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## INNOVATIVE TECHNOLOGIES IN THE FUNCTION OF TRAFFIC SAFETY AND ENVIRONMENTAL PROBLEMS OF COUNTRIES IN TRANSITION

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*Summary:* The process of transportation is a process with which it's possible to take control with the use of intelligent transport methods, which is especially related to the safety management, which would significantly reduce the number of dead, hurt people, as well as material damage. As part of the ITS, intelligent vehicles are being developed, intelligent roads, wireless 'smart' cards to pay for transportation, adaptive systems of crossroads, more efficient public transportation, automated answering and positioning of vehicles in accidents, biometric systems of passenger protection, etc. The bottom line of ITS is to integrate some solutions, starting from common ITS architecture, and well developed specification systems. The EU considers an important part of their transportation policy, the research of resource efficient transport that takes care of environmental protection in all types of travel. "Smart, green and integrated transport" has been determined as the main challenge of financing the project within the EU research project "Obzor 2020", in the period of 2014.-2015., which strives to ensure that Europe is always in the loop with technological progress in transport.

*Keywords:* transport, intelligent transport systems, traffic safety, environmental policy, sustainable development.

### Introduction

The sector of transportation was the key initiator of economic development and transition of the country. Traffic is the cornerstone of European integration and is tightly connected with creating and finalizing the inner market, which in turn increases employment and economic growth. As one of the first areas of common policies of today's EU, traffic is considered the key to accomplishing the three of four freedoms of the common market.

In the past 60 years, the development of traffic in the EU has progressed immensely and still has great importance for the wellbeing and employment in Europe. In the transport industry now, there are 10 million people employed, which makes 7% of the entire number of employed people in the EU, and they, in a similar percentage, contribute gross to the domestic produce (BDP), 40% of public investment and almost 30% energy consumption. Good traffic connections are very important for the EU economy, in matters of export – transport makes 90% of outside market in the EU. In the past few decades, the changes in European traffic politics brought

on the expansion of the internal market of the EU, by opening national markets on which public monopolies have prevailed, like it was the case with the air and rail transport. The expansion, modernisation and the infrastructure coordination across the EU have a fundamental importance for creating networks across the borders without any obstacles for different types of travel. Because of that, the policy for trans-european networks has been built into the Maastricht Treaty from 1992. Furthermore, with the treaty, requests for environment protection have been regulated, as help for the completion of the internal market.

Also, the purpose of the transportation policies in the EU is to help people and protect them in the time of travels, which is one of the accomplishments for insurance and protection of the travelers. However, the traffic doesn't pose a problem itself, but this problem appears in occurrences, relations and activities of the human society. The safety system is very complex, precisely because of the width of the problems, which vary by kind, nature and way of influence.

EU's goal is to create a european space of road and traffic safety during the 2010-2020 decade and to improve the safety of road traffic and with that to contribute to the sustainable mobility.

According to the statistic for the year 2012, there was more than 27.7000 dead and 313.000 severely wounded on the roads of the Union. That decrease of 9% in comparison to the modest 2% in 2011, means that we can hope to achieve the goal according to which the number of dead on the roads will be decreased by the double by year 2020, even though for the

achievement of that goal, the Commission considers that the yearly decrease has to at least reach 7%. With time, the transport systems will become bigger and more complex. From the transport, bigger amounts of travelers and goods, and at the same time fulfillment of ecological, timely and financial limitations are required. The whole process of the transport is being optimized so that the time needed for the transport is as short as possible, and the needs of storing the goods are reduced. In order to accomplish the mentioned requests, more intelligent transport systems are being used, which allow the use of information and communication technology. The transport process is a process with which is possible to manage with the help of intelligent methods.

With that, it's possible to increase permeability of existent traffic infrastructure with relatively little investments insofar as the amount is compared with the amount of needed investments for the extension of existing traffic infrastructure, by constructing new roads. Within ITS, intelligent vehicles are being developed, intelligent roads, wireless 'smart' cards to pay for transportation, adaptive systems of crossroads, more efficient public transportation, automated answering and positioning of vehicles in accidents, biometric systems of passenger protection, etc. The bottom line of ITS is to integrate some solutions, starting from common ITS architecture, and well developed specification systems. Cities that have organized public transportation don't have the possibility anymore to perform its' function without the use of ITS. ITS makes it possible, not only to support the functioning of public transportation, but it

changes its' functioning, and that contributes the more efficient public transportation, successful problem solving in traffic conduction and performing passenger transport in cities. In the western European countries, the implementation of ITS are led by big companies that construct motorized vehicles together with universities in technical domains. Countries in transition have technologically outdated elements of transportation systems. Those elements, regardless of how outdated they are, represent the basis of progression and with correct planning and management, the needed technological level of inclusion to the integrated transport process can be achieved. However, environmental and technological possibilities limit the progress of intelligent transport systems. The modern society has a need for integrated transportation system based on a fast, available and safe infrastructure which offers services to individuals, as well as business companies.

The development of intelligent transportation systems gives an opportunity to the use of advanced technologies into the systems and on methods of transportation for efficient, comfortable and safe highways, railways, waterways, airports, harbours and connections between these different types of transport.

## **I SAFETY OF ROAD TRAFFIC IN BOSNIA AND HERZEGOVINA AND THE WORLD**

### **1. The basics of safety of road traffic in Bosnia and Herzegovina and the world**

Road traffic is one of the important characteristic of the modern civilization. All the benefits of this phenomenon, sadly, we still pay for with a high price of unneeded human suffering. Road traffic represents a part of an all-inclusive traffic system, which is a significant factor of social happenings, because it's an inseparable follower of the progression of the modern society and today, it represents the most common aspect of wide and individual transportation, thanks to the advantage which it has in regard to the other aspects of traffic. The traffic doesn't pose a problem itself, but this problem appears in occurrences, relations and activities of the human society. The safety system is very complex, precisely because of the width of the problems, which vary by kind, nature and way of influence. Because of that it's hard to maneuver this system, because all the elements cannot be covered entirely. For efficient approach of goals and activities which will lead to decrement of the cause to the occurrences of traffic accidents, it is necessary to have reliable results of the analysis and checked foundings which will contribute to a safe environment for all users of road traffic. A plan and goals of activity in the field of safety are needed to create strategic, operational and additional activities.

## 2. European strategy on safety of road traffic

The safety of road traffic has become a part of global policies in all countries, and especially the countries of western Europe. After a line of individual activities of subjects who were in charge of safety of road traffic and achievements of certain, brief results, it came to a conclusion that without a systematical and continual implementation of measures, there is no achievement of long lasting goals. Therefore, countries of the European Union have set up a goal that, by the end of 2020, out of one hundred thousand residents, the number of dead would be decreased to six.

The management of traffic safety (management of risks in traffic, that is traffic accidents), represents a big challenge for every country because of the complex and diverse contexts of activities and specifics in prevention of traffic accidents. The data from year 2014 show that the number of dead in traffic accidents in the EU is about 25.700 people. In comparison to data from the year 2010, the decrease of numbers of dead in traffic accidents is evident, by about 17,5% in the past few years. At this pace of the decrease of dead in traffic accidents, in year 2020 the number of dead in traffic accidents would be around 20.000 people. In order for the planned goals until the year 2020 become reality, it is necessary to undertake additional actions. Because of the goal plan fulfillment in road traffic the European Union, through the European Commission, continually suggests new directives with measures to increase safety in traffic. In the basis, new regulations on traffic safety of the European Union are in place, which should raise the

level of safety. Also, as directives and guidelines, ways of their realisation is being continually followed, and new changes and additions are being reacted to.

## 3. Starting base strategies on safety of road traffic in Bosnia and Herzegovina 2008-2013

With the strategy on safety of road traffic goals, development and functioning safety systems of road traffic of Bosnia and Herzegovina are being defined, and that is the expression of her commitment to be a part of the regional and global systems of safe traffic. The strategy treats interests of the country, safety goals, safety risks and challenges, the possibilities of the country Bosnia and Herzegovina to react on those risks and challenges, as well as the system structure of the country safety of road traffic.

The starting base strategies of road traffic in Bosnia and Herzegovina (2008-2013) have been done according to the request of the Council of ministers of Bosnia and Herzegovina, and that came from the need for professional exploration and determining the conditions and factors which decide the place and role of the safety of road traffic in Bosnia and Herzegovina. Road traffic in Bosnia and Herzegovina is regulated on country and entity levels, and with passing the country law on safety in traffic on roads in Bosnia and Herzegovina, this segment of traffic has to define and realize on a country level, certainly helped by entity institutions (ministry of transport, ministry of internal affairs, ministry of education, ministry of healthcare, directorate for roads and others).

Equally, the safety in traffic as a dynamic system, expresses the need for adequate initiative undertaking and measures in the next time period, as a natural continuation of research in frame of the safety systems, which implies the opening of processes and securing the systematic, thematic research.

#### **4. The condition of traffic safety in the world**

From the start of organized traffic up until the year 2014, in traffic accidents around 40 million people have died, and during 2014 traffic accidents were the tenth cause of people dying in the world. Following the data from WHO - The World Health organization, in the year 2014, 1,119 million people have died in traffic accidents in the world, and the fact that a big number of the hurt people are left with lasting health consequences has to be pointed out. Also, according to the data of The World Health organisation, in newer time more than 1.5 million people die in traffic accidents each year, and about 15 million are injured. In some countries the number of dead in traffic accidents is 4% of all dead, that is albeit 50% dead from the population group of 15-24 year olds. According to the report of the World Health organisation under the name 'World report on road traffic injury prevention' from the year 2015, has predicted that the yearly expenses for traffic accidents in countries of Central Europe and Eastern Europe in economic transition will make out to be about 1.5% of the expected gross national produce, and in the Western European countries, the highly motorized countries about 2% of the BND.

#### **5. The conditions of traffic safety in the European Union**

According to the available data in the safety segments of road traffic, the total number of traffic accidents in a period of 6 years is about 30% smaller than the number of traffic accidents in the year 2007, and it counted 24.680, that is about 8.500 traffic accidents less in comparison to the same year. Such a change in reduction of the number of traffic accidents had a consequence of the reduction in the number of victims in traffic accidents, dead as well as injured people.

#### **6. The conditions of traffic safety in Bosnia and Herzegovina**

Looking at the segment of dead in traffic accidents in Bosnia and Herzegovina with adequate measures in the time period from the year 2008 to 2013, the number of dead people has decreased from 429 to 312, that it there was about 117 less dead people in year 2013 compared to the year 2007. Forward mentioned data of the betterment of the degree of safety in road traffic in Bosnia and Herzegovina until the year 2013 show that BiH is amongst the countries with a medium number of traffic accidents and number of dead in traffic accidents in Europe. On the roads in Bosnia and Herzegovina in 2014, 35.344 traffic accidents happened. In those accident 297 people have died, while the number of injured people was 9.956. As in the majority of countries, in Bosnia and Herzegovina the younger and older population is exposed to a high risk in traffic. During the last year, 2014, 500 more accidents have been registered compared to the year 2013, which, expressed in



percentages, shows the increment the total number of traffic accidents for 1.40%. The number of traffic accidents with dead/injured people is also increased, and that is 158 traffic accidents or 3.37%. When talking about traffic accidents with material damage, in the last year 937 more traffic accidents have been registered compared to year 2013, or percentage wise that is 3.25%. Looking from the aspect of the total number of traffic accidents by entities/district, it is noticeable that the death rate is bigger in Republic Srpska and it consist of more than 15 dead people on 1000 traffic accidents, in the Federation of BiH it's a little bit less than 6 dead people on 1000 traffic accidents while in Brcko Distrikt there is a bit more than 11 dead on 1000 traffic accidents. Looking at the up front mentioned, with a special review on the facts that in during the last year the number of traffic accidents has been increased, that the number of dead in traffic accidents decreased, but it came to the increment of the number of seriously injured people by 32 people, that is 1.9%, and the number of slightly injured people by 317, that is 3.9%, that the sale of new cars has been decreased, and the import of older, used cars has been increased, you come to the conclusion that the condition of road traffic in our country is still unsatisfactory.

## **7. Measures for resolving the causes of traffic accidents**

For taking efficient measures and activities that will lead to the decrement of causes of traffic accidents, it is necessary to have trusted analysis results and checked findings that will lead to a safe environment for all users of road traffic. The measures

can be different, and the measure plan has to be logical and it has to have a source of the main, concrete issues.

### **7.1. Preventive measures in decreasing the number of traffic accidents**

In Bosnia and Herzegovina a fast tempo of motorisation development has been realized, and that is calling for changes in the behaviour of all participants in traffic. Preventive-educational work with all participants in traffic is of great meaning for attaining and raising the traffic-technical culture to a higher level at all. When pedagogical measures are in question, creation and development of humane relationships between all participants in traffic is needed, and after that the development of moral norms, ethical value and the development of needed consciousness about solidarity in traffic.

### **7.2 Regulated and organized measures in decrecement of the number of traffic accidents**

Regulated and organized measures imply the activities that are being taken for suppression of negative occurrences in traffic, regulation and organisation measures of traffic on roads.

### **7.3 Short- and long-term strategic measures of safety in road traffic**

The safety of road traffic has, undoubtedly, become a part of global policies of all countries, and especially the countries of Western Europe. Without systematic and

continuous implementation of measures there is no achieving of long-term goals. For joining the European Union, it is needed that Bosnia and Herzegovina accepts the directives and guidelines which require the countries that are members, to increase the safety of road traffic.

**Strategic measures on safety of road traffic** need to orientate on the these activities:

- Decrement of the strongest consequences of traffic accidents in the conditions of the constantly growing traffic,
- Bringing Bosnia and Herzegovina into the appropriate group of European countries, according to the number on the dead people on the streets compared to the number of residents, or in 100.000 registered vehicles.
- Significant increment of modern, repressive activity of the police and according preventive action.
- Raising the awareness of people about the problem of safety in traffic via media companies.

With quality measures, the decrement of number of dead, severely and slightly injured people has to be achieved, and it has to prevent the growth of the total number of traffic accident.

## **8. The conditions of road infrastructure in Bosnia and Herzegovina and the perspectives of development**

The road network of BiH is amongst the less developed ones in Europe. The old age of asphalt roads in BiH is about 30 years ,

and the density of the network is 0,414 km/km<sup>2</sup>, that is 4.69 km/1.000 of population which is 2.5 to 4 times less than in the countries of Western Europe. Also the roads of Bosnia and Herzegovina are behind on technical indicators, elements of the route, as well as on extended and transversal profiles compared to the roads in well developed countries. The participation of shares of the roads with the curtain width of 5,0m makes out 26%, and even on 41.5% of shares, there is an existent slope bigger than 6%, while on 14 shares the slope is bigger than 10%.

## **9. Legal legislative in the area of road traffic in Bosnia and Herzegovina**

Recently, Bosnia and Herzegovina has implemented a framework traffic policy for the period from the year 2015 to the year 2030, so that the door can be opened for financing the build of new projects from the EU.

BiH puts the railway Sarajevo-Belgrade on the top of the priority list, over Tuzla and Zvornik. The plan is to better the connection Sarajevo-Belgrade with a railway and the nomination of a part of the railway from Trebinje to Montenegro, as well as the close up of Luka Bar.

### **9.1. The construction of the Adriatic-Ionian highway**

The construction project of a part of the Adriatic-Ionian road through Bosnia and Herzegovina is 117 kilometers long. This way, the region will be connected between each other, primarily Bosnia and

Herzegovina and Croatia, but other countries as well - Montenegro, Serbia, Macedonia, because the Adriatic-Ionian highway will connect countries from Italy, Croatia, Bosnia and Herzegovina, over Montenegro, Albania.

A highway that would connect Budapest and Osijek, Sarajevo with Ploce has a great significance. The highway in Bosnia and Herzegovina is 335 kilometers long. Up until now 91 kilometers of the highway has been built on two shares. Tracin - Zenica West and Zvirovici - Bijaca. The construction of two more subshares, 3.10 kilometers long (Biljesevo-Gorica) and 2.9 kilometers (Gorica drivusa) is under way.

The EU emphasizes that from year 2030, the region has to connect between each other, and therefore has to adapt to the transportation network of the EU. However, to ensure the resources for that, the EU is expecting the continuation of the reforms and quality preparation of the projects.

## **10. Action safety plan of traffic in Bosnia and Herzegovina 2011-2020**

The action plan is focused on the construction of the institutions of local capacity development and the key factors of risks, so selected actions can be started.

### **Key goals:**

1. 7% of the yearly decrement of the final number of dead compared to the previous years (around 50% decrement in 10 years)

2. 7% of the yearly decrement of the number of accidents caused by excessive speed compared to the previous year.

3. Increase rate of the use of seat belt (safety belt) by 80%, by the end of the year 2013, and 90% by the end of the year 2015.

4. Decrement of the percent of dead pedestrians by 30% by the end of the year 2015, and 17% by the end of the year 2020.

5. Incidence of accidents caused by driving under the influence of alcohol decreased by 7% each year compared to the previous year.

## **10.1 Pillars of the action plan in Bosnia and Herzegovina 2011-2020**

### **Pillar 1: Management of the plan in Bosnia and Herzegovina 2011-2020**

Safety of road traffic is a multisectoral question which requires a multidimensional system of management, and appropriate technical and financial resources which would enable the responsible agencies to develop and implement appropriate strategies, policies and plans, and to coordinate different actors involved in road safety on all levels.

### **Pillar 2: Infrastructure**

The infrastructure plays a key role in the safety of road traffic. Quality projection of the road traffic can help the people to use roads in a safe manner, and it can decrease the risk of accidents. Within this pillar, the plan will focus on engineered solutions that will decrease speed through the measures of 'calming traffic' and managing speed, especially in zones with high number of wounded on the road, like schools and

residential areas, in built zones and areas of linear villages along main roads.

### **Pillar 3: Safe vehicles**

Improvement of safety in a collision and safety in vehicles are proven factors for the decrement of dead and wounded people on roads. In the past few years, it came to a significant progress in safety of vehicles which protects travelers and other participants in traffic, and it better the ability of avoiding a collision.

### **Pillar 4: Safe behavior of road users**

Within this pillar, the plan focuses on the main factors of 'risks'. That includes low rates of safety belt usage, fast driving, driving under the influence of alcohol, and inadequate safety objects for pedestrians.

### **Pillar 5: Nourishment after an accident**

It is a high possibility that it can come to death from a serious injury due to the impact, in road traffic in FBiH. The non-existence of a unique number for the emergency service and uncoordinated saving action can result to being late in providing emergency treatment to the critically injured victims. Every ten delayed minutes in pulling out a seriously injured victim from a damaged vehicle, can decrease the chance of survival by 10%. The key principle is that the injured receive initial condition stabilisation in time of the golden hour (that is the first hour after the injury) and that the number of trained people in first aid, that are often on the road, increases.

## **II ROAD INFRASTRUCTURE**

### **1. Traffic policies in the EU**

Traffic is the cornerstone of European integration process and is tightly connected with creation and it increases the employment and economic growth. As one of the first areas of mutual policies of the modern European Union, traffic is considered to be crucial for the realization of three from four freedoms of common market.

In the last 60 years the development of traffic in the EU has significantly progressed and traffic still has a great importance for the welfare and employment in Europe. In the transport industry there is 10 million employed people, which makes 7% of the whole number of employed people in the EU, and they contribute the similar percent to the gross domestic product (BDP), 40% of public investments and almost 30% of energy usage. Good traffic connections are very important to the economy of the EU, in matters of export -- the transport makes 90% of foreign trade of the EU. In the last few decades the change in European traffic policies has contributed to the expansion of the EU internal market, opening national markets which used to be prevailed as public monopoly, as it was the case in air and rail transport. The expansion, modernisation and harmonisation of the infrastructure across EU has a fundamental importance for creating overborder connections without obstacles for different types of traveling. Because of that, the politics of transeuropean connections are built into the Maastricht contract from 1992. Apart from that, according to the contract requests for environment protection as a helper for the

completion of internal trade have been included into traffic politics. Also, the purpose of traffic politics of the EU is to help people and to keep them safe i times of traveling which is one of the accomplishments for insurance and safety of rights of the travelers. EU is the first and only region in the world whose travelers enjoy comprehensive and integrated basic rights in all modes of transport. The end goal is to create a unique, european traffic space which will help Europe to stay competitive with the increase of efficiency of the whole transport sector for general welfare.

## 2. Infrastructure

Traffic infrastructure in Europe is currently unevenly developed. In many countries, which have recently become full members of the EU, built high speed lines do not exist and the connections of their highways are on average less developed than in the countries who are old members. To that, it is needed to develop the missing connections, a big part of the european traffic infrastructure needs to be expanded and upgraded.

It is the goal of the transeuropean traffic connection, or of the TEN-T: longlasting and ambitious project for modernisation and ‘‘joining’’ the existing, separated national connections into a functional network, with which all the parts of Europe are connected, while the different types of transportation are being used in the best way possible.

EU is planning, inside of TEN-T, to establish a central network by 2030, which will fulfill the missing overboarder

connections and make the network ‘smarter’, and with the deadlines they will make sure that the implementation of all projects which contribute to the establishment of the central network which has priority.

The goal is to gradually ensure that until the year 2050, a big part of the population and companies in Europe isn’t more than 30 minutes away of traveling to the extensive network. Beside the easier and faster traveling, with that network the traveling will be ensured to safety with less traffic jams.

### 2.1. Innovations and sustainable developments

EU considers the research of efficient resource transport to be important to their traffic policies with which they take care of the environment protection with all sorts of traveling. ‘Smart, green and integrated transport’ is proven to be the main challenge of financing the projects within EU, and for researching the ‘Horizon 2020’, for the years 2014-2020, which seeks to ensure that Europe always is in the loop with technological progress in traffic.

The technological progress represents the base of the future european transport and the transport industry will, thanks to that, be among the most compelling industries in the world. It represents the key to the reduction carbon emissions in traffic because with the innovations and progression, it can contribute to the efficiency - airplane and car motors, for example, or replacing the energy source based on oil. Road traffic is one of the examples of how, with implementing

innovative technologies, the drives can be helped with the reduction of spending fuel and lead them to available parking spots and help them evade traffic jams and collisions.

## 2.2. Pollution caused by traffic

While in cities, thanks to the big bus, taxi and delivery van fleets, which are used in city areas, it's possible to influence the widespread use of alternative fuels and energy sources, in many rural areas the needed infrastructure is missing. The EU strategy for promoting clean fuels in traffic speaks of it, whose goal it is to promote their breakthrough on the market, which by now wasn't able to breakthrough because of their insufficient infrastructure for charging batteries and fueling, and because of the high cost of fuel and low acceptance between the users.

## 3. Investing and Financing: The instrument for connecting Europe

The construction and upkeep of the infrastructure is an expensive venture. It is expected that the development of the needed infrastructure, needed for satisfying the foreseen growth of traffic need in Europe, will cost 1.5 trillion EUR by the year 2030. It's estimated that only by the year 2020 500 billion EUR will be needed for finishing the transeuropean network, and about half of that amount will be needed for the removal of the main narrow gorges. With the TEN-T<sup>1</sup> network, the connections will transform, the narrow gorges will be removed, the infrastructure

will be updated and the overboarder traffic operations will be coordinated. The resources for transportation in the IPA<sup>2</sup> include a big part of the money only for the poorest regions in the EU.

