, or causes the steering shake. If the direction indicator is on, the system is not activated. The camera is usually located behind the rear view mirror at the top of the windshield. The pictures of the centered line (and some of the unmarked road edges) are continuously analyzed using a computer. At the same time, the speed of vehicle movement, steering position and vehicle position are analyzed. The combination of these parameters gives an indication whether the vehicle is leaving the traffic lane or not. In case of reduced visibility or coverage of horizontal signaling with mud, snow or similar, the system will send a signal of impossibility of assistance. It is recommended that the introduction of this technology is extended to personal cars, light commercial vehicles and vans.

4. CONCLUSION

In order to improve road traffic safety and reduce the number of dead in both the EU and BiH, innovative technologies play a significant role. Implementation of recommendations on the application of certain innovative solutions to active vehicle safety in legislative frameworks and regulations on the general safety of vehicles will enable the reduction of a certain number of traffic accidents and the number of people killed in these accidents and contribute to improving the safety of road traffic. The realization of the foreseen effects of the application of new technological solutions must be followed by consistent implementation in practice. In order to implement the recommended measures, it will be necessary to establish and adopt appropriate legal regulations, which will allow for the examination of application procedures for each measure, and give an estimate of the overall benefit and cost ratio according to the procedures and requirements of application. New technological solutions will also make a significant contribution to improving the energy efficiency of vehicles and reducing exhaust emissions, as well as improving sustainable mobility. By implementing and applying new technological solutions as a measure of active vehicle safety, it is possible to achieve the planned improvement of road traffic safety by 2020. Ultimately, this will have a significant impact on the integration, economic development and economy of Bosnia and Herzegovina and will ensure sustainable traffic and development for the future.

LITERATURE

[1] World Health Organization (2015). Global status report on road safety 2015 Geneva, Switzerland.
[2] Law TH (2009). The effects of political governance, policy measures and economic

growth on the Kuznets relationship in motor vehicle crash deaths. Ph.D thesis, University of London.
[3] European Commission (2011). White Paper, Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system. Brussels.
[4] European Commission (2016). Press release. Road Safety: new statistics call for fresh efforts to save lives on EU roads. Brussels.
[5] FBiH Federal Police Administration. (2016). Traffic Safety Information for 2015 Sarajevo.
[6] Ministry of Internal Affairs RSBIH. (2016). Data on traffic accidents and police measures for 2015 Banja Luka.
[7] Brcko District Police (2016). Data on traffic accidents for 2015 Brčko.
[8] European Commission. (2009). Regulation 2009/631 / EC of the European Parliament and of the Council of 22 July 2009 laying down rules for the application of Annex 1. Brussels.
[9] European Commission. (2015). Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the Fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users. Final Report. Brussels.
[10] Republic of Croatia, Ministry of the Interior (2015). Road Safety Bulletin 2014 Zagreb.
[11] OECD / ECMT (2006), Speed Management.
[12] ETSC (2010) PIN Annual Report Road Safety Target in Sight - Making up lost time.
[13] Carsten O., Fowkes M., Lai F., Chorlton K., Jamson S., Tate F., & Simpkin B. (2008), ISA-UK intelligent speed adaptation Final Report.
[14] Carsten, O. and Tate, F. (2005) Intelligent Speed Adaptation: Accident savings and cost benefit analysis.
[15] ECORYS & COWI (2014) Study on the Prevention of Drink Driving by the use of Alcohol Interlock Devices.
[16] http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/513993/IPOLTRAN_ET (2014) 513993_EN.pdf
[17] EU Directive 2003/20 / EC extends the obligatory use of seat belts to occupants of all motor vehicles, including trucks and coaches when a seat belt is available for the seat.
[18] ETSC (2014) Ranking EU Progress on Car Occupant Safety, PIN Flash Report 27.
[19] eIMPACT Project Results. http://www.eimpact.eu/download/eIMPACT_D6_V2.0.pdf
[20] S. Alispahic, T. Djuric, Xh. Podrimqaku. The impact of new technologies on road safety standards. XI. International consulting. Traffic and environmental problems of countries in transition from the point of view of integration into the European Union, 22-23. May, 2015, Vlasic, Travnik, BiH,