With that amount, a better connection to the east and west will be better secured and the development of the most important connections inside and in between those countries. That way, the completion of the transeuropean transport network will be established, especially the planned central networks.

## 4. Future challenges

- The growth of demand for traffic is expected (only for cargo transport, the demand will grow by 80% by 2050.) and the trend of urbanization will continue.
- The transport sector of the EU, especially the road traffic sector, almost completely depends on oil as a source of fuel. Considering the irregular markets of oil and the possible future hardships with the supply, it is needed to find trusting alternative fuels.
- The EU has committed to decrease its emissions of greenhouse gases by at least 80% by 2050. As a main source of pollution responsible for a fourth of emissions of greenhouse gases in the EU, the transport sector has to make a significant contribution at reaching that goal.
- One of the worst traffic problems is the condensation, especially on roads and in air traffic. The

<sup>1</sup> TransEuropean Network

<sup>2</sup> Instrument for pre-accession assistance

condensation costs Europe yearly about 1% of its BDP and causes big amount of emissions of carbon and other non-gaseous emissions.

- It is needed to increase the efficiency of traffic, which includes and upgrades logistics and development of a smarter 'behaviour while traveling', with the optimal utilization of modern systems of the IKT and satellite technology.
- While a significant progress towards the completion of the inside market has been realized in the department of traffic, in some sectors, like the road and railway traffic, it is needed to continue working on opening a market and ensuring a fair and open market competition.

### III MOTORIZED VEHICLES

#### 1. Vehicles as active participants in traffic

A motorized vehicle is described with two main characteristics:

- A product intended for wider usage, that is in traffic, and
- A product with a very complex structure (very complex technical system)

And because of that, motorized vehicles at an exceptionally big rate do affect the safety of traffic, that is the safety of people, the quality of living and work environment and economical interests of society. On the other hand, the abrupt development of the automobile industry is inevitably followed by a string of problems, like: constant

increment of the number of traffic participants, **increment of the number of technically defective vehicles**, increment of the number of traffic accidents, big material and non-material damage and consequences, as well as a string of other economic damages and consequences. Because of multiple influences of motorized vehicles on the economy of the society, but also on other vital interests of the society, in matters of safety, motorized vehicles are with a reason among the most dangerous technical systems of common usage.

#### 2. The influence of technical states of vehicles on traffic safety

There is a big number of '**technically defective vehicles**' that influence traffic safety. It's a worrying fact that from the total number of vehicles which participate in traffic, about **40%** is 'technically defective vehicles, and the growth trend continues. A contribution to this assertion are undisputed facts: expressed commercialisation of traffic, constant increment of the number of traffic accidents, bit material and non-material damages and consequences, increased economic damages and consequences, etc. On the other hand, the technical condition of vehicles is constantly changing - getting worse and all that **without settled laws**. With the act of technical deterioration state of vehicles, every vehicle is with automatism and without anyone's will or influence classified in more numerous group of 'technically damaged vehicles' and as such, in that group, they are treated as potential dangers, that a factor with harmful influence on '**general traffic safety**'. Because of that the technical-exploitation demands are being vitaly

imposed: professional training of influential factors in traffic, on time and quality information, quality use of traffic, social aspect, decrement of harmful influences, rigorous control of technical functionality of vehicles and others.

### **3. Technical - Exploitation demands**

The exploitation of vehicles is a special technical process which has its own parameters and demands. The basic demands of this process are:

- **Good technical condition of motorized vehicles, and**
- **The use of only technically functional vehicles in traffic**

During the exploitation of vehicles, their condition changes - gets worse, so its existence is entirely realistic, ie its being imposed through other very important and influential technical-exploitation demands, such as:

- Increment of professional competence of the drivers, but also others,
- On time and correct information about the state and condition in traffic,
- Quality and sophisticated handling of traffic,
- The social aspect - quality and safe living and working conditions,
- Minimal harmful influence of outside factors (the circumstance and condition of the roads), etc.

## **IV INTELLIGENT TRANSPORT SYSTEMS**

### **1. Informational transport systems**

In a world of expansion and usage of informational technologies, intelligent transport systems are more frequently used in all sorts of transport. These systems have found a wide use in road traffic (active and passive security of vehicles, automated following of vehicles, charging tolls...) The last four decades have marked a sudden increase of the number and complexity of electronic systems in cars. The participation of electronics in today's cars makes even 25% of the total production cost. Analysts estimate that more than 80% of innovations in the car industry is based on electronic systems. The term intelligent transport system represents a system of measures and technologies on a national level, whose goal it is to increase the levels of safety in traffic, more efficient unfolding of traffic with less hitches and decreased levels of pollution of the environment. The use of ITS applications, which are a constituent part of vehicles, in the most number of cases need to help the driver in times of driving and to decrease the risk of creating a traffic accident. These systems, in most cases are used as a prevention of traffic accidents, but they are used as well for reduction of consequences of traffic accidents. According to the placement of the informations being transmitted to users, we differentiate these:

- Intelligent transport means
- Intelligent roads

The functions of intelligent transport means, with a goal of preventing traffic accidents, help the driver to evade or



forestall a traffic accident using the systems which are placed in the vehicle and which estimate the nature or meaning of the threat, considering the condition of the driver.

Intelligent roads represent systems which are a part of the equipment on roads, and are used for increasing the safety in traffic and betterment of the efficiency of the traffic system. Depending on the roles in the system, we differentiate a few types of ITS based on infrastructure:

Systems to manage traffic on roads, systems to control traffic, systems to inform the travelers, systems to manage traffic on intersections, systems of pedestrian safety etc.

Considering that ITS help with removing negative influential factors on safety of vehicles and travelers, their effect can be looked at from two separate segments of vehicle safety, and those are:

- a) active safety, and
- b) passive safety.

By which, every of these segments has many influential factors, which is hard to number. The use of ITS in active and passive vehicle safety has a wide spectre and covers almost all segments.

### Active vehicle safety

From the aspect of vehicles, the basic elements of active safety are:

- Driving safety (the possibility of timely and trustworthy management and braking, acceleration and similar others),
- Conditional safety (comfort driving: comfortable and ergonomic

seats, noise and oscillation of the vehicle, ventilation and air conditioning),

- Safety of managing and handling (trustworthiness of the system: tires, brakes and management systems),
- Timely observation, under which we can count signalisation equipment and lighting, visibility through the drivers glass (defrosting, drying and the wiping of windshields, acoustic signals for warnings and alarm).

### Passive safety

The main function of passive vehicle safety is:

- Decreasing the consequences of injuries of the drivers in case of a traffic accident,
- Decreasing the consequences of injuries of the other traffic participants, including pedestrians.

## 2. Cooperative systems in traffic and transport

### 2.1. What are cooperative systems?

It is possible to define cooperative systems as a combination of technologies, people and organisations which eases the communication and coordination needed for a random group to efficiently perform different activities for the realisation of the common goal, and to reach a use of all members. Cooperative systems in traffic and transport are systems in which a vehicle, wirelessly communicates with another vehicle, with infrastructure (roads

and following equipment) and other users (pedestrians, VRU<sup>3</sup> and others.) In regard to other existing systems, the technology of cooperative systems enables a two-way communication: V2V - vehicles with vehicles, V2I - vehicles with the infrastructure, V2U - vehicle with other users (f.e. VRU), I2U - infrastructure with other users (f.e. VRU). This approach is coming close to natural communication of more participants on a job.

## 2.2. Autonomous systems in traffic and transport

Transport systems are becoming bigger and more complicated. It is required from transport for bigger amounts of travelers and goods to be increased fulfilling the environmental, weather and financial restrictions. The whole process of transport is being optimized so that the time needed for transportation is as short as possible and the needs for storage of goods is as little as possible. How all these requirements can be fulfilled, the intelligent transport systems are being used more and more, which enable the usage of informational and communicational technology. The process of transport is a process which is possible to be managed using the intelligent methods. With that it's possible to increase the permeability of the existing traffic infrastructure with proportionally little investments, if the amount is compared to the amount of needed investments for the extensions of the existing traffic infrastructures by making new roads. As of right now, the needed traffic managing systems require constant observation of operators and the ability of using new

managing methods by the knowledge of the operator. A possibility of communication of such systems with other traffic managing systems is limited.

## 2.3. Location information in traffic

Cooperative intelligent transport systems, C-ITS include advanced technologies which make it possible for vehicles and the surrounding infrastructure to share the three main informations (of location, speed and direction) with other users of C-ITS. These informations are used for the advancement of the traffic system, but they can, with the use of equipment in the car, contribute to the optimized vehicle management (maximal efficiency, energy saving and other). Problematics of the dynamic location elements of the traffic system, primarily vehicles, is one of the main challenges of C-ITS. The location question and it's precision includes a global and local aspect, the absolute location of elements, but above all their relations of all participants of C-ITS system. Therefore are the all-present solutions based on global navigation systems., GNSS (Global Navigation Satellite System) are facing a new challenge which, for an effective solution, will need a row of innovative and advanced location technologies.

## 2.4. Virtual Road Train

Intelligent vehicles and intelligent roads make different ways of traffic, compared to those which we know, possible for drivers. The virtual road train is one of the innovative services which is being offered to the drivers and travelers in road traffic,

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<sup>3</sup> Vulnerable Road User

using cooperative systems. Compared to a real train, the connection between vehicles in traffic in a virtual road train is communication. Communication, sensor and management technologies make an invisible communication between cars possible which then act as a road train. The column of a few cars, without extra intervention from the drivers, autonomously and on a safe distance make traffic possible, one behind the other. Such a concept in the traffic system offers a bit potential of betterment of the flow, decrement of traveling time, increment of comfort and decrement of gas usage and CO<sub>2</sub> emissions.

## **2.5. The significance of communication in cooperative systems**

The needs for mobility in everyday life lead to a continued increment of traffic which generated serious problems in matters of pollution, safety and environment influence. However, information and communication technologies (ICT) offer advanced solutions for today's traffic problems. Today's communications represent a backbone to the development of intelligent transport systems (ITS), that is cooperative systems from the traffic sector.

In the past few years, the accent was put on the research of intelligent vehicles, which wirelessly communicate with one another and/or with the infrastructure, and with other users. Such cooperative systems backed by information technologies and mobile communication can increase the quality and reliability of the accessible

information about vehicles and traffic infrastructure, movement and placement of vehicles and the traffic surroundings.

## **V SUSTAINABLE MOBILITY**

### **1. Mobility and transport**

In the past four decades the mobility of European citizens have reached a completely new level:

In 1970, on average we traveled 17km daily, and today it's 34km daily.

Taking a look on the past 20 years, we see that there has been a lot done in view of european traffic policies: long lines on the borders are a distant past, increased safety of rights for the travelers, larger safety rules have been introduced to the people who work in the transport sector (pilots, bus drivers, trucks etc.) and with that, the safety of travelers grew; with the encouragement of the competition in air traffic and the establishment of precise standards for safety in air traffic, airplanes are being used more and more as means for public transport; the increased number of connections of the fast railway (from 1,024km in 1990, to 6,830km in 2011.) enabled faster and shorter travels with the train; constant attention on the conditions on the road and vehicle safety by using new technologies for safety in traffic, they halved the number of dead in traffic. Also, sea traffic has endured significant improvement in view of increasing the amount of cargo which is being transported by this type of transport, as well as in view of the decrement of accidents (2010/2011 13 thousand tons of oil has been poured out into the sea, compared to the 100 thousand tons recorded in the period of 1980/1990) and bigger security for tourists and people

who travel because of business using sea traffic.

## 2. What is sustainable mobility

Sustainable mobility implies active devotion for changing the way of transport, habits and behaviour of travelers with the goal of decreasing negative consequences of transport for the public, ecology and economy, as there are:

- Air pollution, which results in climate changes;
- Traffic jams;
- Traffic accidents;
- Degradation of urban environments (decrement of space for pedestrians due to the increase of the number of vehicles);
- Exploitation of land (bigger construction of roads and infrastructure).

From the social point of view, transport is sustainable when it's accessible to people with disabilities and impaired mobility, when a possibility exists for alternative ways of transport (f.e. Fast information over the phone or internet, better connection of public traffic, construction of infrastructure for bicycle transport or moving on foot...), decreasing traffic jams and better safety for travelers. From the aspect of environment safety, sustainable mobility implies the decrement of pollution and noise, while from the economic aspect, it implies the decrement of expenses for the use of public transport, individually or in a group.

## 3. Future Challenges

The main challenge which will affect the development of traffic policies in the decades to come are:

- Aging of the population and bigger requests for mobility of older citizens,
- Migration and the inside mobility of citizens,
- Bigger urbanisation of towns and globalization,
- Sustainability of the environment and energetic challenges due to the decrease and lack of fossil fuels.

For solving these problems, the European Union directs its public policies in the traffic section towards modern styles of transport, integrated and easy technologies which are attainable to all citizens, with the focus on needs and rights of users and workers of this sector.

### **The goal until 2050: leaving the need for vehicles which use traditional fuels in Europe**

Until the year 2050 the ejecting the need for vehicles which drive on traditional fuels. This is one of the goals of green transport which has been launched by the European commission, with a special desire to decrease the dependency on oil which today amounts 96% and the goal to, by the year 2050, decrease the emission of CO<sub>2</sub> between 80 and 95%. To be able to fo this, the European Union has to decrease the usage of vehicles which emit carbon dioxide by 60%. This process will get going in a few steps by 2030. The years of passenger vehicles and vehicles of public

traffic which emit pollution will be halved, and cargo transport will use eco-friendly fuels. Also, the middle and long travels for both goods and people will be redirected from road to rail and water traffic. In that context, the European commission has set up a goal of a three times stronger connection of the fast railway by 2030. The number of road vehicles with the need of alternative fuels has risen since 2009 by 5%. The majority of these vehicles use liquefied petroleum gas (LPG) while with electric vehicles only 00,2%. The introduction of electric vehicles (EV) and hybrid electric vehicles (PHEV) is still very difficult in Europe. The main factors which are influence are: high prices of electric vehicles, decreased acceptance on the side of users and the lack of space and stations for fuel supplement which represent a vicious circle.

#### **4. Sustainable plans of urban mobility**

A sustainable plan of urban mobility is a plan of local authorities for solving the problem of city transport efficiency. It is based on existing practices and laws of countries who are members, and its key characteristics are:

- Participatory and integrated access
- Pledge for sustainability
- Clear vision with goals and measurable results
- Oversight of transport expenses and acquires

The policies and measures defined in a sustainable plan of mobility has to include all forms of transport attainable in the whole town area: public and private,

passenger and freight, motorized and non-motorized, as well as traffic and parking.

#### **5. Smart cities**

A smart town is based on six main forms: economy as a competitive system; mobility as an attainable and sustainable transport integrated with new technologies; environment as a security and advancement of natural resources; people in terms of a social capital; way of life as a social cohesion and quality life; government which implies the participation of the citizens in public policies. With the liberation of the transport sector, it came to an increase of competition with big use to the citizens of EU who travel. However, it is necessary to implement legislation in the EU about the rights of travelers and an even more efficient fight with unfair practices and irregularities.

#### **6. Top 10 best systems of public transport**

Public transport is the key for a successful solution for traffic in big cities. Individual transport of automobiles implies a following infrastructure (highways, by-passes, parking spots, etc.) traffic jams, air pollution and noise pollution, problems with existing road and street infrastructure which has to receive bigger loads with the increase of the number of citizens, etc.

Considering that public transportation makes a backbone of a functional city gives an overlook of 10 best examples of public transport systems in the world, selected by

the site AskMen. With this overlook, the Big Dig project is being represented - the construction of the tunnel in Boston which needed to relocate the highway from the center of town.

### No.10 - Metro in Copenhagen

The metro in Copenhagen, capital city of Denmark, was finished in 2002 and was connected with the railway system S-train which connects the capital city with the suburbs and the rest of the country.

Apart from the metro, Copenhagen has public bicycles as well which are rented when you leave money and get it back after you return the bicycle. In 2006 this metro had a percentage of reliability of 98-99% with passenger wagons which are known for their hygiene, which also is directly connected with the exceptionally high level of culture of the Danish. Metro relies on an automated system of stopping - ATS (Automated Train System) which with the help of computers manages the whole system in a safer and more efficient way.



**Copenhagen**



**Berlin**



**Hong Kong**



**New York**

### No.9 - U-Bahn, Berlin

The underground railway (subway) in Berlin is made up of 132km of tunnels. The metro is connected with the S-Bahn, the above-ground railway which connects Berlin with other parts of Germany. The complete network of tunnels has availability to the networks of operators of mobile telephony. The train comes into the station every two of five minutes, both in rush hour as well as outside of it.

### No. 8 - Hong Kong MTR

About 90% of people transport in Hong Kong happens in public traffic, and the biggest part is in metros - MTR (Mass Transit Railway). With the metro, which is 172km long, daily there is about 7 million people who ride it, and the trains are known for their punctuality. The doors of the wagons have platforms which increase security for the passengers who are entering the train. Buying the Octopus Card is very known option, a card with which a traveler can limit the amount he wants to spend on transport, parking, fast food on metro stations, etc. Also, a full coverage of 3G network for mobile phones and computers is provided.

### Honorary Place - Portland, Oregon

This is one of the newest systems of public transport in the USA. It is made of buses know for their punctuality, easy railway, trams and cable cars, in the central zone of town the bus rides are free. The town is known for advances cycling and good bicycle track coverage. Apart from personal bicycles, the citizens and visitors can ride with bicycles as part of public transport.



### No.7 - Metro in New York

The New York metro is one of the icons of the town, like the Statue of Liberty. It's over 100 years old and today it has a total amount of 375km of railroad. In the system there are also express lines, and the metro works every hour of every day in the year. After 11th September, security in the metro has been significantly increased, and together with that, hygiene (it was also know for the graffiti). The system is daily being used by 4.5 million people.

### No.6 - Metro in Paris

Alongside 110 years of tradition, the 214km of railroad with the shortest stations in the world, the Paris Metropolitan Metro is distinguished and the biggest metro station in the world - Chatelet les Halles. Daily, 4,5 million people ride it, and it covers a bigger area from the one on which the travelers can use Navigo Card (charge card). The system of transport in Paris includes buses, the fast railway (RER) to suburbs, but also Velib - a system of public bicycle transport. The buses have an advantage compared to individual transport with automobiles, while other think that the metro isn't reliable like in other towns, especially when traditional strikes of french workers happen.



Paris



London



Seul



Taipei

### No. 5 -Metro in Seoul

The Metropolitan metro in Seoul daily drives 8 million people on lines 287km long, which are connected to public bus transport. This metro is especially known by their relationship to the travelers: daily notifications on LED screens (on English as well), Wi-Fi connection, robots which give information, etc. It's not surprising because South Korea plans to, in the period between 2015-2020, to have a robot in every household and their set up in the metro is just a big test for this idea.

### No. 4 Tube in London

Tube, the well known metro in London, is the oldest and longest in the world - the complete network of underground lines has 400km. In 2007, it was recorded that this metro has brought millions of travelers together. The metro is connected to other railway systems out of town, including Docklands Light Railway (light rail) which drives the passengers by the Thames. Tube is characterized by upholstered seats, LED information screens, but also occasional delays. Of course, the metro is covered by the famous London system of CCTV cameras which cover the whole town.

**Shanghai metro** - is made of classic underground and light railway. It was opened in 1995 and today is one of the most modern systems with the fastest advancement in the world. It has 268 stations and over 420km of rail which is at the same time the longest system of city rails in the world. During 2009, daily it drives 3,56 million passengers and noted a record of 6,46 million people.

### No.3 - Taipei MRT

The metro in Taipei, Taiwan, is one of the most expensive metros constructed in the world. However, this has been paid off, because for three years now, it's being valued as the best metro in the world as to safety, reliability and quality. MRT offers its passengers information on four languages. In the metro (on the stations and trains) it is forbidden to smoke, eat, even chewing gum. The passengers on the metro gave it a score of 95,5% on tidiness. Apart from the metro, the public transport system in Taipei includes a system of ropeways with a total length of 4km which daily drives 1,1 million travelers on the relation between the zoo - suburbs of Maokong.



**Moscow****Tokyo****No. 2 - Moscow metro**

This is one of the oldest systems of underground city railways and one of the most affected in the world - it drives over 7,5 million passengers daily. The metro in Moscow has a total length of 293km, and it's known for the representative stations which distinguishes a high level of hygiene but also the architecture which is worth to see. However, maybe the best characteristic of the Moscow metro is the efficiency. Many think it is the best in the world, because sometimes it reaches to even 40 trains an hour. Apart from all, this metro is known for the small number of accidents and for many it represents the best metro in the world.

**No.1 - Metropolitan metro, Tokyo**

The underground railway in Tokyo drives 8 million passengers daily, and is a part of the big railway network with a total length of 27.270km. The seats in the trains have seat warmers, notifications are on Japanese and

English, and it's said that it's impossible to see trash. The Tokyo metro is known for its precision, lack of vandalism and crime, and on the platforms there are marked places where the train doors will be when it stops on the station. However, the popular scenes seen on Youtube in rush hour, workers in white gloves will literally push you into the crowded wagon.

**Big Dig**

Big Dig is the unofficial name of the projects for the construction of the tunnel in Boston, which should relocate the highway 93 out of the center of town. The total length of this road under Boston is 5,6km, and the project was followed by the construction of the tunnel Ted Williams (the connection of the highway 90 to the airport), the bridge over the river Charles and the 'green line' Rose Kennedy Greenway on the place of the former route of highway I-93.



Big Dig was the most expensive project of highways in the USA. Even back in 1995, it was estimated that the expenses will be 2,8 billion dollars then, but the price came over 8,08 billion dollars (14,6 dollars of value in 2006). In July of 2008, Boston Globe wrote that the interest amounts 7 billion, which will raise the total price to 22 billion dollars, and the missing payments will last until 2038.

Many assumed that something like that can just happen, and one congressman even

asked: 'Isn't it easier to raise the whole town instead of letting down one highway?' Beside the price, the project was followed by arrests and charges worth half a billion dollars because of the poor work done.

The park Rose Kennedy Greenway, opened in 2008, long about 2,4km and is actually made of parks and public surfaces in the center of Boston, on the place of the former highway I-93. It represented the final phase of the project Big Dig. However, the park is still not done, even after announcing on speakers in 2001 that it will happen in 2005. The construction of a building for culture on this move was planned, but those works have been delayed because of the crisis and the production of a space for urban analysis.

## **7. Environmental policies of the EU and sustainable development**

### **7.1. Environmental policies of the EU**

Environmental policies in the EU has an important place in the activities of the EU. The European association has only at the beginning of the seventies of the 20th century started to undertake more intensive and political actions in this area, which is coinciding with the growing trend or raising awareness about the significance and global consequences of problems of the environment.

The protection and advancement of the environment is more and more becoming the first plan of the EU policies with clearly positioned goals: preservation of the environment and betterment of its quality; protection of human health; careful and rational use of natural resources; advancement of measures on a international level for overcoming regional and global problems of the environment.

The international association also correctly notices the danger from different types and aspects of harming or threatening of the environment. In that directions today, in international circles, a unique base in the direction of achieving "sustainable development" of the environment has been set up according to the economic and social needs. That is the new social relationship with the environment, spca and natural resources with full awareness of existing responsibilities in front of future generations.

## **8. Sustainable development in countries in transition**

### **8.1. How to achieve sustainable development in countries in transition**

The transition doesn't take place on a space and in surroundings which are completely new and unburdened, but it includes a complex task of reformulations of old social and economic relations. A new, capitalistic system would have to be constructed on leftovers of old and ruined communist systems. Furthermore, the sustainable development in countries in transition would have to use it a good bit, because it didn't have access to anything else. Breaking the communist regime in 1989, countries of eastern Europe have walked into a hard and complex period of transition. This process included, before all, a political democratization of the country and community, as well as the transition to trade economy. In the beginning, in the countries of postcommunism and in the west it was considered that it was enough to pass through political and economic models of west European countries and that will in a reasonable time period ensure a full advancement towards the western economic and political system.

The level of change acceptance was also different from the public. Balkan countries have faced a low level of the transition acceptance, as an inevitable process, for many years (both, from ruling elites, as well as the public), and the wars in this area of former Yugoslavia have considerably affected the process of transition to flow slowly with many sacrifices. The mentioned reasons have led to today, after almost two decades, it is hard to find common threads which would unite the experiences of all countries in transition. Because of that, the stigma of economy in transition has to be understood literally, more like a regional-territorial, than a social and economic entry.

The transition, towards trade economy the way it happened in the countries of central and eastern Europe, covered all the meaningful political, economic, social and other institutions, affecting among all, the use and management of natural resources as well. For this segment of the transition, the most meaningful mechanisms were next.

The process of transition leads to change of the whole value system. Changed of the economic and social system values, among all, bring different expectations and uses of natural resources in the future. Based on the experience of countries who are finishing their transition process it can be talked about four phases through which the ruling perception of resource use is changing, today.

The first phase represents a period of centrally planned economy before political and economic changes. In the second phase, which matches the first years of transition, it comes to a crash of marketing channels, for inputs as well as for placement, and crushing lawful and institutional structures needed for any kind of economic activity. Old structures are ruined, and new ones have to be built. This phase is characterized by institutional changes, liberalisation,

restructuring and (usually) inflation. The subvention system is cut or majorly lowered, as well as the demand on market, which leads to an unfavorable relationship between the input and output. This unfavorable economic climate affects the environment favourably.

In the third phase, which is characterized by establishing new rules in economy and society, and by forming new institutions, the system of the environment is still under reduced pressure. The chronic lack of capital still isn't allowing the economic activities to recover fast, which would affect the environment. What is characteristic for this phase is the renewed 'finding' that the problem of protection of the environment exists. The transition is finished with phase four, whose characteristics are set up policies of environment protection, institutions and systems of managements of natural resources and the environment.

## 9. Dimensions of sustainable development

Sustainable development, as it was described in the previous chapter, doesn't represent only the environmental question. Three aspects of sustainable development have been determined, ie:

- Economic sustainability
- Environmental sustainability
- Social sustainability

The first aspect implies the economic growth and development, the second includes the integrity of the ecosystem and care of its capacity and biodiversity, while the last one includes values like equality, competence, availability and participation of individuals in social life. Apart from these three components, the leading principles of the sustainable spatial development of the european continent are introducing a fourth dimension, that is cultural sustainability. Cultural sustainability is made of normative eco-

development which appreciate the plurality ‘local, that is economic, cultural and social specifics.’

The term sustainable development is usually being brought in with protection of the environment, planning of social development, ecologic, economic and political questions. The concept of sustainable development represents a new developmental paradigm, new strategy and philosophy of social development. In that context, the term ecology is often wrongfully considered protection of the environment.

Ecology is a science which deals with studying the interpersonal relations between living being and the outside environment, and the protection of the environment is just a small segment of it. Actualities of the term sustainable development especially contribute challenges, which come with endangering the environment. The economic growth isn't without risk, because if the economy grows too fast, it can come to the exhaustion of resources and pollution of the environment. Sustainability of the economic growth in conditions of exhausting the natural resources is more and more complicated.

## **VI HUMAN RESOURCES IN TRAFFIC**

### **1. Managing human resources**

Human resources are one of the most recent and the most publicized themes of the 21st. century, imposed by challenges of the ‘new economy’ - economy of knowledge, economy which is global and which is in a constant fight with uncertainty and changes. That ‘new economy’ was made as a new direct consequence of a big progress of computer science technology, science

and technology in general, changing the characteristics of the work environment, which compared to the sixties and seventies of the 20th century become more and more complex. The interdisciplinary concept of managing the human potentials is showing a need for recognizing the human factor as the most important resource in the company. The work environment imposes a high need for active participation of companies and creating changes, as well as the need for fast adaptation of permanent and new business conditions. So the question becomes, how to make it possible, how to make a company creative and adaptable with the goal of surviving in the trade market - humans. So, for any company and its success, capabilities, knowledges and creativity of its workers are crucial. Introducing the concept of ‘managing human potentials’ in companies in departments of traffic, the paradigm of the content of work and ways of organizing personnel functions is changed. With that the workers, people, are becoming a key factor in the business success. For managing human resources, it is important to set up a vision, mission and policies of the company which is considered to be the best matching business goal that fits. The company policies imply each aspect of business, and with that the policies of managing the human resources. The role of human resources is key and special, for which there is a need for education and implementation of new technologies for management of crucial significance.

### **2. Employees as the most important resource in companies**

Statements known as ‘For the success of the company all workers have to contribute, but failure occurs mostly because of poor quality handling. ‘. The workers are the most important resource in the works of a company. the quality of a service which is provided to the users depend on the

engagement of the employees. Apart from the services which are the most important, we can mention a few more employee influences like usage, efficiency, productivity and rentability of other resources which are used in the company and which are in the most part depending on human resources which work with them. Because of that it's needed for all companies to define the methodology of managing than human resources as a foundation for long term, strategic planning of human resources on objective showcases. long-term planning of human resources implies processes, procedures and methods which have the goal to describe , analyze, predict and plan in the which way the human resources will progress the company so they could secure the realization of the organizational goals and realization of the company on a turbulent trade market. With this base act, the foundation areas of human resources are covered and brought on inspection methods and techniques which they use from the moment of attracting the candidates, and through their career path in the company to the department of the employees into retirement.

The management methodology of human resources determines and defines:

- Recruiting candidates from the labour market
- Employment, progression and movement,
- Selective procedure (procedure of choosing candidates),
- Organisational orientation,
- Estimation of work success,
- Exit interview

The base in 'Methodology of managing human resources' makes the organisational orientation. Organisational orientation is a structured process with which new employees transform into efficient members of the company. It refers to newly employed and prentices. It's being implemented in three phases, which don't

have to happen one after one another, but they can happen at the same time, depending on the work and capabilities of the new employee:

1. Socialisation of the new employee into the work environment
2. Introduction into the job, and
3. Confirmation in the job.

Socialisation starts at the very coming of the employee into the company, and its structure and length depends on the work space, work in chronological organisation which the employee will do and the skills, knowledge and capabilities of the person. The direct manager has a job to give the new employee a warm welcome and basic information about the organisational unit and importance of the job which he will be doing, and to take him to his work spot, introduce him to the mentor and work colleagues. Mentoring in every company is an important segment of management of human resources which you cannot neglect and in whose development every member of the company has to participate, and with that making it possible to develop further and develop the company itself. The importance of mentors in development of a new employee doesn't end with writing a report about the work of the new employee, but it continues further. Findings that the mentos owns about the new employee can help the direct managers a lot in grading the work success of the employee.

## Conclusions and recommendations

On the streets of Bosnia and Herzegovina in 2014, there were 35.344 traffic accidents. Like in the majority of countries, in Bosnia and Herzegovina the older and younger population is exposed to a high risk in traffic. During 2004 and 2005, about 14% of death cases and 27% of injured in Bosnia and Herzegovina in traffic, was at the age of under 24 years. During 2005, up to 40% of injured were younger people. The

statistic in traffic accidents on roads of Bosnia and Herzegovina is in the process of development and currently there are only basic indicators available. For taking efficient measures and activities which will lead to the decrease the causes of traffic accidents, it is needed to have reliable analysis results and checked findings which will contribute to a safer environment for all users of road traffic. The measures can be very different, and the plan of the measures has to be logical and it shouldn't spring out of the nub of the concrete problematic.

**Strategic measures of safety in road traffic** have to orientate to the next activities:

- The decrease of the hardest consequences of traffic accidents with conditions of growing traffic,
- Bringing Bosnia and Herzegovina into the appropriate group of european countries according to the number of dead people on roads with regard to the number of citizens or with regard to 100.000 registered vehicles,
- Significant increase of modern repressive acting of police and appropriate preventative action,
- Raising awareness of the citizens to the problem of safety in traffic via media companies.

The action plan is focused on constructing institutions for developing local capacity and on key factors of risks, so that certain activities can be started.

**Key Goals:**

- 7% decrease of the total number of dead in regards to the past year (about 50% decrease in 10 years)
- 7% decrease of the number of accidents caused my speeding in regards to the past year

- Increased rate of using the safety belt by 80% by the end of 2013, and 90% by the end of 2015.
- Decreased percentage of dead pedestrians by 30% by the end of 2015, and 17% by the end of 2020.
- Incidence of accidents caused by driving under the influence of alcohol decreased by 7% each year in regards to the previous year.

In the past decades, changes in the European traffic policy have contributed to the expansion of the internal market of the EU, by opening national markets on which public monopolies have prevailed, like it was the case in ai and rail traffic. Expansion, modernisation and convergence of the infrastructure in whole EU have a fundamental importance for creating overborder networks without obstacles for different types of traveling. Because of that, the policies of trans-european networks have been implemented in the Maastricht Treaty in 1992. Besides that, by the contract, requests for securing the environment have been included into the traffic policies as a help to finish the inner market. Also, the purpose of traffic policies in the EU is to help people and keep the safe in times of travel, which is one of the accomplishments for security and protection of people's rights. The transport systems are becoming bigger and more complex. It is requested from transport to have a bigger quantity of travelers and goods, and in the same time to fulfill the environmental, weather and financial restrictions. The whole process of transport is being optimized so that the time needed for transport is as short as possible and the needs for storing goods is less. So that all these requests are fulfilled, intelligent transport systems are being used, which enable the use of informational and communicational technology. The needs for mobility in everyday life lead to a continued increase of traffic, which generated serious problems as in

asphyxiation, safety and influence on the environment. However, informational and communicational technologies (ICT) offer new, advanced solutions for today's traffic problems. Today's communications represent a backbone to development of intelligent transport systems (ITS) that is cooperative systems from the sector of traffic. The main challenges which will affect the development of traffic policy in the decades to come are:

- Ageing of the populations and even bigger requests for mobility of older citizens,
- Migrations and inner mobility of citizens,
- Even bigger urbanization of cities and globalisation,
- Sustainability of the environment and energetic challenges amidst the decrease and lack of fossil fuels.

By 2050, it is planned to eject vehicles that run on traditional fuels out of use. This is one of the goals of green transport which the European commission has launched, with the special wish to decrease the dependence on oil, which today reaches about 96% and with the goal to, by 2050, reduce CO2 emissions between 80 and 95%. Implementing electric vehicles (EV) and hybrid electric vehicles (PHEV) is still a difficulty in Europe. The three main factors which affect this are: high prices of electric vehicles, decreased acceptance from the side of users and the lack of space and stations for recharging fuel, which represent a vicious circle.

Europe has provided significant investments to encourage the creation of smart cities, which are actually cities which offer clean and affordable energy for all, connecting rational uses of natural resources alongways of the integration of clean technologies. A smart city is based on six main characteristics: economy as a competitive system; mobility in form of

affordable and sustainable transport integrated by new technologies; environment as a protection and advancement of natural resources; people as a social capital; lifestyle as a social cohesion and quality life; government which implies the participation of citizens in public politics.

Human resources are one of the most actual and most publicized themes of the 21st century, imposed by challenges of the 'new economy' - economy of knowledge, economy which is global and which is in a constant fight with uncertainty and changes. That 'new economy' has appeared as a direct consequence of a big advancement of computer technology, science and technology in general, changing the characteristic of the work environment, which compared to the sixties and seventies of the 20th century become significantly more complex. The interdisciplinary concept of managing human resources highlights the need for recognizing the human factor as the most important resource in the company. The work environment imposes a big need for active participation of companies in creating changes, as a need for fast adaptation to permanent, new conditions of business. The question arises, how to make the company creative and adaptable in order to survive in the trade market? The concept of human potential speaks just about that and emphasises on what is inside the companies - people. So, for any company and it's success abilities, knowledges and creativity of their workers is crucial.

## LITERATURE

- [1] Ibrahim Jusufrić: Basics of road traffic, Faculty of Traffic, Travnik, 2007.
- [2] Ibrahim Jusufrić: Traffic and environmental problems of countries in the European Union with a special focus on

Bosnia and Herzegovina - introductory paper, XI International consulting "Traffic and environmental problems of countries in transition from the aspect of integration into the European Union", Travnik, 2015.

[3] White Book - Plan for an inimitable European traffic space - Way towards the traffic systems of competitiveness inside which the resources are effectively ruled, Bruxelles, 2011.

[4] White Book - Transport policies in Europe until 2010 - time of the decision.

[5] Starting basics of safety strategies of road traffic (2008.-2013.), Sarajevo, 2008.

[6] Kristina Kosor: European policy on environment protection, Center for public and non-profit development sector TIM4PIN.

[7] Vanja Biletic: Basics of common transport politics of the EU, Directory for European integration of the Council of Ministers of BiG, Sarajevo, 2014.

[8] Policies of the European Union: Environment, European Commission, Bruxelles, 2013.

[9] Information about traffic accidents, their causes and consequences in Bosnia and Herzegovina in 2014, BIHAMK - Auto-Moto club of Bosnia and Herzegovina, Sector for information and documentation, April 2015.

[10]<http://www.gradjevinarstvo.rs/tekstovi/1305/820/top-10-najboljih-sistema-javnogprijevoza-u-gradovima-sveta>

## OVERVIEW ON FINANCING PUBLIC TRANSPORT BASED ON PPP EXPERIENCE

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***Summary:** The development of public transport modes is growing and becoming an important part of the urban sustainable development. Rail based modes are quite expensive for its construction. City or even State budgets could not easily cover the capital for new systems. As a result, the private sector taking its part in developing financial ambient for building new projects. The main principles of Public Private Partnership (PPP) as well as few examples were presented in this paper. Because of the size restriction of this paper more PPP practical cases will be shown in the Author slide presentation.*

**Keywords:** Urban transport, Light Rail Transit, Financing, PPP



## 1. INTRODUCTION

The form of Public Private Partnership (PPP) is not something new. Most tramway and street cars systems developed in the period 1890-1910 were built and operated by private concessionaires, often linked to electricity, rolling-stock manufacturers or real-estate promoters. In Paris, the Metro was built by the city for the tunnel, tracks, energy, signalling, rollingstock, etc.. by the operator, a Belgian entrepreneur. As public transportation became less and less a profitable activity, financing of operation and renewal was widely taken over by the local authorities. The US is paradoxically an extreme example of this evolution. The UK terminology Private Finance Initiative (PFI) means roughly the same as PPP, simply Partnership and Private Finance are essential. The definition embraced by The Canadian Council for Public-Private Partnerships is as follows: „A cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards“ From a banker’s point of view, PPP should be defined as following:

1. An alternative procurement scheme opposed to traditional procurement
2. The public sector has a tendency to shift as much project risks as possible to the private sector
3. Partnership: both the public and the private sector are involved during the whole lifecycle of the project private finance involved

Forms of PPP can vary significantly, due to the local condition as well as the characteristics of the constructed LRT system. Variations should be defined in the fields of:

- ownership
- nature of contractual obligations
- period of contract
- revenue structure

## 2. RANGE OF PPP STRUCTURES

There is a number of financing structures that are typically used in transactions with private participation and the nature and extent of public support is a key element for the success of these structures. Most of the implemented structures are within the range, starting from greater public sector control and ending in the greater commercial freedom.

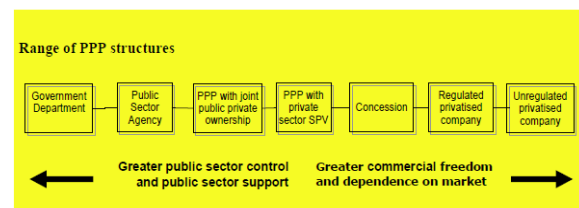


Figure 1. Range of PPP Structure

It is important to recognize that transactions that are not generating assignable cash flows (e.g. the financing of vehicle or equipment sales) require the use of specific instruments:

- Typical private finance structures
  - BOT structures
  - PPP structures
  - BOT & PPP projects to generate assignable cash flows
  - Alternative structures (some form of public commitment required)
    - operating leases
    - asset based finance
    - above financing suitable in principal for vehicles / E&M equipment finance (assignable project cash flows not required)
    - securitization of receivables (LUL presents a first hybrid example, where PPP concession receivables secure senior debt)

## 3. BOT and PPP STRUCTURES

BOT and PPP structures are widely used for infrastructure finance including rail transactions, with PPP offering more flexibility to structure transactions:

- BOT structures

- private sector companies design, build & finance a rail system, own, operate & maintain it during the concession period and transfer the system to the public sector thereafter;
- lenders take limited recourse to private BOT companies but enjoy some form of public support
- PPP structures
- Essentially the above structures but with more flexibility as to asset operation, ownership and transfer and appropriate public sector support; lenders take limited recourse to public (and private) parties.

The following graph shows the main contractual relationships between the parties of a typical PPP project. Such structures allow to split scope, responsibilities and risks between public and private parties in such a way as to allocate the key risks and responsibilities to the party controlling them most effectively. This may include to “carve out” the civil works portion from a rail PPP project and leave its financing and implementation in the hands of the public sector:

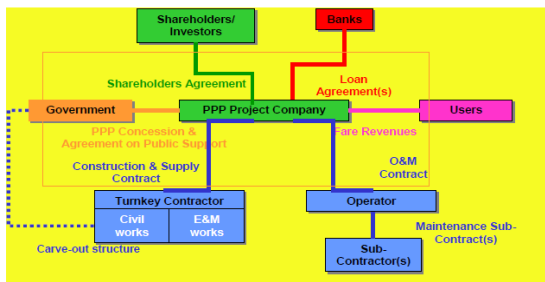


Figure 2. Main contractual relationships between the parties of a typical PPP project

List of most common PPP forms (with corresponding short abbreviation) is presented in the following table:

Table 1. Most common PPP forms

<i>BOOT (build, own, operate, transfer)</i>	
BOO	Build, own, operate
ROO	Rehabilitate, own, operate
FBOOT	Finance, build, own, operate.
BOOST	Build, own, operate, subsidies.
<i>BOT (build, operate, transfer)</i>	
BOL	Build, own, lease
BOD	Build, operate, deliver
BOS	Build, operate, sell
BOM	Build, operate, maintenance
BRT	Build, rent, transfer
BTO	Build, transfer, operate
BOTM	Build, operate, transfer, maintenance
FOT	Finance, operate, transfer
LOM	Lease, operate, maintenance
BLT	Build, lease, transfer
ROL	Rehabilitate, operate, lease
ROM	Rehabilitate, operate, maintenance
DBOT	Design, build, operate, transfer
DBOM	Design, build, operate, maintenance

## 4. PPP EXPERIENCE FROM UNITED KINGDOM

### 4.1. MANCHESTER LRT – “METROLINK”

The case of Manchester Metrolink, with its “Phased Development”, is of particular interest in the evolution of “private finance” in Britain, illustrating in particular how *the method* chosen affected investment definition, project execution and subsequent operation, i.e. changed the economic behaviour of the public authorities and the private sectors alike.

#### 1. Phase One: 1989-1996

In essence, Manchester Phase one is a public funding and public finance associated with a private concession which brings virtually no capital of its own to the table. Looking at the case from our finance - investment management perspective, the crucial innovation (practised for centuries in France) consisted of allowing the concession holder to co-determine, at the (late) design stage, how the public debt should be used. The birth of the project was political. Greater Manchester applied for central government funding after a five year planning process had yielded a fully specified design for a tram system. Reflecting new government thinking,

funding was made conditional on private sector involvement. Accordingly, the design's detailed technical specifications were transformed into *performance* specifications. To simplify the tender, the material details (and costing) of the original design were offered to all tenderers as a reference, greatly reducing the cost of tendering. The tender took the form of a Design-Build-Operate-Maintain contract, with the construction and commercial risk assumed by the private sector. The consortium bid was won in September 1989 and the first section of the system opened for use in April 1992.

<b>The Project:</b>	1989. Operated 1992-1996 Design, build and operate a <b>new tram system</b> connecting existing ex-BR track with new inner city infrastructure (total 31.5 km, including tunnels and surface tracks. Procure and operate new rolling stock: 26 light rail (heavy trams) (GEC-Alsthom). Detailed <i>performance</i> specifications derived from 5-year conventional public project preparation.
<b>The Concession:</b>	<b>DBFO. 15 years;</b> termination option after 4 years
Granted by:	Manchester Public Transport Authority & Executive
To:	GMMML (Greater Manchester MetroLink Ltd.
Owned by:	GEC Alsthom; 2 civil engineering firms
<b>Finance</b>	<b>Total: £ 145 million</b>
Free transfer of	~ £ 100 million worth of existing BR track (pre-privatisation)
Treasure Grant	£ 48 million
Manchester Grant	£ 69 million + £ 15 million EIB municipal loan + £ 15 million
ERDF	
"Equity"	£ 5 million (essentially fee paid to Manchester for right to run public assets.

Table 2. Basic data for Metrolink Phase One

Once the new system was fully operational passenger numbers turned out to be well above forecasts. By 1995, the operators had made a profit equivalent to their initial investment. In 1996, Manchester decided to exercise their termination clause. This resulted from the fact that a tender for an extension of the system (Phase two) was won by a different consortium, and Manchester wanted a single operator for the whole system.

## Phase II

In 1996, the 15-year contract for "Phase I" with GMMML was terminated. There was an innovative new tender which asked bidders to quote a single price for  
– operating the Phase I system

– DBOM an extension with an investment volume of around £ 148 million.

The existing consortium was one of three bidders, but did not obtain the contract. Since Manchester wanted a single operator for the whole system, the existing (two-way) termination option was exercised. Manchester could easily afford to pay the contractual "penalty" for the premature termination of the Phase I concession, £ 7 million. The winning consortium offered £ 90 million for the right to run the system.

## Current situation

Metrolink was originally built and operated from 1989 by the consortium Greater Manchester Metrolink Limited (GMMML). In 1997 the contract was awarded to a new consortium, Altram (Manchester) Limited, a consortium of Ansaldo Transporti, Serco Investments Limited, Laing Civil Engineering and 3i. Serco Metrolink, a wholly owned subsidiary of Serco Limited, took over the operations and maintenance of the system on 26 May 1997. In March 2003, Serco Investments bought out its partners and Altram (Manchester) Limited became a wholly owned subsidiary of Serco.

In July 2007 the 10-year contract to operate Metrolink was awarded to Stagecoach Metrolink, a subsidiary of the Scottish transport company, Stagecoach Group plc. Unlike Serco, Stagecoach do not own the concession, merely operate it on a fixed-term management contract.

RATP Group bought Stagecoach Metrolink Ltd from Stagecoach Group on 1 August 2011.

– From the point of network length several extensions were performed, such as:  
Branches to Altrincham and Eccles  
– Manchester Airport extension (opened in 2014)

## 4.2. CROYDON TRAMLINK

The Croydon project is partially financed under procedures elaborated under the private finance initiative (PFI). While over 60% of the initial investment of £ 300 is covered by a public grant (as against 100% common in continental European practice, notably for infrastructure), the company is committed to run the service subsequently without operational subsidies altogether (as compared to the 60-80% operational subsidies common in continental Europe). The project contains several interesting features.

- both track and rolling stock are financed through leases
- the manufacturer (& co-shareholder) has concluded a Tram Maintenance agreement
- the concession is for 99 years, but the operator (& co-shareholder) can be replaced when EU legislation requires periodic tenders for operator services.

<b>The Project</b>	Operational start: November 1999. (D) BFO a <b>new tram system</b> , combining old British Rail track with new on-street lines; hence: (1) upgrading former British Rail track; (2) adjustment to present heavy rail (3) new street-level tracks (4) maintenance and command-and-control facilities (5) new rolling stock: 24 low floor units.
<b>The Concession (D) BFO 99 Year Concession</b>	
Granted by	British government (Act of Parliament !); Authority functions delegated to London Transport
To	Tramtrack Croydon Ltd
Owned by	Builders, stock suppliers, a private bus operator, financial institutions (see diagram)
<b>Finance:</b>	£ 300 million (of which ~ 40 million to re-purchase track from Railtrack) Government grant: £ 175 M Private finance: £ 125 M, much in the form of leases for both track (!) , land, and rolling stock.

Table 3. Key elements of Tramlink development

### Phased development

In the first phase, the public sponsors - London Transport and the Borough of Croydon issued a tender for development of a new Tramlink, i.e. traffic forecasts, design, technical specifications and commercial parameters for the subsequent

BFO contract. This initial tender was won by a consortium formed by:

- Tarmac Construction
- AEG (rolling stock manufacturer)
- Transdev (the French operator and subsidiary of the Caisse des Depots).

The design group was dissolved in 1995. The partners participated in the subsequent tender, but lost to a rival consortium. They were compensated for the intellectual property - about £ 6 million.

The winning consortium was composed of private sector companies from four different fields:

Construction: Amey and Sir Robert McAlpine in a construction joint venture, CIV

Operator: Centre West Buses

### Current situation

In March 2008, TfL announced that it had reached agreement to buy TCL for £ 98m. The purchase was finalised on 28 June 2008. The background to this purchase relates to the requirement that TfL (who took over from London Regional Transport in 2000) compensates TCL for the consequences of any changes to the fares and ticketing policy introduced since 1996. In 2007 that payment was £ 4m, with an annual increase in rate.

In October 2008 TfL introduced a new livery, using the blue, white and green of the routes on TfL maps, to distinguish the trams from buses operating in the area. The red colour of the cars were repainted green, and the brand name was changed from Croydon Tramlink to simply Tramlink. These refurbishments were completed in early 2009.

## 1. JERUSALEM LRT

The First LRT Line in Israel, was constructed as a part of large LRT network development in Jerusalem. Total length of first line was 13.8 km segregated double track with 23 stations. For day to day service LRT system requiring 46 vehicles with 100% low floor. Maximal designed gradient is 9.2%. In accordance to expected demands peak headway should be 4.5 Min. Demand (in accordance to the serious modelling process) were considered in the range 100,000 passengers per day. Today some 140,000 passengers using LRT. Start of operation began in 2011. Purchase of additional vehicles are on the way. On the request of the Ministry of Transport, LRT promoter (JTMT) insist on Full form of Public – Private Partnership, with contractual commitments for supporting transport scheme for the 30 years of concession. Severe security situation was developed after issuing the tender documents, which led towards the extension of tendering procedure, and postponing of contractual activities. Relatively high demand expected, assuming importance of the corridor of the first line. Urban integration within the Central Business district (CBD) and its revival as part of the project. Promoter JTMT organised public referendum for the vehicle design. Financing Scheme – The risk allocation within the *Public – Private Partnership* In order to optimise cost of risk coverage, JTMT and Private sector agreed following risk distribution:



Figure 3. Risk Sharing principles between Private and Public Sector

JTMT as promoter on behalf the City of Jerusalem and Transport Ministry, proposed the following Contractual commitments:

- Full priority at traffic lights (Concessionaire has right to claim additional costs caused by delays on traffic lights)
- Restrictive traffic arrangements in the city centre which will reduce or eliminate possible congestion with other cars on the LRT sections in the city centre.
- No competing bus lines. Bus network will be rearranged in order to form fully complementary public transport network.
- Fully integrated bus feeder system, which will be time coordinated with LRT services.

### **Non-binding measures**

P&R facilities combined with restrictive parking policy Full urban integration & CBD revival

### **Dealing with the security challenge – compensation to Concessionaire**

Local Authorities in Jerusalem responsible for the realisation of LRT project considered any possible impact of worsening security situation, such as:

- Compensation for inability to work during construction period
- Compensation for loss of passengers during regular operation

Authorities also allowed additional costs for specially reinforced windows and protected

vehicles bodies. Authorities will accept additional operation costs due to the closing of some or all stations because of its security check.

## 2. REFERENCES

- [1] David Catling, Scott McIntosh, Gradimir Stefanovic, Joachim von Rohr, Guidelines for Selecting and Planning a New Light Rail System, UITP, February 2004
- [2] G.Girnau, Light Rail in Germany, VDV, Dusseldorf, 2000
- [3] C.Hass-Klau, G. Crampton, Rabia Benjari, Economic Impact of Light Rail, Environmental & Transport planning, Brighton, 2004
- [4] C.Hass-Klau, G. Crampton, C.Biereth, Valker Deutch, Bus or LRT: Making the right choice, Environmental & Transport planning, Brighton, 2003
- [5] Gradimir Stefanovic, Florian Dabu, Claudiu Miseanu, Michael Pospisil, Guidelines for Tramway Modernization in CEEC and CIS, Final report published by Working Group of Tramway Modernization, UITP Brussels, February 2010
- [6] Gradimir Stefanovic, Optimisation of Light Rail System Parameters in Various Traffic and Economical Conditions UITP Congress Report –. Earls Court Conference centre, London 2001
- [6] Gradimir Stefanovic, PT development in the former Yugoslavia, Urban Transport International, Paris, No. 55, October 2004
- [7] Ibrahim Jusufanic, Gradimir Stefanovic, Transportation systems for passengers in cities, International University Travnik, 2014
- [8] Gradimir Stefanovic, Tramway modernization, UITP Public Transport International – No 3, 2010
- [8] Gradimir Stefanovic, Doubling PT Modal share - Measures in the field of better integration and development of additional services, UITP 2011 Congress Report, Dubai, 9-15 April 2011
- [9] M.Taplin, Light Rail in Europe, Capital transport, London, 1995
- [10] M.Taplin, M. Russell, Trams in Eastern Europe, Capital Transport, London, 2003
- [11] C.Walker, A.J Smith, Privatised Infrastructure-the BOT Approach, Thomas Telford Publications, London 1995
- [12] M.Webb, Jane's urban transport Systems 2009-2010, Jane's, Coulsdon, 2009
- [13] G.Stefanovic-Chairman of WG, Reports of UITP Working Group for LRT statistics, UITP, Brussels, 1995-2015 (update every 6 months)

## INNOVATIVE REQUIREMENTS IN SUSTAINABLE DEVELOPMENT IN THE COUNTRIES OF WESTERN BALKANS

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**Summary:** *A key challenge with which, in the biggest measure, the countries of Western Balkans will face is expressed in the development of the millennium goals of the UN in the department of long-term development of energy by year 2050. Scientism understood as the belief in science, ego became like the base of our reality at the beginning of the third millennium. It is felt that the faith in science and scientific advancements is the base of every rebirth and society advancement overcoming all obstacles. Does then the science responsibility exist if its the only true knowledge, if only science responsibility, with its own power, accomplish good? Shouldn't it be that moral justification is by itself moral and good, which is the base of every moral justification? To practically answer these questions, philosophers, sociologists, economists, engineers, ecologists and other researchers have to critically deliberate the nature and factology of the environmental catastrophe. Economic and environmental influences of company business on the community require from the manager to confront the (non)efficiency, that is (non)effectiveness acting on departments for environment protection, and also accepting responsibility in a way where the companies use energy and energetic resources. With this coauthor piece, the need for more than renunciation from the scientism problem is shown, to be able to find the meaning of science and to determine the aggressiveness on its principles, because development contributes the advancement without borders for growth.*

**Keywords:** *Western Balkans, innovations, energy efficiency, eco-security, sustainable development.*

### INTRODUCTION

Numerous changes in the world in case of interests in sustainable development have happened at the turn of century, which has to be considered when planning medium term measures and implementing millennium goals of further development

and 'survival' in the globalisation conditions.

The development concept of Western Balkans countries (society of knowledge - Knowledge Society)- of the scientific and technical progress, is pointed to the society of knowledge into the center of happenings establishes a personality and knowledge by

using scientific and informatic technologies, informatic and expert systems (Informatic - Expert Systems - IES), computer connections and Internet. The Knowledge Society has new approaches with more aspects: knowledge, manufacturing, quality, technology, informatic - expert systems, time and space etc. The increase of competitiveness of produce and services is accomplished by decreasing expenses of manufacturing, that is offered services created by decreasing the consumption of energy by produce units, that is services by implementing measures of energetic efficiency. This concept implies the use of less energy for the same unit of the social gross produce with sustaining the quality of the produce, including labeling the energetic efficiency of the produce which affect the use of energy as well. With this work, the viewed aspects of methodology of systematic analysis which precedes the scientific and research work in the area of human actions in energetics, economy and ecology, thanks to more science fields. Those fields in circular approach include branches and disciplines which are pointed to man and his survival on Earth. The need for multidisciplinary research approach will be analyzed so that science can answer the demands of sustainable development, where energetic efficiency and eco-safety have a first class significance.

## **1. Sustainability in a postmodern ambient**

Scientists and experts warn about modern society being in conflict with fundamental bases of life. That is understandable, if you consider that climate changes and disturbances, exhaustion of natural

resources, transborder transport of polluting materials, technological pollution of nature and other ecological problems inevitably affect on a bigger, almost every day growth of natural catastrophes, danger and risks of crisis situations of different natures and characteristics which can have unpredictable for all living earth. The modern society characterises a system of sustainable development. It implies a systematic approach from one side to development, and from the other protecting the environment, which implies monitoring and a number of preventive-corrective activities according to the valid law procedure. With that goal, we will show how in the existing business system (through energetic efficiency) the work conditions and life are being examined, and the according to that we will propose concrete measures of eco-safety. Sustainability of the use of energy implies the decrease of energy consumption, better use of available technologies and requests of eco-design, bigger efficiency and economy in using energy as well as the sustainability from the standpoint of influences on the environment, with using known principles of environment safety. There is a suspicion on human activity/influence on eco-systems by means of science and technology. The technological euphoria only covers the surrounding outputs, the lack of ethics in the science and responsibility for science which today shows as the only force, the one that unifies all other forces: legislation, execution and jurisdiction.

Mans' task is to behave smart, to take care that the order in nature sustains, and to dynamically and mutually acts between natural and cultural systems. From this



aspect the modern experiences prove that the mentioned idea is unfounded, that it belongs to those big stories of traditional metaphysics. The economy is out of the sphere of mutuality and voluntary cooperation, and ecology is out of the sphere of economic activities and lucrative interests. It does not imply them. The results of the ecology research aren't superior to rationality: it uncovers efficiency boundaries of economic activity and its' extra economic conditions. Ecology, specially, uncovers that the economic effort of coming to relative rarities after a built boundary causes impermeable obstacles caused by shortage of natural resources: contributions become negative, what the production destroys is bigger from what it creates. That inversion appears when the economic activity disturbs the balance of elementary cycles and destroys resources which is not cadre to renew.

## 2. Globalisation - imperative of the modern society

The industrial revolution represents the turn to the new production processes from around 1769. To the time between 1820 and 1840. It consisted of transitioning from hand production methods to mechanic, new chemical productions and process for iron production, advancement of the water energy efficiency, heightened use of steam energy and development of mechanic tools. It also includes the transition from wood and other bio-fuels to coal. The textile industry was dominant during the industrial

revolution in ways of hiring, value of the products and invested capital; the textile industry was also the first to use modern methods of production.

The imperative of modern production is integrated economic, technological, social and cultural development. This development is possible only if it's harmonized with the needs of securing the environment, formulated through the concept of sustainable development. In whichever way sustainable development is defined, in its basis it represents the balance between the use of natural resources and energetic abilities, to satisfy the needs on future generations. Today the global ecological crisis resulted in unfolding life in an ecologically dangerous epoch.<sup>4</sup> The ethical questions and dimensions of globalisation:

1) *What is Interdependence?* Under the term interdependence we imply a mutual dependence of more countries, social groups, occurrences and processes, as well as their main actors: Interdependence exists since the earliest times of social life. *Why?* There is more forms of interdependence (primary, technologically marketable, multifaceted interdependence).

2) *Globalism* - a state which implies a complex interdependence on translucent distances; etymological origin; lat. globus; eng. Globalism (Raiser and Davis - 1944); the decrease of globalism - deglobalization (exp. From 1918 - 1945, economic deglobalization, but military, social and

<sup>4</sup> Forest spasms are shrinking at a rate of 50 ha / minute, causing the disappearance of about 2,000,000 species and subspecies of plant and animal life (20% of the total quantity). The fact that vegetation makes up over 98% of the total biomass,

tropical forests above 40%, suggests that 50 years of such a pace of shrinkage and development will be enough to make it disappear, leaving behind a new desert "Sahara".

ecological globalisation); globalism as a modern political ideologies - the concept of domination of the most powerful worldly forces;

3) *Globalization* - the first time this term showed was 1961 in an English language dictionary by Dirk Mesner; today it can be defined in more ways, because of which the term is subject to ideologizing; mainly the definitions highlight the social, political, military, economic and ecological aspects of globalization, often globalization today is said to imply backlighting, the causes of bigger globalization: end of block separation and the Cold War, bigger role of the MNK and the expansion of informational and communication technologies.;

4) Some definitions of globalization - Globalization is a process of expanding the removal of obstacles to the free market (Dz. Stiglic); Globalization implies the expansion of capitalism in all countries of the world (Friedman); Globalization is a process which made sure that happenings on one end of the world have a stronger impact on the completely opposite side of the world (Smith and Baileys); Globalization is: internationalisation, westernisation, universalisation (expansions of values and free market), deterioration - Scott.

5) Historical eras of globalization - authors often speak about three big eras of globalization:

1. The first big era (from 1866 and setting up the big transatlantic cable, to the beginning of the WWI) - it was created thanks to the drop of prices of transport, the appearance of the steamboat and railway;
2. The second big era (from 1980 to 2000)

- the drop of computer prices, computer equipment and telecommunication;

3. Third big era (lasts even today) - the expansion of computer use, new computer software and massive use of modern ways of communication (Skype, Facebook, video-link...)

Dimensions of globalisation - ecological (environmental) - transport of meaningful matter for human health and wellbeing, on bigger distances; the expansion of global environmental awareness (massive environmental movements); military - new military technologies, advances military industry, the finding of new types of weaponry; social - political - migrations, expanding ideas, religions, cultures, moral forms, political idealisms and values; economic - bigger economic connection of countries, development of TNK, free flow of goods, people, services and capital; bigger economic dependency, expansion of modern technologies in manufacturing ao.

7) Globalization and MEO subjects - Thanks to the process of globalisation the country isn't the only subject of international relations and international economic relations (MEO); International subjects MEO: international government organisations (UN, EU, IMF, WB, WTO, NATO) and international nongovernmental organisations (Human Rights Watch, Transparency International, ao.); Transnational subjects of MEO: transnational social and political movements, TNK, religious organisations, • National subjects of MEO: country, NVO, and even the individuals. The changes of limits in economic sovereignty of the country ;

8) Controversies of globalization - environmental (the spreading of new diseases, viruses, global warming, ozone

hole, exhaustion of non-renewable resources on Earth); military (spreading of technologies of making weapons for mass destruction, bigger number of wars, destructiveness of wars, new kinds of war, terrorism, proliferation of nuclear weaponry); socio-political (overpopulation of the planet - 7,4 billion people, bigger illegal immigration into developed countries, domination of certain languages and cultural forms, interventionism in the name of certain ideas or ideals ao.); economic (inequality, bigger differences between countries, increased number of poor, domination).

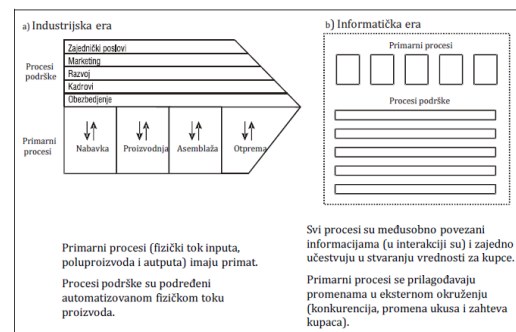
9) Ethical problems of globalization - socio-political globalization: spreading of certain values, moral forms and norms of behaviour in different surroundings; Globalisation of economy - globalization of business processes and relationships - globalization of (non)ethical business behaviours and works; Ethics of globalization and/or globalization of (non)ethics.

10) The need for new business ethics - The complexity of new economic, political and social relationships; Different roles of individuals in the modern society; Value Crisis: *what are global values and do they exist?* Corporate social responsibility as a new ethical category is directly determined by globalization.

11) *Accomplishments of science or the era of cyborgs today?* The society is mostly experiencing robots as helpers in industry, space or robots which play football. But Tradino is a dragon. It is the biggest robot on earth, long 15,5 meters, it spits fire, wags its' tail, moves independently, the span of its' wings is almost 13 meters and it's over 11 tons

heavy.

His body is circulated by 80 liters of artificial blood, the skin is polyurethane and advanced wool, and the glass eyes are especially interesting. In them, cameras a place with sensors, which can move independently, with blinking, expanding and shrinking the pupil. Unbelievable but true.



Pic. 1.. Paradigm change - era interactivity

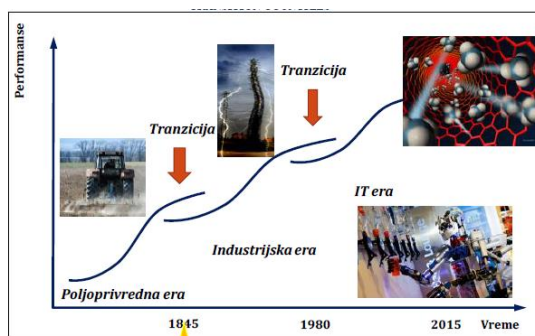
### 3. Conflict between man and nature

Development of the millenium goals of the UN ( The UN Millenium goal) the World Energy Council (WEC) has set three goals in their statement (The Millenium Statement) of development sustainability of energetics. They're made as three, and those are \*Accessibility\* to modern, acceptable energy for all, \*Availability\* in means of continuity of supplying and quality and reliability of services, and \*Acceptability\* in means of social golad connected to environment safety. Since then, these goals are the base of WEC works and they marked even the analysis in scenes of energetic policies by 2050. Energetics is a economic activity which deals with studying and using different sources of energy and manufacturing electric energy. Modern economic

development of a country completely depends on the attainable sources of energy, exploitation and use in manufacturing and consumption. Based on the source of energy which the human has used in the past and ways of using them, it can be separated into three phases:

- Phase of biological energy (from the middle of the XVIII century)
- Phase of mechanic energy (during the XIX century)
- Phase of electric energy (during the XX century)

Classical sources of energy are: wood, coal, oil, natural gas, water energy and atomic or nuclear energy. Alternative sources are: energy of the sun, energy of the wind, energy of the sea waves, geothermal, biomass energy, energy of the tide, energy of lightning and thunder, earthquake energy, nuclear energy, ao. The main sources of energy in the XX century are non-renewable sources of energy like: coal, oil, natural gas and nuclear energy. In the next period of time, those have to be renewable sources of energy.



In the history of european social studies, up until recently, the bigger part of the thinkers, not concerning the philosophy they followed, considered that human is the only one important, and everything else

was there for humans and the fact about their affiliations, nature or ecosphere was neglected. Until the appearance of the Bacon program it wasn't that important, because the matter was usually about indifference, and not the wish for 'enslaving' nature. To consider the scientific fields and disciplines inside of them, which consult in the analysis of sustainable development and environmental research, it starts from the 35th chapter of Agenda 21, which the UN set up, and which refer to science. The primary goal of every country is to, with the request and support of international organisation, identify the condition of its scientific findings and research needs, to be able to sooner accomplish important betterments in:

-Global expansion of scientific bases and empowerment of scientific and research capacities and abilities, especially in countries in development, in fields which are relevant for the environment and development;

-Forming such measures of environment safety and development, which are based on the best scientific findings and estimations, and they consider the need for expanding the international cooperations and relative uncertainty of different processes and options in this field;

- Interaction between science and deciding, by using preventive measures, because of the change of the existing model of manufacturing and usage, to get time for decreasing uncertainty connected with choosing the different options;

- Creating and applying knowledge, especially domestic knowledge, in different environments and cultures because of the realisation of sustainable levels of

development, considering the relationships of national, regional and international levels;

- Improving the cooperation between scientists through promotion or interdisciplinary research programs and activities;

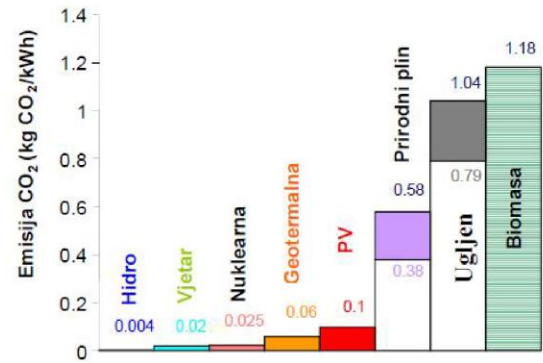
- Public cooperation in setting priorities and making choices which refer to sustainable development.

For science to answer the requirements of the researchers in the direction of sustainable development, it's development has to go towards multidisciplinary which includes four fields of science:

1. Natural sciences - their postulates and principles which mark a natural environment and connected with that the requirements which are set according to the developmental-investigative procedures;
2. Technical-technological sciences which mark the existing accomplishments and developmental flows of science in general (automatisation, computerisation, cybernetisation and bionisation);
3. Social sciences - demography and sociology of work and creativity, economics, environmental law;
4. Synthetic and organisational sciences - social ecology as a coupling for functional connections of projections of nature development and social environmental basis of adequate developmental engagement of technical-technological and organisational-developmental scientific disciplines.

Industrial ecology is a multidisciplinary study of industrial systems and economic works, as well as their relationships with the basic natural systems. It ensures theoretical bases and objective understanding where reasonable betterment

of the current practice can be based on.



Pic. 4. Harmful pollutants in different energetics

Economic instruments enable the market incentives to decrease pollution and change of technology, increase flexibility and decrease expenses using these measures, they provide sources of finances for control and realisation of policies on decreasing pollution (before all using market and financial incentives). In the group of Eastern European countries, Czechoslovakia was first to officially start keeping the environment safe with the economic way (end of the 60ies taxes for pollution were introduced). Modern technology, despite the use of big financial means and managing them, offers an extraordinary possibility for environmental decentralisation, and according to that organisational principle it achieves unbelievably favourable work and financial results. The problem of economic growth based on old technologies, usually has a consequence of the increment of environmental loads. The energetic efficiency of the manufacturing system is conditioned by the technological level, so the non-developed countries which don't have modern technologies installed can't have a concept of development, because of what they will stay behind in matter of energetic efficiency.

Modern strategies of development in developed countries are built on a line of sustainable development based on the 'new economy'. And the most important parts of the new economy are based on knowledge are using ICT technologies and sciences, which among everything else implies, even on scientific bases, a conceived environmental policy. The use of ICT technologies, especially in matters of manufacturing and company business in general is based on the rule on the precise programming and scientifically confirmed technical business.

#### 4. Responsibility of environmental research

The consequences of global warming are more visible every day. Natural catastrophes and weather disasters are more frequent and they destroy life on Earth. The warmest summer of 2003 took 30.000 lives in Europe, and now that number is incomparably bigger. Extreme droughts, unrecognized floods and fires and worrying oscillation temperatures are the main themes of expert reports which speak of climate changes and global warming. New sorts and big amounts of energy on the environment have implicated big problems which have been piling up in the past two decades. Just like any other human activity and electro energy and oil industry affect the environment. The biggest pollutions are recorded in the most industrialized and most urban countries, which are the source and driving force of development.<sup>5</sup>The degradation system and environment pollution is proportional to the level of economic development and

industrialisation, that means that the connection state between causative consequential and development of the economy and environment is very clear.

And because of that there are three clear, defines principles of sustainable development:

- development cannot harmfully affect wireless systems which maintain life on earth (air, water, ground and the biological system)
- the use of natural resources has to be, not only more careful but more efficient than now;
- establishment of sustainable 'ecological' social systems is a necessity and the need on all levels (local, national and global);
- the imperative of 'green' development is the decrement of disproportions between rich and poor.
- energetics received more global scales than any other activities, which is caused;
- high requirements for energy (amidst the increase of number of residents, increment of quality and standard of life, serious influence of manufacturing and exhausting energy on the environment and changes which happen in the world market);
- changes in the geo-political-economic structure of world development.



Pic. 3. Economy in the life cycle of energetic products

<sup>5</sup> And if the OECD countries own 20% of the world's territory, and about 25% of the world's population,

they produce over 80% of goods and 65% of all types of pollution.

The strategy of environment safety of every country has to fulfill goals concerning the safety of safe life of environmental growth, as well as keeping safe the quality or regional and global mutual goals.

Problems which have to be addressed are:

- climate changes: the last decade of the XX century was the warmest in history of mankind, and it is expected that the global temperature will grow 1-6°C by 2100. For example, parts of northern Europe are exposed to abundant rainfall and floods, while in the south the climate is more and more dry;
- endangered plant and animal species are in growth, many ecosystems in rivers have vanished, as well as 75% of sandy dunes in France, Italy and Spain;
- the pollution of the air is concerning;
- growing concentration of the ozone on a level of earth since 1994 has been harmful the health of humans, ecosystems and agricultural crops;
- depositing trash provokes the pollution of water and soil;
- the use of pesticides in agriculture is alarming (in use 30.000 chemicals);
- natural resources - clean water, salts and minerals are not renewable and they are being exhausted;
- participation of the sector of energetic in harmful emissions is growing.
- The key aspect of a successful system, in means of industrial metabolism is the internalisation of the material cycle, which implies a need for energetic efficiency and total minimisation of waste. The other characteristic of the technological system, as a part of the industrial system would be the systematic integration, to achieve optimal efficiency and profit.

## Conclusion

Globalization and a constant development of new technologies in the department of industry and construction and more complex requirements of investors and the social community for the construction of Energetically efficient objects with a big number of integrated installation systems, are asking from us innovations and a constant search for new solutions, especially those of significance for manufacturing, sustainable development and eco-safety. For environmental research it is needed to have multidisciplinary, which is built by connecting more segments of science without functional connections. The holistic approach to the environmental problem is built on transdisciplinarity. Based on the connections made that way, or bridges establish relationships between research teams. All organisational forms of multidisciplinary and transdisciplinary works are considered, on which the whole functional organisation is brought to reality, and they project and establish dynamic systems which are synced to their surroundings and by us a carrier of sustainable development. Our research point out that, that even if  $\frac{2}{3}$  of business leaders recognize the use which socially accountable business brings, only  $\frac{1}{3}$  of them intends to make an estimate in a way where social and environmental topics affect the company business.<sup>6</sup> As a new paradigm, which would have to change the neoclassical deliberations, which was, through many centuries of traditions and

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<sup>6</sup> ESCO (energy service company) is a company or other legal entity, that is, an entrepreneur registered for the performance of energy services that, by providing energy services, refer to the energy efficiency of the facility, technological process and service and which to a certain extent accepts the

financial risk for the performed energy services which, in whole or in part, collects the collection of its services on the basis of the savings achieved on the basis of the implemented measures and satisfying other agreed performance criteria

biochemical metaphors, founded on knowledge, organization and readiness for acting in the system of eco-safety, everywhere and in all situations on a national, and even more on a regional level.<sup>7</sup>

The mechanisms of energetic efficiency are common instruments which the Government of one country uses, state administration officials and other state officials or other bodies, unit of the local self-government, as well as other public services because of the creation of the frame of support or incentive for participants on the market to provide and acquire energetic services and enforce measures for betterment of energetic efficiency. The economic profitability of measures secures that the investments in the measures of energetic efficiency are economically just. Saved energy is energy that doesn't have to be manufactured, where even the positive consequences for the environment are taken into consideration, which happened during the decrease of use, as well as the decrement of expenses connected to the securing of energy supply safety. The decrease of energy consumption in manufacturing sectors, distribution, transfer and consumption sectors are secured by fulfilling minimal requirements of energetic efficiency for new or reconstructed manufacturing facilities, transfer and energy distribution.

<sup>7</sup> Eco-design is a set of conditions that must be met by a product that uses energy in terms of environmental protection in a period that involves

## Literature

- [1] Beard, T.R. Lozada, G. (1999) Economics, Entropy and the Environmental Cheltenham, UK, Edward Elgar.
- [2] Biocanin R., Obhodas S., Badic M. Economic-energetic influenza - reengineering and paradigm of the approximation to the European Union, I Symposium inovacion BiH research, Serbian Palace, 27-28th september 2011, Belgrade.
- [3] Biocanin R., Skrbic V. Ecologic safety and sustainable development as a condition for european integration, NUBL, Banja Luka, 2011.
- [4] Biocanin R., Badic M., Milosevic T., Cordas T. The concept of eco-safety of Western Balkans as determinants of sustainable development of the region, XXXII Med. Savetovanje 'ENERGETIKA-2016', 22-25th March 2016, Zlatibor.
- [5] Bio'anin R., Sadovic M., Mirkovic M., Badic M. The prism of sustainability of time dimension of Serbia according to the Aarhus convention, Conference with international attendance 'Social-economic development of Serbia with an accent on Novi Sad and Vojvodina', 15-16th April 2016. Fruska Gora.
- [6] Crnjar M. Economics and policies of environment safety, Faculty of Economics in Rijeka, 2002.
- [7] Jusufurancic I., Biocanin R., Waste and sustainable development, International University Travnik in Travnik, 2012.
- [8] Lucas R. E. Jr. (2002) Lectures on Economic growth. Cambridge, Harvard University Press.

the process of creation, use and placing of products out of use.



- [9] Mijanovic K. Environmental ethics for engineers and managers, Mostar 2010.
- [10] Rodger J., Gemery H. Science, Technology, and the Environment (multidisciplinary perspectives), The University of Akron Press 1994.
- [11] Poincare H. La Valure de la science, Paris, juni 2008, Vol. 41, No 3, pages 232-237.
- [12] S. Stefanov, M Vojinovic-Miloradov, R. Biocanin, Energetic efficiency in sustainable development, II Congress 'Ecology, Health, Work, Sport' 231-240, 09-8-10.09. 2011. Banja Luka.
- [13] Sarcevic A. Ecological problems in cultural change, Sarajevo 1990.
- [14] Stefanov S., Vojinovic-Miloradov M., Biocanin R. Ecological modelling of pollutants in process industry, ICET 2011 & PEC-9, Faculty of Engineering PSU, p.202-208, 2011. Thailand.
- [15] Young, J.T. (1991) Is the entropy law relevant to the economics of natural resource scarcity? Journal of Environmental Economics and Management 21(2).

## REAL EFFECTS OF AUTOMOBILE AUTOMATIC STABILITY CONTROL

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**Abstract:** *One of the most significant technologies for improvement vehicle's active safety is automatic vehicle stability control. The primary function of this technology is to assist the driver in maintaining control of the vehicle during sudden maneuvers or adverse weather conditions. This technology detects drivers steering input and compares it with true attitude of the vehicle and, depending on detected difference, activates braking system and regulates engine power to compensate for eventual difference. The automatic vehicle stability control has been highly effective in preventing single-vehicle crashes. The future studies with more data may even find reduction in some types of multiple-vehicle crashes. This paper deals with the basic characteristics of automatic vehicle stability control and its effects.*

**Keywords:** *Automatic, Control, Stability, Automobile*

## 1. Introduction

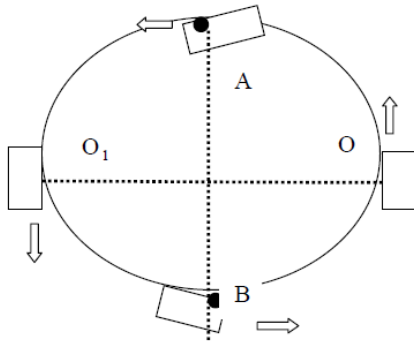
In the past two decades numerous technological innovations have improved active safety of vehicles. Each new technological improvement, in this domain, has a goal to help drivers to avoid a traffic accident. One of the most important technologies is the automatic stability control (ASC). The basic function of the ASC technology is to help the driver to maintain control over the vehicle in times of sudden steering wheel maneuvers or in unfavourable weather conditions. ASC is classified as an active control vehicle congestion which uses the anti-lock brake system (ABS) function of brakes and control of the pulling force on the wheels. Detecting the drivers steering command and comparing it with the true movements of the ASC vehicle, depending on the detected difference, it activates the braking system and regulates the motor power, compensating possible differences. An ASC device is made of a sensor, brakes, motor control modules and microcomputers which constantly follow the behavior of the vehicle on the road, depending on the drivers reactions on steering. This device has showed up first in Europe in 1995, and three year later in America. The marker has many names and nicknames for this device, from which the most popular are: electronic stability control (ESC), dynamic stability control (DSC), automatic stability regulation (ASR), integrated vehicle dynamic (IVD) and so on. However, the goal and function of all these devices are the same in the basis - keeping the stability of the vehicle.

According to the data of the American national highway traffic safety administration (NHTSA) from 2004, in the three years ASC has influenced on the risk decrease of individual vehicles to participate in traffic accidents with deathly consequences by 54%, which makes for 34% decrease of all accidents with deathly

consequences. In this work, a check up of the ASC characteristics and the results of numerous test and ASC efficiency analyses in real conditions is given.

## 2. THE CONCEPT OF AUTOMATIC STABILITY CONTROL OF VEHICLES

Automatic stability control of cars is made so that the ASC device estimates the drivers steering command comparing it to the true movement of the vehicle. If differences are detected the ASC will activate the braking system and regulate the motor power with the goal to compensate those differences. ASC system determines the movement direction, measuring the (drivers') intended and real movement direction. If this doesn't fit the drivers intent, ASC turns the car around using different forces of braking on the wheels of the vehicle. The movement speed and the turning angle of the steering wheel are used to determine the drivers' intended movement direction. The behaviours of the car is registered with a sensor which identifies the transient acceleration. If the vehicle behaves according to the drivers intent, the turn degree of the vehicle will be balances in accordance with the speed of the vehicle and it's transient acceleration. The concept of 'degree of transient acceleration' can be illustrated following the vehicle movements on a big circle drawn in a parking area. If the vehicle starts to move in that circle towards north (Picture 1, position 0) and goes over half of the way, its orientation will then be towards south (Picture 1, position 01). In that case, the turn of the vehicle will be changes for 180 degrees. If the movement took 10 seconds, then the 'degree of turning the vehicle' is  $180/10$ , that is 18 degrees per second



Picture 1. Effects of stability control of vehicles in the time of excessive or insufficient steering wheel turn

If the speed is constant, the vehicle will move around the vertical axis in the amount of 18 degrees per second. If the speed is doubled, that's when the degree of the turn will double as well and it will be 36 degrees per second. In a situation of an excessive steering wheel turn (position A, Picture 1) the driver will lose control and the back part of the vehicle will start slipping. In this case, the ASC will activate the braking force on the front outer wheel, with the goal to redirect the vehicle into the original (intended) position. In a situation of insufficient steering wheel turning in a curve (position B, Picture 1) the front part of the vehicle will have a tendency to slip from the path. In this case, the ASC will activate the braking force on the inner back wheel, with a goal of redirecting the vehicle into the original path.

### 3. REAL EFFECTS OF AUTOMATIC STABILITY CONTROL

Potential benefits of the ASC in sustaining stability of vehicles were demonstrated in numerous testings and simulation drives. On the testing, which were done by Toyota, 45% of the vehicles without ASC has lost their stability, while only 5% of vehicles with ASC device has lost stability. Driving simulations which were done on the modern national simulator with the models Oldsmobile-Intrigue and Ford Expedition

SUV 28% of the drivers without ASC and 3% with ASC has lost control over their vehicles. However, the testing results and simulation results don't have to be reliable indicators of real performances in real conditions. For example, the test results of the anti-block braking system (ABS) were impressive, but the real happenings in real conditions were disappointing. Reasons for such differences are in inadequate reactions of the drivers who were normal, average drivers and not test-drivers.

### 3.1. Security Effects

The first published study of real effects of ASC was done in Japan. The results of this study for three Toyota car models show a 35% reduction in vehicle traffic accidents after the installation of an ASC device. The same vehicle models, the same year of production without ASCs, had 2.5 individual vehicle accidents per 10,000 vehicles during the year, while vehicles with ASCs had 1.6 accidents per 10,000 vehicles during the year. In Germany, the ASC device became standard equipment for all Mercedes vehicles in 2000. On the basis of a sample with more than 2 million traffic accidents, researchers have registered a decrease in accidents from 1.32 in 1998-1999 to 1.10 in 2001-2002. The percentage of traffic accidents in which drivers lost control on the vehicle has been reduced from 21% to 12%. Investigators in Sweden analyzed 442 traffic accidents with injured persons in which vehicles with ASC devices and 1967 accidents of similar vehicles without ASC devices participated. It was estimated that the ASC device contributed to reducing all types of accidents by 22%, and that the number of accidents on wet highways decreased by 32%. In a study done in the US in 2004, data were compared on a "before-after" basis. The data on incidents involving individual vehicles with an ASC ("after") vehicle were compared to the previous car models ("before"). These relationships

were then compared to "before-after" accident data involving more than one vehicle (control data). The ASC effects were performed using the following formula:

$$E_{ASC} = 1 - \frac{f_{ASC} / f_{BezASC}}{f_{ASC-Kontrol} / f_{BezASC-Kontrol}}$$

Gdje je:

$E_{ASC}$  - efekti ASC uređaja,

$f_{ASC}$  - broj nezgoda pojedinačnog vozila sa ASC uređajem,

$f_{BezASC}$  - broj nezgode pojedinačnog vozila bez ASC uređaja,

$f_{ASC-Kontrol}$  - broj nezgoda sa više vozila, sa ASC uređajem,

$f_{BezASC-Kontrol}$  - broj nezgoda sa više vozila, bez ASC uređaja.

Tabela 1 Efekti ASC- a po vrstama saobraćajnih nezgoda i vozila

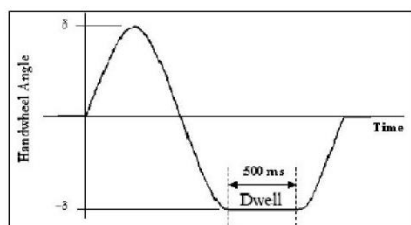
Vrsta saobraćajne nezgode	Putnička vozila [%]	Laka teretna i kombi-vozila [%]
Pojedinačno vozilo	35* (34)**	67 (59)
Prevtanje	69 (71)	88 (84)
Više vozila	19 (11)	38 (16)
Ukupno	14 (18)	29 (13)

Izvor: [1] National Highway Traffic Safety Administration, US Department of Transportation, Washington, D.C., 2006.

xx\* - Saobraćajne nezgode sa poginulim licima

xx\*\* - Sve saobraćajne nezgode

Vehicle equipped with an ASC device must meet certain criteria in order to alleviate the tendency of slipping or eliminated. The slip is defined here as the final direction of the vehicle that is greater than 90 degrees in relation to the initial direction after the symmetrical maneuvering of the steering wheel, with the number of right-hand steering wheels turning identical. During this test, the vehicle is not allowed to lose its transverse stability. The test of the excessive steering of the steering wheel. To detect real ASC performances, this test uses a maneuver based on a modulated 0.7 Hz sine-directional control input. A maneuver known as the 0.7Hz Sine and Dwell maneuver is shown in Figure 2.



Slika 2. Sine i Dwell manevar

Figure 2. Sine and Dwell maneuver

Retrieved from: [1] National Highway Traffic Safety Administration, US Department of Transportation, Washington, D.C., 2006. The test uses a rotating machine that delivers the appropriate steering wheel maneuver

vehicles to achieve vehicle stability during the ASC intervention. The change of steering position is initiated at a speed of 80 km/h and two series of tests are carried out. One series is with the steering wheel "from right to left" and the other "from left to right". Each series of testing begins with a moderate angle of steering rotation. The starting angle of the steering wheel is increased by each experiment in the series until the set criteria are met.

The transverse stability criteria. The transverse stability here is defined by the ratio of the "degree of rotation" at a certain point and the maximum turning point at 0.7 Hz of the Sine and Dwell "counter" rotation of the steering wheel. The maximum amount of this ratio may be 0.05, which practically means that the vehicle is equipped with an ASC slipper less than 5%. Based on this, it is required that the ASC must fulfill the following two criteria:

a) One second after 0.7 Hz Sine and Dwell maneuver the degree of turning the vehicle must be less than 35% of the maximum degree of rotation ie:

$$\frac{\psi_{(t_0+1.0)}}{\psi_{\max}} \times 100 \leq 35\%$$

b) 1.75 seconds after the maneuver, the degree of turning the vehicle must be less than 20% of the maximum turning point ie:

$$\frac{\psi_{(t_0+1.75)}}{\psi_{\max}} \times 100 \leq 20\%$$

where is:

$t$  - degree of turning in time  $t$ ,  
 $\max$  - maximum turning value generated with 0.7 Hz Sine and Dwell counter-rotation Controls,  
 $0 t$  - steering wheel complete steering time.

Accordingly, the probability of slipping prevention is at least 95% for an ASC system that meets the specified criteria.

### 3.2 The effects of cost and benefits

ASC is increasingly being offered as standard or optional equipment on new car models. It is estimated that in 2006 about 30% of cars in the US were equipped with ASC, and that in 2011 about 70% of cars would have this equipment. The initial unsatisfactory results of the braking system (ABS) contributed to the slow adoption of ASCs in the US as the automatic stability control contained ABS as a component. However, the ASC does not require the driver to activate the brakes. Considering that in the previous tests this device has met the set criteria for improving active safety, and at the same time achieved a positive ratio of cost and benefits, it is to expect that the number of cars with these devices will increase rapidly. When all cars on the US roads have an ASC installed, it is estimated that the number of people killed in traffic accidents will decrease from 52000 to 10300 annually, and the number injured from 168,000 to 252,000 in relation to the 2011 level. The technological costs of developing and installing the ASCs are around \$480 per vehicle, including the anti-blocking system, so that the total rising costs of installing this device by 2011 will be around \$985 million, assuming an annual production of 17 million passenger cars and assuming a gradual-rising cost of 58 dollars per car. The installation of ASC in cars will prevent numerous traffic accidents and thus reduce material damage and traffic congestion due to traffic accidents. It is estimated that about 453 million dollars will be saved by installing

this device on vehicles, based on material damage and traffic congestion costs. As far as fuel economy is concerned, the device will increase fuel consumption due to an increase in vehicle weight. However, this increase is negligible given that the average weight of the vehicle will increase by about 1kg, which will increase fuel consumption by about 9 liters during the car's life and will cost about \$4. Net cost per saved life equivalent is estimated at around \$430000 while the total value for preventing traffic accidents with fatal estimated at \$3.75 million. On the basis of the above it is predicted that the net benefits of ASC devices will be about 10.6 billion dollars.

### 4. CONCLUSION

Previous research and testing shows that the Automatic Stability Control (ASC) of the vehicle contributes to reducing the number of traffic accidents per vehicle by 35%. In fact, the 95 percent confidence interval indicates that this reduction is in the range of 33-48%. However, according to previous research, the ASC device has no significant impact on reducing the number of traffic accidents involving multiple vehicles. It is possible that future tests and studies that will include substantially larger samples and additional data show reduced and other types of traffic accidents. The initial unsatisfactory results of the anti-block braking system (ABS) contributed to the slow adoption of ASCs in the United States as the automatic stability control contained ABS as a component. However, the ASC does not require the driver to activate the brakes. By meeting the set criteria for improving active safety and favorable cost-benefit ratio, it is predicted that the number of cars with ASC devices will increase rapidly in the near future.

## LITERATURE

[1] Proposed FMVSS No. 126 Electronic Stability Control Systems, National Highway Traffic Safety Administration, US Department of Transportation, Washington, D.C. 2006.

[2] Electronic Stability Control: Review of Research and Regulations, Prepared by Michael Paine, Vehicle Design and Research Pty Limited for Roads and Traffic Authority of NSW, 2005.

[3] Charles M. Farmer, Insurance Institute for Highway Safety, Arlington, VA Effect of Electronic Stability Control on Automobile Crash Risk, Taylor & Francis Group, Traffic Injury Prevention, 2004.

[4] Christina M. Rudin-Brown and Peter C. Burns, The Secret of Electronic Stability Control, Ergonomic and Crash Avoidance Division, Road Safety and Motor Vehicle

## THE USE OF MOBILE PHONE IN THE CAR AS A RISING ROAD SAFETY PROBLEM

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***Abstract:** Obstruction of traffic is another risk and is becoming an increasing problem in the world. Previous studies in the field of traffic safety indicate that about 25% of all traffic accidents related to driver distraction or distraction while driving. In fact, mobile phones are now extensively used in a motor vehicle, and taking into account mobile operators increasingly offer new products or services to drivers that are useful for them (using the Internet, send and receive e-mail messages, watching movies, etc. .), the total time and the risk of using mobile phones while driving is increasing. Taking into account that the use of mobile phones while driving just as much dangerous as driving under the influence of alcohol, over the past few years, the impact of mobile technology on traffic safety has become the subject of numerous studies that aim.*

***Keywords:** mobile phone, traffic accident, traffic safety*

## 1. INTRODUCTION

A number of factors have been identified that influence road accident occurrence in road traffic, and limiting the exposure of these risk factors is crucial to reduce road traffic injuries. For example, there is now a large number of scientific studies that show that the increased risk of traffic deaths and injuries is due to speed overruns, driving alcohol, non-use of the seat belt, child seat or motorcycle helmet. Over the past several decades, program developments around the world have helped provide solid evidence-based grounds, based on which policy makers can make solutions to improve road safety in their countries.

Basically, most of these surveys focus on the risk that arises as a result of using a mobile phone while driving. What is significant is that these studies reveal that the use of a mobile phone while driving results in an unsafe driving pattern. Taking into account the foregoing, it can be concluded that the activity "mobile phone use" during driving is recognized as a factor contributing to the occurrence of a traffic accident, in which case most countries prohibited the use of mobile phones while driving. Bosnia and Herzegovina is also one of the countries that banned the use of mobile phones in traffic.

## 2. RESEARCH METHODOLOGY

### 2.1. RESEARCH SUBJECT

Driver distraction is an important factor in increasing the risk of injuries in road traffic. There are various types of driver disturbances, usually divided into those in which vehicle interference sources, such as radio, mobile phones and alike, and those out of the vehicle, watching billboards or watching people by the side, etc., This paper focuses on the use of mobile phones while driving, in response to concerns among lawmakers that this potential road

safety risk is accelerating rapidly as a result of the exponential growth of use mobile phones in general.

### 2.2. RESEARCH GOALS

- Determine whether more often male or female drivers use mobile phones when participating in traffic;
- Determine whether the age of the driver affects the awareness of the use of the mobile phone while driving;
- Determine how many drivers consider it dangerous to use a mobile phone while driving a vehicle;
- Determine the consequences of using a mobile phone while driving;
- Determine how often drivers of passenger cars use mobile phones or handsfree devices;
- Determine the scope of use of mobile phones in urban and rural areas of the municipality;
- Determine whether existing preventive measures for regulating the use of mobile phones when participating in traffic should be more rigorous.

This paper aims to raise awareness of driving risks associated with the use of mobile phones, as well as to present countermeasures that are being used worldwide to combat this growing problem.

### 2.3. RESEARCH SPACE

The survey was conducted in the municipality of Šamac. The municipality of Šamac is a northeastern municipality of Republika Srpska and a central municipality in Posavina. The municipality of Šamac is located in the following municipalities: Vukosavlje, Pelagićevo, Donji Žabar, Modriča, Domaševac-Šamac, Gradačac, and on its north are the river Sava and the Republic of Croatia. Through the

municipality, the Sava and Bosna rivers flow, and in the area

The municipality is the mouth of Bosnia in the Sava. It is about 10 km to the main road from the Belgrade-Zagreb highway. A favorable geographical position provides the possibility of developing transit tourism. On the Sava River, a freight and transport center "Luka" was built with a port, with the hubs of land and river transport modes: road-railroad-river, road-river, railroad-river.

## 2.4. RESEARCH TIME

The time period of the research covered a period of 5 years, that is, it encompassed time period from 2009 to 2013.

## 2.5. RESEARCH METHODS

The method is a procedure that defines the set goal. There are different types of methods used in traffic safety. Each of these methods has its advantages and disadvantages. For the purposes of this paper, the method of the survey and the comparison method was used.

## 3. DEFINING THE DRIVER OBSTRUCTION

A driver's obstruction is generally considered to be different from the driver's negligence or poor attention. Driving occurs when some kind of attention is distracted by the driver and the driver shifts attention from the driving task (for example, a cell phone is ringing). Thus, attention is paid because the driver performs an additional task and temporarily focuses on an object, event or person that does not relate to the primary task of driving. Invalid driving involves all occurrences or events that cause the driver

to pay less attention to the driving task. Some studies show that the impact on driver's driving performance that speaks to a mobile phone is similar to that influenced by conversation with passengers. However, other recent observations indicate that there is a significant difference between these two situations, with greater risk of disturbance and driving impact when using a mobile phone than those who talk to a passenger. Research has shown that the reaction time is slower among drivers talking to a mobile phone, but among those in conversation with a passenger. This seems to be the case, since passengers are aware of driving situations, unlike those with whom we talk to the phone, and can adjust the conversation during challenging driving situations, occurrences that do not appear in telephone conversations. However, this does not mean that talking with a passenger does not have the potential to interfere with the driver. Various studies have shown that the risk of colliding young drivers is significantly higher in the presence of people of the same age as in-car occupants. The driver's disturbance can be one of four types:<sup>8</sup>

- Visually (it arises when visible irritations in / out of the vehicle distract us from basic task - safe driving);
- cognitive (occurs when mental (cognitive) tasks are executed simultaneously, and execution of both tasks is often much more difficult than if they are separated);
- Physical (occurs when drivers have to move their hand from the steering wheel to hold the mobile phone while controlling the vehicle);
- Audible (occurs when drivers respond to a cellphone ringtone, or if the device is rings so loudly to mask other sounds, such as car horns).

<sup>8</sup>[http://www.fvv.um.si/dv2013/zbornik/policijska\\_d\\_ejavnost/Obradovic\\_Magusic.pdf](http://www.fvv.um.si/dv2013/zbornik/policijska_d_ejavnost/Obradovic_Magusic.pdf)



#### 4. THE USE OF MOBILE PHONES IN A VEHICLE AS A GROWING PROBLEM IN TRAFFIC SAFETY

Numerous research attempted to determine how many drivers use mobile phones while driving. For example, in many high-income countries (for example, in the United States, New Zealand, Australia and some European countries), 60-70% of drivers report the use of a mobile phone at least sometimes during driving. Some surveys also try to estimate and the length of mobile phone usage time while driving, because not only driving use but the length of use also affects the risk, the longer the use is the greater the risk. Most of the data is obtained from self-reported drivers, on-the-spot monitoring or police records. The following results were obtained:

##### Research in the world:

- In the United States, in Washington, 11% of surveyed vehicles had drivers using a mobile phone.
- Surveys by surveys in Canada revealed that 28% of Ottawa drivers use mobile phones while driving in rural areas, but this figure was significantly higher (59%) in urban areas.
- Police reports of traffic accidents in one US state show that the use of mobile phones while driving has more than doubled between 2001 and 2005, from 2.7% to 5.8%.<sup>9</sup>

##### Research in the municipality of Samac:

- The survey found the use of mobile phones of 26% in rural areas, while in the urban environment this figure was 22% higher (due to lower speeds) and amounted to 48%.

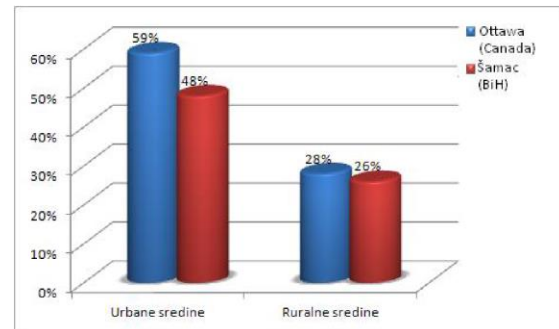


Diagram 1. The relationship between the use of mobile metaphones in urban rural areas of Samac and Ottawa

Although it is clear that there is increasing evidence of the use of mobile phones while driving, there is very little available data on the prevalence of the use of handsfree devices. Two studies providing these types of data are presented below:

##### Research in the world:

- In research in the Netherlands, it was found that 2% of drivers stated that they often used mobile phones, compared with 14% who reported using handsfree devices while driving.
  - Observing research in the UK, London, showed that 2.8% of drivers use mobile phones, while this figure was much higher (4.8%) for handsfree devices.
- The use of a handsfree device has grown more than using the latest handsets years.
- However, data from the UK show that the rate of use of mobile phones and handsfree devices outside the city is lower than in London: in 2009, 1.1% of car drivers, 2.2% of truck drivers and 1% of truck drivers are classified as users mobile phones while driving, while the corresponding figures for handsfree devices are 0.5%, 0.8% and 0.5%, which is significantly less than in London.<sup>10</sup>

This can be a reflection of lower speeds in the capital resulting from relative

<sup>9</sup> World Health Organization, Geneva 2011. Mobile phone use: a growing problem of driver distraction

<sup>10</sup> World Health Organization, Geneva 2011. Mobile phone use: a growing problem of driver distraction

congestion in traffic, which means where the speed is lower, the use of mobile phones in traffic is higher.

#### Research in the municipality of Samac:

• Data obtained by the survey indicate that the use of mobile phones in the municipality of Šamac is considerably higher than for handsfree devices, by 9%. The increased use of mobile phones from handsfree devices in Samac, unlike London, can be justified by the insufficient distribution of new technologies in our country.

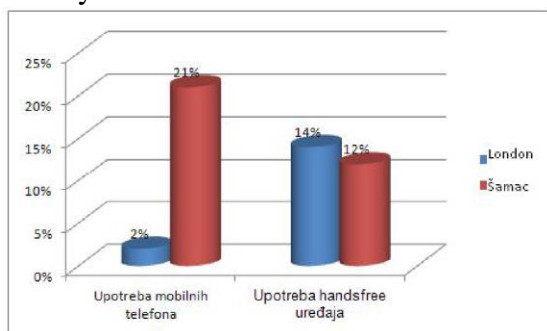


Diagram 2. Relationship between use of mobile phones and handsfree Samac and London

#### 4.2. Estimating the level of use of text messages while driving

There is limited information about the scope of writing text messages while driving, partly because of the difficulty in observing such behavior in vehicles.

##### Research in the world:

- Research in the UK, London found that 45% of drivers reported reading or writing SMS messages while driving.
- Research in Australia shows that one in six drivers regularly write SMS for driving time.
- A survey in the United States showed that 27% of Americans reported writing or reading text messages while driving.

Research in the world also shows that the share of drivers who write text messages while driving seems larger among young or inexperienced drivers:

- Australian research (above) showed that 58% of drivers aged 17 to 29 regularly read or write text messages while driving.<sup>11</sup>

#### Research in the municipality of Samac:

• A survey by drivers in the municipality of Samac revealed that 49% of drivers are reported writing and reading SMS messages while driving.



Diagram 3. The ratio of reading and writing SMS messages while driving in Samac, London, Australia, and the United States

#### 4.3. The impact of mobile phones on driving behavior and involvement in accidents

As noted earlier, some jobs are considered essential for the safe driving, and are called "primary tasks." Other, such as the use of mobile phones, constitute "secondary tasks". Research shows that it is difficult for drivers to perform, the primary tasks necessary for the safe management of motor vehicles when they are involved in secondary tasks. The result is that their driving efficiency is reduced in many ways. Most research on how distraction leads to a worsening of driving behavior refers to to use mobile phones, although other sources of interference can also affect it

<sup>11</sup> World Health Organization, Geneva 2011. Mobile phone use: a growing problem of driver distraction

behavior. The impact of mobile phones on driving behavior can be expressed in two ways:

- Impact of driving behavior
- The impact of text messages on driving behavior

### 4.3.1. Impact of calls on driving behavior

Assessing the connection between the use of mobile phones and the risk of collision is not easy. Some of the difficulties relate to the fact that information about whether or not drivers use mobile phones at the time of a traffic accident are rarely recorded. In addition, the risk of miscibility can make accidental locking impossible (for example, if drivers drive too fast, the mobile phone can not be the cause of the collision).

However, surveys conducted to assess the risk of collision show that drivers who use mobile phones while driving have a greater risk of collision than those who do not.

The estimated increased risk varies depending on the research, and ranges between two and nine. Some criticisms were also made that examined the positive and negative aspects of all research related to this problem and are based on the estimation of how much research methodology is robust. They indicate that the use of a mobile phone increases the risk of driver collisions by a factor of four, the risk associated with the use of mobile phones while driving, and the use of a handsfree device. The effects of gender and age on collision risk are unclear, despite studies suggesting that these factors influence driving behavior.<sup>12</sup>



Figure 3. Traffic accidents on the highway

Source: <http://www.subotica.com/vesti/dan-secanja-na-zrtve-saobracajnih-nesreca>

### 4.3.2. The impact of text messages on driving behavior

The effects on driving behavior when sending or receiving SMS messages are potentially very important. While there is still a lack of research in this area, existing research (mostly experimental) suggests that text messages lead to an increase in cognitive requirements to write text messages, physical interference as a result of holding the phone, and visual impediments arising from writing or reading message, this has a significant impact on driving skills. For example, one experimental survey showed results among drivers who wrote text messages:

- The amount of time the drivers spent with eyes turned from the road rose to 400% at reading and writing SMS messages.
- Drivers made 28% more excursions from the road and 140% more wrong maneuvers when sending and receiving SMS messages.

Writing messages or e-mails during driving doubles the time needed for a reaction, reveals a study conducted by the University of Texas Transportation School at 42 drivers at the age of 16 to 42 that measured the response time to the yellow light. The average time it takes to react to the flashing light at the traffic light, the driver who does not write the SMS is one to two seconds

<sup>12</sup> Farmer, C., Braitman, K., & Lund, A. (2010). Cell phone use while driving and attributable crash risk.



Figure 4. Writing SMS messages while driving  
Source: <http://www.visokoin.com>

However, drivers who write messages during driving, the reaction is slowed down to three to four seconds.<sup>13</sup> Drivers who write messages while driving are almost 11 times more likely to not see a blinking light than those who do not use mobile phones while driving. Drivers who send messages try to make up for distracting attention by increasing their safety distance or speed reduction, which again impacts traffic safety.

## 5. WHAT DID THE SURVEY SHOW

According to the sex in the observed sample, there were slightly more men, ie 68% compared to 32% of female respondents. In the structure of the observed sample there were slightly more respondents of the younger age, so that from 19-25 years of life there are more than half of the respondents of the observed sample (64%). The representation of respondents from 26-45 years was 25%, while the elderly from 45 years were only 11%, and younger than 18 are not. So we can conclude that very the low and very high age of the driver will not significantly affect the results. According to driver's experience, the dominant group of drivers has a driver experience of up to 5 years (49%). The fact that 78% of respondents declare that they

use one, 17% two, and 5% do not have one mobile phone pointing to the size of this communication medium in the driver's population, so it can be safely stated that there are rare drivers that do not own at least one mobile phone.

The general information about the frequency of using a mobile phone while driving gives us the answer to the question "Do you use mobile phones while driving a vehicle?", Only 1/3 (32%) stated that they never use a mobile phone, while the other 68% It does. Depending on the mode of use, this primarily refers to the interview with the holding of a mobile phone, which is sanctioned by law as an offense, as it leads to physical and cognitive interference of the driver. Conversation with the use of handsfree devices that are generally considered to prevent interference and, therefore, in some countries such conversations are permitted, only sometimes 12% of respondents use it. The fact that 32% of the driver of the observed sample, that is, 1/3 reads and writes messages while driving, is especially worrying because reading messages leads to all three types of distractions: visual because the view is focused on message words, physical, because as a rule the mobile phone also includes keeps in hand and cognitive, because the content of the message is being contemplated. The most difficult form of combined visual, physical and cognitive distraction is when writing messages while driving. Encouraging data on the number of drivers using mobile phones for landscape photography or video recording, only 5% of drivers photograph or record video material while driving, while 95% do not. Photographing and recording video materials undoubtedly represent the most risky forms of behavior, as they completely exclude the possibility of driving a vehicle. In the end, it is significant that GPS navigation is not used

<sup>13</sup> <http://www.psihologija/zbog-sms-anja-tijekom-voznje-vozac-sporo-uocava-opasnosti-237754>

by 83% of drivers of our sample, while the other 17% use occasionally, while no driver uses it frequently. To the question "Do you use mobile phones more in urban or rural areas?" 44% of respondents said they use more in urban and 24% in rural areas, while 32% do not use it at all while driving. 26% of respondents (mostly female) said they were worried that they could be victims of a traffic accident due to the negligence of other drivers in driving when talking, 58% are not worried while 16% are not worried because they consider that there is no risk of collision due to telephone calls driving. In spite of the fact that 74% of respondents are not concerned that they might be victims of a traffic accident or consider that there is no risk of collision due to telephone calls while driving, as many as 98% believe that the use of mobile phones while driving is dangerous and only 2% is not. By adding the answer, we received exposure to risk, drivers (respondents) due to a particular visual, physical and cognitive distraction. This exposure of the driver to risk is presented in diagram 32.

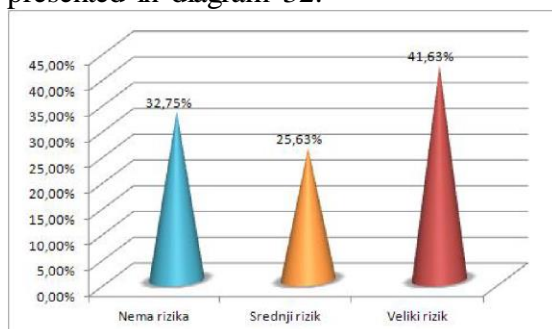


Diagram 4. Exposure to risk due to expressive visual, physical and cognitive distractions

In this way we have obtained a diagram showing that 32.75% of respondents do not have risk because it does not exhibit any kind of interference during driving due to the use of a mobile phone. The average risk is 25.63%, most often because it occasionally uses a mobile phone for data exchange or calls while driving. In the high risk category, individuals are often classified as two or more of these risky

actions. According to our data, such individuals are 41.63%.

## CONCLUDING CONSIDERATIONS AND PROPOSED MEASURES

Driving obstruction is a serious and growing problem of traffic safety. More and more people have mobile phones, and the rapid introduction of new in-car communication systems will make this problem even greater in the coming years at a global level because technology is rapidly evolving. Evidence clearly indicates that driver interference is an important issue of road safety. At the same time, the quality and quantity of existing evidence is insufficient to believe how much disturbance affects driving, and among the many disruptions that pose the greatest danger, and under what conditions. Although the problem of driving interference can have many causes, internal or external in relation to the vehicle, this thesis was focused on the risk associated with the use of mobile phones while driving. This is briefly what is known about interventions, and tries to draw attention to some preliminary recommendations. Using mobile phones in a vehicle requires more interaction from other sources of interference, such as drinking coffee or eating sandwiches. When using the phone by the driver, the driver is more guided by the technology itself, when the phone rings the driver will automatically react, regardless of the traffic or driving conditions at that moment. The use of mobile phones while driving has shown that it has a number of adverse effects on driving behavior. This is because drivers are not only physically hampered by the simultaneous holding of the phone and driving, but also cognitively disturbed, share their attention between conversations that include driving related tasks. Also at the time of writing this thesis, no convincing evidence was found that the use

of a handsfree device is more secure than the use of mobile phones in hand, due to the cognitive impairment that is present in both types of device. Research shows that using mobile phones, whether manual or handsfree while driving leads to increased collision rates compared to when drivers do not use a mobile phone. What is clear is that the relative impact on the ability to drive during interference may vary depending on the type of phone, age, gender or driving mode, the use of a mobile phone while driving absolutely increases the likelihood of collision for all drivers.

A significant number of research suggests that writing text messages also leads to significant physical and psychological disturbances, and driving performance is reduced. Young drivers use mobile phones more often while driving and appear to be at a special risk of the effects of interference resulting from this use. Text messages appear to have a particularly damaging impact on driving behavior, and this is a problem that is likely to increase in frequency, as this is usually a cheaper form of communication than a phone conversation. There are a number of challenges to successfully addressing the use of mobile phones while driving. First, more efforts need to be made to improve the systematic collection of data on the use of mobile phones in traffic accidents in order to assess the scale of problems in individual countries and to understand more about the distribution of problems, for example, which groups of drivers are most affected, in in which geographical areas, in what period of time. These data will enable the prevention measures to be effectively carried out. In addition, although available evidence suggests that the use of mobile phones negatively affects a range of performance driving, more research is needed to better understand the impacts of different forms of mobile phone use, for example, talking, sending or receiving text messages, driving behavior, and real-life

accident risks. Also, the overall contribution of interference to the use of mobile phones on the occurrence of road traffic crashes in relative to other risk factors.

Numerous countries have taken measures to pass laws on the use of mobile phones in traffic, as well as a wide range of laws. Regardless of whether you need to introduce laws that prohibit the use (and how to use) of mobile phones, and who needs to apply them, the effectiveness of these laws will in part also depend on the ability to execute it continuously. However, the data that exist indicates that it is very difficult to detect and maintain law enforcement regarding mobile phones, partly because of the difficulty in detecting this behavior. Awareness raising campaigns of the broadest public in the fight against the use of mobile phones are also very important, in order to increase the public's understanding of the hazards of driving in the event of interference and to encourage safe driving. Although the focus of this work is primarily on the interference caused by the use of a mobile phone, the technology systems inside the vehicle can also be used to protect against interference. There are several new technologies that can reduce injuries in road traffic caused by driver interference. For example, warning functions that alert the driver to sudden out-of-band traffic exits, or the technologies used by sensors in the vehicle, to estimate the scope of the driver's work and redirect mobile phone calls. However, having a mobile phone in the vehicle also has good sides as it creates security that if needed, it can be called for help. However, the driver should not use them while driving, but, if already, must stop by the carriageway and perform an interview.

## LITERATURE

[1] World Health Organization, Geneva, 2011. Mobile phone use: a growing problem of driver distraction

- [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://www.fvv.um.si/dv2013/zbornik/policijska_dejavnost/Obradovic_Magusic.pdf)  
[http://blog.telekom.rs/internet/drustvenemreze/kada-vozis-parkiraj-telefon-odideje-doviralne-campaigns /](http://blog.telekom.rs/internet/drustvenemreze/kada-vozis-parkiraj-telefon-odideje-doviralne-campaigns/)  
[http://www.ams-rs.com/images/pdf/zakoni/Strategije\\_bezbj.\\_saob.\\_na\\_putevima\\_RS.pdf](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](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.

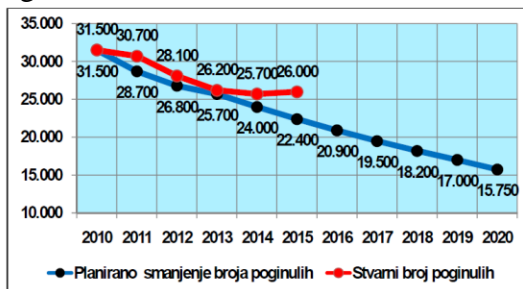


Figure 1. Planned and actual number of those killed on the EU roads 2011-2020. Source: (4).

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.

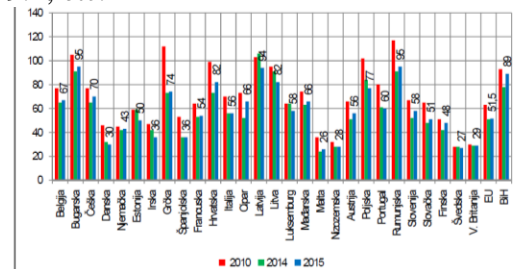


Figure 2. Number of deaths per 100,000 inhabitants in certain EU countries in 2010, 2014, and 2015.<sup>14</sup> Source: (4).

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

<sup>14</sup> 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).

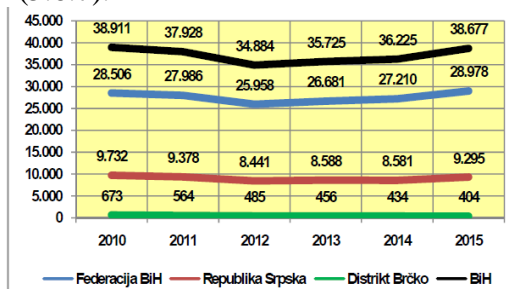


Figure 3. Total traffic accidents in BiH from 2010 to 2015 Source: (5,6,7)

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).

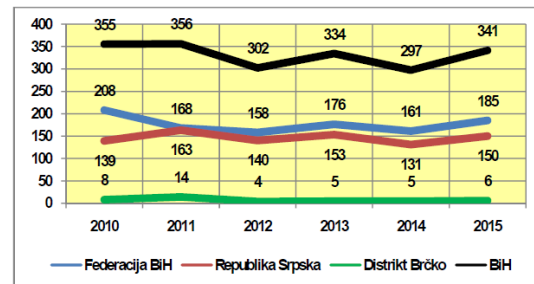


Figure 4. Number of persons killed in road accidents in BiH from 2010 to 2015 Source: (5,6,7)

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.

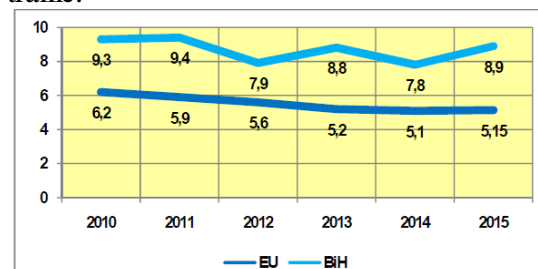


Figure 5. Number of deaths in the EU and BiH per 100,000 inhabitants from 2010 to 2015 Source: (5,6,7)

### 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<sup>15</sup> 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<sup>16</sup> 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.

<sup>15</sup> Study conducted by Advisors Transport Research Laboratory (TRL), UK, England

<sup>16</sup> The study is available at:

[http://ec.europa.eu/transport/road\\_safety/pdf/vehicle\\_speed\\_limitation\\_evaluation\\_en.pdf](http://ec.europa.eu/transport/road_safety/pdf/vehicle_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](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](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,

## AUTOMATED DRIVING SAFETY

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***Abstract:** The purpose of this paper is to provide an overview of automated driving, point out its significance and major safety benefits and offer some recommendations for creating a regulatory environment that gives priority to road safety. Prototypes of automated vehicles capable of self-driving new technologies were and will continue to be tested on public roads throughout Europe and other continents. Automated driving brings many benefits, such as improving traffic safety, reducing the possibility of human error, accelerated use of security technologies, reducing downtime and so on. It is expected that commercial production of automated vehicles started in 2017. The market will be a wide range of models of automated vehicles in place until year 2030. Automated driving technology allows self-driving vehicles, but today is not yet clear how these vehicles will be able to self-drive in all circumstances, especially in trade with conventional vehicles, other participants in traffic and in different climatic conditions. In addition to the benefits brought by automated driving, there are also other potential challenges such as addressing key road risk, but also create new ones. It is necessary to investigate a number of strategic questions that will provide answers and contribute to the efficient use of the partially and fully automated vehicles.*

***Keywords:** automated driving, automated vehicles, the potential benefits and challenges.*

### 1. INTRODUCTION

Automated driving technologies built on vehicles already prevent the occurrence of traffic accidents and fatal consequences on roads. Systems such as electronic stability control, automated harsh braking, intelligent speed adjustment, traffic lane departure warning and many others are active on-board safety systems. All these systems use technology to compensate to some extent drivers' mistakes, taking in some circumstances some of the vehicle controls from the driver. Full autonomy of the vehicle can bring significant changes in public transport, employment, in day-to-day performance and urban development in the near future. Theoretically, the potential safety benefits of automated driving are enormous. Autonomous vehicles will not drink and drive, or interfere with telephone conversations. Such vehicles will be programmed to run at custom and regular speeds, and will check the conditions in

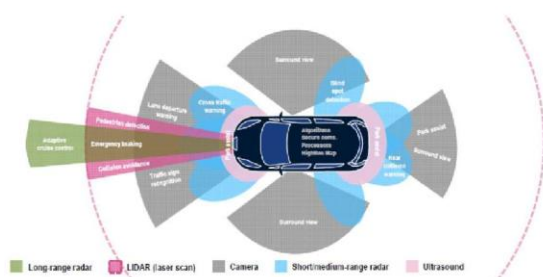
their environment several times every second. These technologies will clearly mitigate some of the risks, but they can also create new ones. In real driving conditions, automated vehicles will communicate with a large number of unautomatized vehicles and the most vulnerable traffic participants, pedestrians and bikers. Other road users, like pedestrians and bikers, will not become automated. How will it work in traffic that can not contact the eyes with drivers in crossing the road? How this will affect security is one of the important issues. Also, the important issue concerns the adoption of regulations for autonomous systems that have been tested and approved in accordance with common standards, especially in the conditions in which Self-propelled cars already receive software updates that affect security performance, such as the recently updated Tesla Autopilot. Also, Google is in the patent application of a sticky substance applied to the body of self-propelled cars, the purpose of which is in the event of an



encounter with pedestrians, to remain glued to the vehicle instead of being discarded or overturned. In the last seven years, how long has the development of autonomous driving technology lasted more than 2.4 million test kilometers. Among the first in the world with the project of development and testing of the autonomous driving system is Volvo, which carries out an experiment with more than a hundred vehicles equipped with autonomous driving on Chinese roads. This experiment will gain valuable experience and gain knowledge of the behavior of the most advanced automated driving system on the network of urban roads in the real conditions of traffic. Despite the rapid technological advancement and development of the past few years, there are still no clear answers to many research and regulatory issues related to partially automated and fully autonomous vehicles. Therefore, there is a prior need to consider certain assumptions before the implementation of these vehicles in practice.

and communication with other vehicles and infrastructure. An automated vehicle, like a driver, must collect information, make a decision based on that information, and make that decision. The information comes from vehicle equipment, physical infrastructure, physical-digital and digital infrastructure. Many of these technologies exist today and are capable of driving the vehicle and in some cases with a minimum vehicle drive

or without input from the driver in test situations and in different driving conditions, Figure 1.



## 2. AUTOMATED DRIVING

Automated driving involves a wide range of technologies and infrastructures, capabilities and contexts, uses, and business cases, and products and services (1). Automated driving should also be seen in a wider context of new developments in the field of automating the imminent connection with new technologies and mobility systems. Automated vehicles can use built-in sensors, cameras, GPS and telecommunications to obtain information on the safety critical crisis assessment.

An automated vehicle is one that can, at least in part, perform a driving task independently of the driver, or read out its environment and move without input from the driver. The concept of self-driving, on the other hand, refers to the ability of an automated vehicle to operate independently and without a driver in a dynamic traffic environment, relying on its own systems

*Figure 1. Technologies that enable vehicles to feel, plan and operate in response to the dynamic driving environment, (1).*

From a technical point of view, the current technology and systems for highly automated driving in controlled conditions give satisfactory results. These vehicles use sensors (radar, GPS and video camera system) in combination with high accuracy of digital maps that allows control systems to recognize the corresponding motion itineraries, such as barriers and relevant signaling. However, since 2015, there is still no consensus on automated driving. It is to be expected in view of the announcements by some manufacturers of the use of highly automated vehicles before 2020, and even more advanced vehicles by 2030. At the same time, consideration should be given to the risks associated with the implementation of the safety of these vehicles and the possibility of regulatory

measures that prevent the development and implementation of new technology.

## 2.1. Levels of automated driving

The International Automotive Engineers Association has adopted six levels of automated driving, as guidelines describing the emergence of the most common levels of automated driving (SAE, 2014; Adapted from SAE Standard 33016), Table 1 (1).

The levels determine that the "dynamic driving task" is divided between drivers and vehicles. The task is entirely performed by the driver at level 0 (without automation) and with a fully automated system for driving at level 5 (complete automation). Level 0 is quickly becoming less important, as technologies that lead them to Level 1 are already on the market with the emergence of new automated vehicles. Levels 0 and 1 will help develop the program to level 5, and the security systems used for these levels, too to draw developmental guidelines for level 5, potentially with greater security benefits.

Table 1. Automated driving levels, Source: Adapted from SAE Standard (SAE, 2014)

Razina	Naziv razine	Upravljanje i usporavanje	Kontrola vožnja u okolini	Izvođenje dinamičkih zadataka vožnje	Sposobnost sustava –moduli vožnje	
Vozač kontrolira okolinu	0	Ne automatizacija pune sposobnosti vozača po svim aspektima dinamičkih zadataka vožnje, čak i kad je pojačano upozorenje ili sustav za intervenciju	☹	☹	☹	
	1	Pomoć za vozača izvršenje specifičnih modula vožnje uz pomoć sustava za upravljanje ili ubrzavanje/usporenje putem podataka za vožnju iz okruženja i s očekivanjem da vozač obavlja sve preostale aspekte dinamičkih zadataka vožnje	☹	☹	☹	neki moduli vožnje
	2	Djelomična automatizacija izvršenje specifičnih modula vožnje s po jednim ili više sustava pomoći vozaču za upravljanje i ubrzavanje /usporenje koristeći informacije za vožnju iz okoliša i uz očekivanje da vozač obavlja sve preostale aspekte dinamičkih poslova vožnje	☹	☹	☹	neki moduli vožnje
Vožilo kontrolira okolinu	3	Uvjeta automatizacija izvedba specifičnih modula vožnje s automatiziranim sustavom vožnje za dinamičke poslove vožnje s očekivanjem da vozač primjereno odgovori na zahtjeve intervencije	☹	☹	☹	neki moduli vožnje
	4	Visoka automatizacija izvedba specifičnih modula vožnje s automatiziranim sustavom vožnje po svim aspektima dinamičkih poslova vožnje, čak i ako vozač ne primjereno odgovori na zahtjeve intervencije	☹	☹	☹	neki moduli vožnje
	5	Potpuna automatizacija potpuno automatizirana vožnja sustava sa svih aspekata dinamičkih zadataka vožnje na svim cestama i ekoloških uvjeta koji mogu biti upravljani od strane vozača	☹	☹	☹	svi moduli vožnje

The expert commission responsible for this textual description (SAE, 2014)

emphasizes that these are not normative, technical or legal, but descriptive levels of automated driving. They do not mean any particular order of introduction to the market. Elements indicate a minimum, not the maximum system capability for each level. A special vehicle can have more automated driving possibilities, so it can work at different levels, depending on its characteristics.

## 2.2. Automated driving in Europe

Europe has a long history of investing in research projects that contribute to automated driving (2). A number of European Union (EU) member states are already open for automated driving, both in terms of the ability to test new vehicles and in terms of project implementation. The example includes urban mobility showing the use of a robotic vehicle for transport services in a protected urban area (3). Sweden plans to introduce 100 self-suffers vehicles, which will be used on public roads in Gothenburg in 2017. Finland will also enable the testing of robotic vehicles on public roads in limited periods in predefined areas (4). The United Kingdom has also announced rehearsals, including taking practical steps (5). Belgium develops a similar program based on the UK document and prepares, together with the Netherlands presentation of freight vehicles. In Spain, the General Transport Directorate approved the framework for testing autonomous vehicles on open roads at the end of 2015 (6). One vehicle is already on the market, the Tesla Model S, which has an autopilot function that, by combining cameras, radars, ultrasonic sensors and data, automatically directs the vehicle by motorway, still under the control of the driver, and also allows changing the route, and adjusting the speed to the traffic conditions (7). Vehicle manufacturers are also interested in the benefits of this new area. Various studies have uncovered a potential (8) economic impact on

automated driving in the years to come in the range of up to 71 billion euros in 2030. The estimated global market for automated vehicles is 44 million vehicles by 2030 (9).

### **3. POTENTIAL SAFETY ADVANTAGES OF AUTOMATED DRIVING**

The potential safety benefits of automated driving are manifested through the achievement of a European vision of zero-dead by 2050, by reducing human error, speeding up the use of security technology, and by supporting high-risk drivers of driving.

#### **3.1. Achieving the safety benefits of automated driving**

According to the European project (2), the safety and potential for reducing traffic accidents caused by human errors is one of the main drivers for higher levels of automated driving. Thus, automated driving can be considered as a key aspect of supporting the achievement of EU transport policy goals, including road safety (10). However, based on previous research results, it is estimated that the potential benefits of automated driving are only beginning to be achieved, with improvements in all areas of road safety, including road infrastructure and driver behavior. A study by a group of authors from Finland (10) shows that traffic safety is on the rise, given the gradual development of automation. The positive impact of traffic automation on traffic flows will be seen at Level 3, that is, at the level of conditional automation, with road traffic flow and traffic efficiency improving and speeding down.

Impacts in the context of the transport system will already be visible at Level 2, where congestion and congestion will be reduced, and traffic safety will be improved.

However, the authors (11) in their research claim that self-driving or automated driving will be difficult to perform perfectly, for example driving in different weather conditions or due to collisions caused by other road users, such as the sudden crossing of pedestrians across the road or a pedestrian crossing. The benefits of road traffic safety by reducing the driver error by introducing automated driving can be significant, as most collisions include certain elements of its error, and autonomous driving reduces or eliminates these errors (1). The European Commission accepts such an approach to the "safety system", which means that "the driver / driver has made a mistake and his mistakes must be foreseen and the risk of serious consequences should be reduced to a minimum." Also, for further consideration of automated driving, it is of great importance and "that responsibility for reducing deaths and serious injuries is not only placed on traffic participants but also shared with vehicle manufacturers and management of road infrastructure". There are currently many different circumstances that can lead the driver to a wrong assessment of the situation, negligence or interference. Estimates are those contributing to road deaths from 10 to 30% (12). Increased vehicle automation levels can contribute to the elimination or mitigation of conflict situations. It is expected that this could contribute to the reduction of visual errors, in the collision of one vehicle and on collisions at intersections. Automation can be expected to reduce some collisions due to excessive speed on the highway due to the rapid reaction time (13,14). It could also solve crashes related to driver fatigue, although driver drowsiness due to monotony and separation from vehicle control can be enhanced. However, the OECD report claims that the true safety test for

autonomous vehicles will be to restore a good ride without collisions and drivers.

New challenges and new types of road accidents that may occur when autonomous vehicle technology becomes commonplace, such as mixing autonomous and conventional vehicles or other road users, will arise. Therefore, in the first years of introduction, full automation can be allowed only in certain places where the traffic environment will be more homogeneous and more customized to automated vehicles. This can minimize the mixing of autonomous and conventional vehicles and thus reduce conflicts between different types of vehicles.

Accelerated introduction of security technology today in the market has several consequences

systems that emerge outside the framework of human abilities (1). According to the SAE classification, vehicles have currently reached level 2 in automated traffic (partial automation), and level 3 (conditional automation) of vehicles can come on European roads in two or three years, and by 2020 at the latest. Some of the systems are already legally prescribed in respect of EU vehicle safety regulations. The goal of most of these active technologies is to intervene

this way to prevent the collision. One of the other implications for automated driving is a limited number of disabled drivers with difficulty in starting or continuing driving using automated systems or within a fully autonomous mode. It is recommended that when designing automated systems, a diverse population of driving in different traffic situations should be taken into account. One group that might benefit is older drivers, very relevant in the context of society's aging in Europe. Thus, automation could bring benefits to high-risk drivers, increase or expand mobility with the potential reduction of security risks that might pose for other road users.

In contrast, young drivers who have access to automated driving can gain less driving experience. It's an area that needs more research. It also presents driver training questions: how through training you can train people to drive safely and use an automated driving technique, and how drivers will be trained to be safe transition between fully independent and automated driving.

### **3.2. Potential safety challenges of introducing automated driving**

Potential safety challenges related to automated driving are possible through solving key road risks, reducing collision, transition phase of automated and non-automated vehicles, automated vehicles and vulnerable traffic participants, smart roads, or roads and digitization, customization of driver behavior, social acceptance and accountability data protection. One important issue in assessing the possible impact of an automated safety drive is whether the automation of key road risks such as speeding or driving under the influence of alcohol is resolved. Some recent preliminary analysis of the reality of the collision on the involvement of self-propelled vehicles taken over in the United States comes with various findings. The first set of research reveals that self-propelled vehicles for millions of miles of travel are more involved in traffic accidents than

conventional vehicles (11). This research indicates important warnings. Firstly, the distance traveled by self-propelled vehicles is still relatively low (about 1.2 million miles, compared to about 3 trillion per year in the US by conventional vehicles). Until now, autopilot vehicles have been driven only in limited (and generally less demanding) conditions, such as avoiding snow runs. Therefore, their exposure is not yet representative as the exposure of conventional vehicles. The study also showed that self-propelled vehicles were

not wrong for the collisions they were involved with and that overall crash injuries involving self-propelled vehicles were lower than conventional vehicles. Other recent surveys also from the United States, "A comparison of data on collision of automated vehicles" conducted by the Virginia Tech Transportation Institute (VTTI), was commissioned by Google. It has been shown that self-propelled cars are less involved in car accidents than normal cars, especially for more serious traffic accidents. In addition, in the same research, when the events of automated vehicles were analyzed, not a single vehicle operating in an automated mode was considered to be guilty of an event. One of the key challenges on the road to full automation is the ability and way of managing automated and semi-automated vehicles in a transitional phase that could last fifteen or more years, depending on market conquest and vehicle renewal. Security assessments and forecasts are based on assumptions that include fully equipped fleets of vehicles and vehicle comparisons, with very few studies performed on safety effects during the transition phase (15). Another problem, especially at the time of the introduction and the transition period, is the way in which these vehicles will communicate with the most vulnerable traffic participants. Of course, some of the safe technologies have already been incorporated into vehicles, especially to prevent vehicle collisions on the most vulnerable participants. Although research with new ideas is in progress, current pedestrians and bicyclists with their ITS safety equipment in interaction with automated vehicles are generally incapable. The interaction between current vehicle drivers and the most vulnerable traffic participants (pedestrians and cyclists) sometimes takes the form of communication through eye contact. Vehicles and their sensors and cameras will have to go above and beyond simple detection and be able to communicate with

different forms of communication. This communication should be able to function even in bad weather conditions. The operation of automated vehicles in a safe condition should be ensured even under unfavorable conditions. This also applies to digitization and road infrastructure, and both will require investments for upgrading and maintenance. Numerous semi-automated or fully automated technologies will rely on road infrastructure to read their applications. Infrastructure performance (visibility, repair status) related to traffic signs, signals and road markings to support a higher level of safety and reliability of automated driving must be recognized. This will include common standards and harmonization. One option, which could be very likely in the context of facilitating common urban traffic, is to limit the area in which automated vehicles operate or provide them with a dedicated infrastructure, such as the use of traffic lanes for public passenger transport vehicles (1).

#### 4. CONCLUSION

Based on the prior knowledge about the safety benefits and challenges of automated driving at the EU level, recommendations have been made aimed at introducing measures that can have a priority impact on improving road safety. In doing so, it is most important to develop a single and comprehensive EU regulatory framework for the implementation of automated vehicles and automated driving standards. It is necessary to establish a broad and effective monitoring and evaluation framework covering all aspects of automated driving, including investigating traffic accidents during the testing and implementation of automated vehicles and conventional vehicle relationships. In order to obtain relevant responses to numerous challenges, it is necessary to continue research on the implementation of automated driving with emphasis on the

interaction of automated vehicles and the most vulnerable traffic participants, the ability to solve the mobility of high-risk traffic participant groups and driver engagement during automated driving. By introducing automated driving, driver training needs to be adapted, including the development of a curriculum so that drivers can get operational knowledge of when and how to use the benefits of automation and understand the basics, advantages and limitations of innovative Technology.

## LITERATURE

- [1] OECD / ITF (2015). Automated and Autonomous Driving: Regulation under Uncertainty.
- [2] City Mobil2 and ERTRAC (2015). Automated Driving Roadmap.
- [3] <http://www.citymobil2.eu/en/>
- [4] Aurora Project: [http://liikennelabra.fi/test environments / aurora /](http://liikennelabra.fi/test_environments/aurora/)
- [5] <https://www.gov.uk/government/publications/automated-vehicle-technologies-testingcode-of-practice>
- [6] [http://www.dgt.es/Galerias/seguridad-vial/normativa-legislacion/otras\\_normas/modificaciones / 15.V-113-Vehiculos-Conduccion-automatizada.pdf](http://www.dgt.es/Galerias/seguridad-vial/normativa-legislacion/otras_normas/modificaciones/15.V-113-Vehiculos-Conduccion-automatizada.pdf)
- [7] <https://www.teslamotors.com/presskit/autopilot>
- [8] KPMG, Connected and Autonomous Vehicles - The UK Economic Opportunity, Boston Consulting Group (2015). Revolution in the Driver's Seat: The Road to Autonomous Vehicles in ERTRAC (2015) Automated Driving Roadmap.
- [9] Autonomous Vehicles, Navigator Research Aug / 13 and ERTRAC (2015) Automated Driving Roadmap.
- [10] Innamaa, S. Kanner, H. Rama, P. & Virtanen, A. (2015). Automaation lisaantymisen vaikutukset tieliikenteessä. Trafi reports 1/2015, available at <http://www.trafi.fi/index.php?id=11408>.
- [11] Sivak, M. & Schoettle, B. (2015). Road Safety with Self-Driving Vehicles: General Limitations and Road Sharing with Conventional Vehicles.
- [12] TRL (2015). Study on good practices for reducing road safety risks caused by road user distractions.
- [13] Carsten, O. (2015). Presentation on Automated Driving Australian International Driverless Vehicle Conference in Adelaide November 2015.
- [14] Carsten, O & Kulmala, R. (2015). Road Transport Automation as a Societal Change Agent EU-US Symposium on Automated Vehicles White Paper II 2015
- [15] PACTS Conference Report (2014) Driverless Vehicles: From Technology to Policy.
- [16] ECTS Briefing (2016). Prioritizing the Safety Potential of Automated Driving in Europe.
- [17] [www.ec.europa.eu/roadsafety](http://www.ec.europa.eu/roadsafety), May 20, 2016.
- [18] [www.etsc.eu](http://www.etsc.eu), May 23, 2016

## SOME ASPECTS OF SUSTAINABLE URBAN TRANSPORT IN THE CITIES

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**Abstract:** A sustainable urban transport system requires strengthening various features of the system including mobility, accessibility, affordability, social equity, efficiency, safety, security, convenience, low carbon, comfort, and people- and environment-friendliness. In order to achieve all these elements, various challenges need to be addressed in an integrated manner. There are various ways to describe an implementation method for sustainable urban transport in a city. Energy efficient, safe transport and sustainable mobility is a cornerstone of a sustainable city. The paper describes the main features of the above elements. A holistic response to urban mobility optimises both supply and demand solutions to facilitate more sustainable outcomes.

**Keywords:** eco-efficiency, safety, urban mobility, sustainable transport.

### INTRODUCTION

Transport plays an important role in the economic development of each country, the development of cities, the mobility of the population, the organization and use of space and the quality of the environment. Traffic and economic development are essentially interconnected, as traffic facilitates, facilitates, and catalyses economic development. [1] The connection between traffic and the environment is paradoxical. On the one hand, traffic activities support the increasing demands of mobility for travelers and goods, especially in urban areas. On the other hand, these activities resulted in increased motorization and traffic congestion. With technologies that are almost entirely based on the use of oil and its derivatives, or with internal combustion engines, the impact of traffic on environmental systems has increased. In recent years, this has reached a point where spatial traffic accumulation is the dominant factor behind the emission of most pollutants and its environmental impacts.

[2] The complexity of traffic systems in cities is high. Many cities, in developing countries, are experiencing rapid growth in motorized modes of transport. [3] Today, each city, in accordance with its requirements and possibilities, organizes city traffic, and it is difficult to determine the identity or unification of the world's urban traffic, which greatly complicates more rational planning traffic on a global scale. Urban traffic in modern conditions has everything more complicated transport requirements, and the conditions for its normal development are complicated. The rapid pace of urban development and the complexity of this development lead to many conflicting situations in the city life. For the normal functioning of the city organism, there are growing demands right before traffic. [4] A smart city is an efficient city, a city suitable for a quality life, also an economically, socially and ecologically sustainable city. This vision can be realized today, using innovative operational and information technology, and aligning meaningful and reliable data in

real time, supported by appropriate urban infrastructure. [5]

**Energy efficiency, traffic safety and sustainable mobility** are the cornerstone of a sustainable city. Urbanization accelerates the pace of life and creates new, more intense pressures on city resources and infrastructure. Energy-efficient, safe and mobile urban traffic are one of the greatest future challenges for cities around the world. In many cities, existing mobility systems are inadequate, and urbanization and population increase will further increase traffic demand in the future. Cities have traditionally sought to address such challenges by adding new capacities to respond to rising traffic demand. However, only the construction of new transport capacities is neither efficient nor sustainable. At the peak of rising traffic demand, mobility needs are changing and evolving, and user expectations are getting bigger. Many new emerging solutions improve service delivery technology and demand management. A holistic response to urban mobility optimizes solutions both for supply and for traffic demand, in order to achieve more sustainable results.

## 1. TRAFFIC ENERGY EFFICIENCY

The traffic sector is a major energy consumer.<sup>17</sup> It is also imminent that there will be an increase in negative implications, due to increased emissions from the transport sector, and the reduction in the use of fossil fuels in this sector is one of the highest priorities. Without significant changes in development policies, it is foreseen that it will remain (IEA, 2009a). Changes in the number and structure of transport means as well as in fuel quality standards are important factors for the impact of traffic on environmental pollution. The energy efficiency of road

transport is determined by three main parameters:

**Road traffic energy / consumption** = (fuel consumption) x (vehicle movement, km) x (population using vehicles)

*where energy efficiency of a vehicle or fuel consumption is determined by technical energy efficiency; movement of the vehicle means the type of journey / drive and the number of kilometers traveled; and the population is determined by the number of vehicles on the road.*

It is clear that individual measures do not provide a solution, and that necessary activities are also necessary, which also include: (1) Improvement of vehicle technologies (increasing the energy efficiency of vehicles); (2) Changing the behavior of the driver (to use less fuel on the way); (3) Reduction of traveling distance per vehicle; and (4) More sustainable modes of transport.

The implementation of various measures, in order to achieve energy efficiency, remains a priority goal for all countries. [7] Energy saving is without a doubt the fastest, most efficient and cheapest way to reduce greenhouse gas emissions, as well as to improve air quality in densely populated urban areas (Figure 1). Measures that could be implemented to increase energy efficiency can be classified into three main categories: technical measures, infrastructure measures and organizational and customization measures.

To technical measures fall; encouraging the development of a market for more efficient and environmentally friendly vehicles (hybrids, plug-in hybrids, electric vehicles (EV)), developing a market for more efficient alternative fuels (natural gas, electricity, hydrogen), increasing urban transport efficiency, water and air traffic.

<sup>17</sup> 19% of global final energy consumption in 2007, and it is estimated that in the world there will be an

increase in primary oil consumption by 97% between 2007 and 2030.



Infrastructure measures are included; expansion of railway infrastructure and increase of number

buses in public urban transport.

In organizational and customary changes, we include; moving towards more efficient traffic forms and optimizing their participation in total traffic and increasing the factor of occupancy.

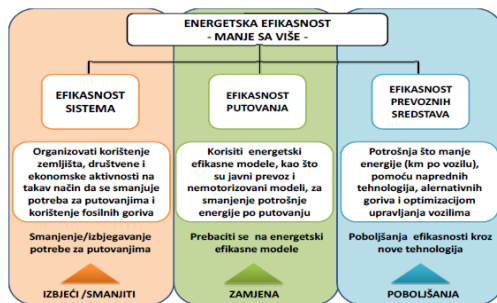


Figure 1. Energy efficiency in traffic

Avoidance-Replace-Improvement, the most widely accepted approach, to manage traffic demand in modern cities:

1) "**Avoiding / Reducing**". This approach seeks to reduce the need for travel, for example, through online shopping and telecommuting. Good land use planning, focused on the development of compact cities and mixed-use land, contributes to reducing the need for motorized travel and reducing the length of travel required.

2) "**Replacement**". This approach seeks to convince people to distance themselves from their motorized ones means of transport, using public transport and non-motorized forms traffic, which are more efficient, in terms of urban space they occupy, the amount of fuel consumed and the amount of polluting substances they emit. For this purpose, it is necessary to discourage the use of private cars and ownership of them. Some of these measures include: increasing fuel taxes and parking fees, limiting the number of parking spaces available in the city, increasing vehicle registration fees, and even limiting the ability to purchase personal cars.

3) "**Improvement**". This approach seeks to reduce the negative effects that inevitably occur when using motor vehicles. Improving traffic flow, energy efficiency of motor fuel, and the quality of fuel used, help reduce the negative impacts of motorization (Figure 2).

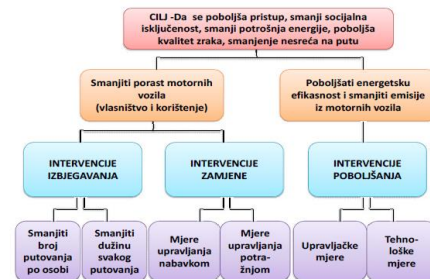


Figure 2. A comprehensive "Avoidance-Replace-Improvement" framework

Considering that traffic systems around the world are very different, it's important to get worse mentioned strategies apply in ways that fully take into account the specificities and major problems in the given regions. Many developing countries rely largely on non-motorized modes of transport, and therefore they have a greater potential for creating a sustainable transport system, unlike developed countries. [8] By adopting "avoid, replace, and improve" strategies, adequate investment in research, development, production and management is required in: (1) Infrastructure, such as bus and railways, bicycle paths and park-and-ride facilities; (2) Ecological vehicles and environmental transport models (including bicycles, public transport vehicles and low emission vehicles); (3) Fuel cleaning; (4) Telecommunications technologies; (5) Green Transport Support Technologies (GPS systems, Intelligent Transport Systems, Green Logistics, etc.).

### 3. SECURITY OF TRAFFIC

"Traffic systems should be such that they keep us moving, but they must be so designed to protect us in every step we take."

Traffic safety appears as one of the most important goals, not just the traffic policy, but also the entire society, because parallel to the growth of motorization development, there is a continuous decline in traffic safety.<sup>18</sup> The importance of focusing on traffic safety has contributed to the definition of the Decade 2011-2020 as a "Decade of Traffic Safety Action" by the World Health Organization. [9] Investing in road safety leads to economic savings, while protecting the current number of inhabitants of one country and its future generations. Priority road safety provision should not be equated with creating additional burdens for road users, which, for example, are linked to the implementation of new or more stringent traffic regulations, such as speed limits or the mandatory use of the belt. Securing road safety means a greater evaluation of human life and respect for others in the community we share. [10]



Figure 3. Proactive and reactive approach to improving road safety through road design

The traditional (reactive) response to road safety referred to: (1) identification of the danger and its ranking for treatment / treatment; (2) diagnosis of the problem and the way to resolve; and (3) "drug / activity" to address the safety problem. This was an effective strategy where it was applied, but not long-term sustainability. An integrated (holistic) approach is the engineering security of the system, based on proactive activities. It implies the removal of all road

safety risks, but during their design (in the land use planning phase) and passenger transport. It is achieved through the use of empirical predictive tools that quantify the level of safety on roads for each project. This approach allows for permanent, sustainable solutions for safer roads and the community itself and ensures sustainable security (Figure 3).

## 2.1. Sustainable traffic safety

Sustainable safety aims to prevent all mistakes and acts as much as possible, or to mitigate their consequences for the health and safety of all traffic participants, designing traffic systems to the extent of man. For this purpose, it is important to consider the system of people / vehicles / infrastructure as a complete system. Interactions between users and physical elements are a critical point (Table 1).

Table 1. Interactions between three factors (people, vehicles and infrastructure)

	FAZE	LJUDI	VOZILA I OPREMA	INFRASTRUKTURA
Prije nesreće	Prevenција udesa	Informacije Stavovi Policijske akcije	Tehnička ispravnost Stjela Kočnice Rukovanje i upravljanje Brzina	Dizajn i raspored cesta Ograničena brzina vozila
U toku nesreće	Prevenција povreda za vrijeme udesa	Primjena ograničenja	Pojasevi Nasloni Ostali sigurnosni uređaji Crash-zaštitna konstrukcija	Zaštitni objekti na cestama
Nakon nesreće	Održavanje na životu	Vještina pružanja prve pomoći Pristup medicinaru	Jednostavnost pristupa Opasnosti od požara	Objekti za zaštitu

The table (above) shows the interaction between three factors (people, vehicles and infrastructure) during the three stages of the collision: before, during, and after the impact.

**Vehicles.** Modern vehicles are much safer than older models. Today, manufacturers agree that it will take a long time to develop future technological discoveries, with the aim of improving security improvements. Technical safety standards and annual

road accidents are pedestrians, bikers, public transport passengers and motorcyclists.

<sup>18</sup> In fact, injuries in road traffic are the leading cause of mortality among people aged 15-29 (traffic accidents kill more young people than HIV / AIDS). In addition, nearly half of those killed in

vehicle testing are mandatory in highly developed countries.

**Road infrastructure.** The road infrastructure observed as a whole is an important factor in traffic safety. Roads should be designed to minimize the consequences of human error. It has been proven that some not so expensive improvement of road infrastructure, can significantly reduce the occurrence of traffic accidents and reduce their weight.

Examples of improvements include the separation of different types of traffic, better road markings and road signs, safer pedestrian and two-way tracks, the construction of sidewalks and more visible pedestrian crossings, as well as the speed of traffic. On already existing roads, these improvements should primarily be in high-risk areas, especially at entry and exit from inhabited areas and in areas of high activity (such as markets and schools).

**Human behavior.** The behavior of traffic participants is, in fact, the main cause of traffic accidents, injuries and mortality. Among the many risk factors that increase the severity of injuries, the four most common ones are: beltlessness, wear of protective helmets, inappropriate driving speed and driving under the influence of alcohol.

The government of each country is ultimately responsible for the security of the country and should take a leading role in improving road safety. Only the Government can develop and implement policies and laws related to road safety, by providing the available resources needed for long-term improvements, ensuring that traffic laws are consistently implemented, organizing national information campaigns, introducing road safety in the school curriculum, setting standards to train drivers, but also to ensure that the road network is properly planned and maintained (Figure 4)

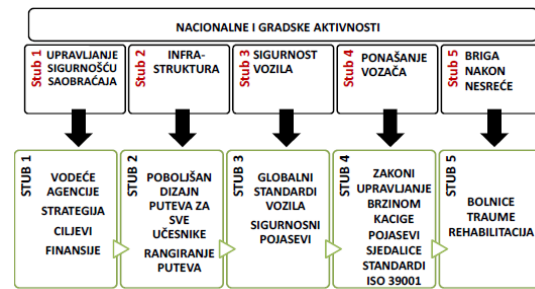


Figure 4. Strategy for sustainable urban traffic safety

The structure of local road safety can be crucial in achieving the national transport safety policy applied at the local level.

### 3. SUSTAINABLE MOBILITY

"If you are planning towns for cars and traffic, you will also get cars and traffic. If you are planning for people and places, you will get people and places." Fred Kent

Today's living conditions require the daily space and time distribution of the population, which creates traffic demand. Increased traffic demand, especially in peak periods, can be solved by traffic management strategies. In the city, high quality mobility is a necessity for the success of other urban sectors and for job creation and plays a key role in creating an attractive environment for residents and business. However, mobility is widely cited as one of the most difficult and universal challenges in cities around the world. [5] Sustainable mobility is the ability to satisfy the needs of society to move freely, to make society free access to content, to communicate, to trade and establish relationships without sacrificing other important human or environmental values, today or in the future. Mobility is vital to the internal market and to the quality of life of citizens, as they need to enjoy the freedom of travel. [11]

The sustainable urban mobility plan is a more efficient way of solving traffic problems in urban areas. The goal of the Sustainable Urban Mobility Plan is to create a sustainable transport system that: ensures the availability of jobs and services to everyone, improves security and protection, reduces pollution, greenhouse gas emissions and energy consumption, increases efficiency and economy in the transport of people and goods, increases attractiveness and quality urban ambience. A smart mobility system requires the integration of various structures: physical infrastructure, operational technology and communication and information technology. Without any of the components of this system, smart mobility products can not fulfill their full potential for managing operational efficiency and customer demand. The coordination of activities and integration between the different layers in the structure will enable improvement operational efficiency. A smart mobility system can be conceived as the number of "layers", each of which depends on and adds value to the layers below and above itself (Figure 5).

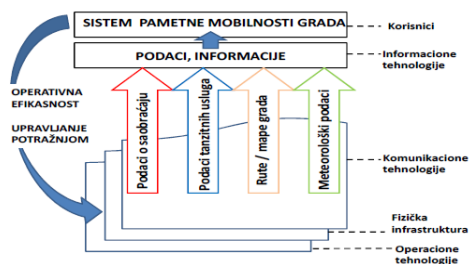


Figure 5. Structure of the "smart mobility" system

**Users, passengers, operators and planners.** It is primarily necessary to establish clear strategies for the management of urban transport logistics at the national and local levels. These strategies need to set clear goals and measures to be implemented. Implementation must be regularly monitored and plans must be periodically revised. In order to provide reliable support

at local level, it is necessary to understand the contribution of city transport logistics to the economy to a deeper and clearer understanding. In order to improve urban logistics in the long run, it is necessary to better define, collect data, monitor and evaluate.

Urban planning is essential for the management and regulation of spatial organization of cities in order to achieve an efficient distribution of urban infrastructure and modern land use needs.

There are four key advantages that are available as the main potential of the mobility mobility teams:

- Travelers. Better travel experience in urban areas and improved travel reliability, reduced time and travel costs, creating a more humane city for life.
- Transport operators. Balancing supply and demand in order to ensure improved functionality, more efficient use of transport resources, promotion of alternative ways of traveling, safe and environmentally sustainable outcome for urban transport systems.
- Urbanists. Improving the planning of future transport infrastructure and providing services based on actual data on passenger demand and behavior.
- City authorities. Generating economic growth and development of the economic sector based on technology, data and information.

Together, all these benefits contribute to the improvement of the urban sustainability agenda, on the principles of functionality, ecology, humanity, politics and economics.

**Mobility, urban form and physical infrastructure.** The shape and functionality of the city is crucial for the promotion of sustainable mobility. The larger the city, the greater its complexity and the potential to influence the future traffic situation. Larger cities have significantly higher average urban density

than smaller cities, and thus greater traffic density (eg, a larger number of vehicles traveling on roads per square kilometer). Physical infrastructure of urban mobility; roads, railways, bicycle paths, other trails and other physical means that enable the transport of passengers and goods. Data and information that supports smart mobility are continuously generated in dynamic patterns of human behavior, in ways that people move through the city and how they use the available infrastructure. Each city develops its unique spatial structure and traffic system in a way that enables easier access to people, goods and information. Today, urban agglomeration can be based on many possible combinations of traffic and urban forms, providing different levels of access. [12] The best world experiences show that it is better integrated to manage measures and packages that include: (1) walking, (2) cycling, (3) public transportation, (4) individual car + freight and (5) planning.

**Urban mobility and IT architecture.** An integrated urban environment for cities is a good opportunity to develop platforms that provide services to citizens, transport agencies and private sector actors. As cities are rapidly changing and growing, and requirements for efficient traffic flows and service information are also changing rapidly.

Globalization is accelerating this trend. Intelligent business models will, in whole or in part, automate smart transport processes (such as detecting when a car enters the collection area, collecting fees, managing customer requirements), resulting in a reduced need for operators. To achieve this, most processes need to be well defined, simplified and standardized, before it is automated. In principle, there are three limiting factors for adopting new IT applications in the urban transport system, namely: (1) high costs for users in

relation to perceived benefits, with costs that increase for users, if more than one layer in the system is involved, including fixed infrastructure, (2) technological complexity, and (3) various legal issues, which have not been sufficiently resolved.

**Communication technologies.** Wi-Fi, 3G, 4G and Bluetooth channels are essential for real-time communication, based on accurate data at the site of the Internet of Things, and between human operators, data processors, and user information.

**Operational technologists.** Operational technologies generate raw materials needed for smart solutions: data. They allow; real-time data collection, data exchange between physical infrastructure and services, and rapid adjustment of management infrastructure, to create additional capacities where needed at a given moment. Such technologies have already been installed in many cities to directly coordinate and maintain traffic flows with passenger requirements, thereby contributing to increased operational efficiency on the network.

## 4. CONCLUSION

Cities should be designed so that they can adequately meet the daily needs of citizens and respond to peoples' demands in the peak period, not only in the transport sector, but also in the energy sector, water sector, public services, the construction sector and IT services. Each of these systems, today, faces similar challenges in balancing peak demand and constraints, or a sustainable level of supply. Densely populated urban areas require connection with world markets, and also the need for reliable transport goes far and away to rural areas. Sustainable and affordable traffic solutions provide vital access to markets, employment opportunities, education and health services. A sustainable balance between the needs of society, businesses

and the environment is best achieved through comprehensive institutional planning policies. In the world of rapid changes, traffic energy efficiency, traffic safety and urban mobility are the key to sustainable development. Sustainable traffic solutions can transform cities into places that enable a healthy life, research and innovation development, and more efficient production. The future belongs to efficient and innovative policies and technologies that can significantly and automatically change consumer behavior.

## LITERATURE

- [1] Dalkmann H. and Huizenga C., "Advancing Sustainable Low Carbon Transport Through the GEF", Global Environment Facility, Washington, D.C., (2010)
- [2] Jusufrić I., "Passenger Transport Systems in Towns", Travnik, (2007)
- [3] Publication, "Towards Sustainable and Energy Efficient Urban Transport, Energy Efficient Cities, "(2014)
- [4] Vasilj A., Činčurak B., "Interaction of Traffic Development and Town Development", Josip Juraj Strossmayer University of Osijek, Faculty of Law Osijek, (2009)
- [5] Publication, Smart Cities Cornerstone Series, "Urban Mobility In The Smart City Age", (2011)
- [6] Bretzke W-R, Barkawi K., "Sustainable Logistics: Responses to a Global Challenge", (2013)
- [7] Kojima K. and Ryan L., „Transport Energy Efficiency. Implementation Of IEA Recommendations“, International Energy Agency, (2014)
- [8] Dalkmann H. and Sakamoto K., „Transport Investing in energy and resource efficiency“, Transport Research Laboratory, UK. (2011)
- [9] World Health Organization and FIA Foundation, „Decade of Action for Road Safety“, 2011-2020, (2010)
- [10] Practical guide on road safety, „A Toolkit For National Red Cross And Red Crescent Societies“, The International Federation's Global Agenda (2006–2010), International Federation of Red Cross and Red Crescent Societies and Global Road Safety Partnership, (2007)
- [11] Publication of the project Catch-MR, „Moving People: Towards Sustainable Mobility In European Metropolitan Regions“, Postdam, (2012)
- [12] Rode P. and Floater G., „Accessibility In Cities: Transport And Urban Form“, (2014)

## MODERN LOGISTICS TRENDS

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**Abstract:** *Modern market trends in developed countries directly affect the design, planning and design of transport systems and technologies, storage, loading, ordering, packaging and other logistics activities. The economic system under the heavy action of the market in terms of quality logistics services and logistics costs, subject to changes to the application of new trends and strategies, including changes and adapting the structure of the logistics system and continuous training of professionals who are able to apply the new logistics technology. By applying the principles of logistics and new trends, expansion of logistics knowledge and application of relevant technologies and quality management systems, as well as other logistics tools have been developed and new forwarding strategy. In this article we will focus on condensed explication of only some modern logistics trends.*

**Keywords:** *logistics, freight forwarding, trends, strategy*

### 1. INTRODUCTION

Logistics is a key factor in the development of successful companies of both national and international associations. Logistics is present in industrial, commercial, logistic companies (transport, freight forwarders, ports and other companies) and in service companies in the field of catering, tourism, medicine, publishing, banking, military, sports and the like. Logistics and SCM<sup>19</sup> are in the focus of the interest of developed countries, so logistic processes and systems of ordering, packaging, storage, transshipment, transport and stockpiling are subject to continuous improvement. In short, logistics deals with the organization, planning, control and realization of commodity flows from the place of origin to the place of sale of goods, through production and distribution, in order to meet the market demands with minimal costs.

Logistics, as a concept, the scientific field and micro and global system has its own evolution, and today's phase gives an indication of the future by combining increasingly smaller and more frequent logistics flows with the goal of reducing inventories, creating logistical profit systems through: outsourcing processes, specialization and expansion of assortment of services, designing new logistics centers, logistics and supply networks with a wider range of activities and participants, development and the application of automated and advanced IT systems, the formation of alliances by geographical, technological and interest principles and other affinities, the creation of supply chains with strong performance of flexibility, transparency, security, economy and sustainable development, and through the education of a new profile of experts with general and specific, multidisciplinary and interdisciplinary knowledge.<sup>20</sup>

<sup>19</sup> Acronym from Supply Chain Management

<sup>20</sup> See Zecevic, S. and Gojkovic, P. : Logistic Trends, Proceedings of the First International

Scientific Expert Conference of Logistics, 2010, Faculty of Transportation Doboj, University of East Sarajevo, 2010 p. 1.-10.

## 2. GLOBAL LOGISTICS TRENDS

Over the past 20 years, in developed economies, there has been an expansion of all logistical activities, which is a consequence of many trends in the global, highly competitive economy. The group of authors<sup>21</sup> lists two trends: 1. cutting costs in the procurement and distribution of goods through reducing the number of manipulations (storage, transshipment, pre-packing, etc.), which requires the concentration of these operations to a smaller number of specialized operating centers, and 2. a trend of outsourcing. We'll talk later. These two trends open a new space for the further development of logistics operations, where a large service market opens, where freight forwarders should offer their own solutions, infrastructure and know-how.

In recent years, trends suggest that freight forwarders, as transport architects, are expanding their traditional business more and more intensively for additional logistical activities for the needs of companies, from which they take orders for the storage and distribution of goods and financial means for its procurement.<sup>22</sup> The second source<sup>45</sup> lists the trends that characterize the development of logistics in the world, such as the introduction and implementation of new logistics strategies, the formation and construction of logistics centers and networks, the development of logistics technologies, the training of logistics experts, and the establishment of logistics companies and associations.

<sup>21</sup> Ivaković, Č. and Šafran, M. & Stanković, R. : A review of the operations of the international freight forwarder in the European Union, *Transport & Logistics*, bi-monthly magazine for transport and logistics, year 2005. number 3. p. 38.

<sup>22</sup> Poletan Jugovic, T. and Jurcic, J: Logistic forwarding operator as a perspective of the classical freight forwarder, *Pomorski zbornik*, year 43. (2005) number 1. p. 151.-163.

Otherwise, within the freight forwarding, as activities and sciences, there are mainly discussed some important strategic logistical dilemmas, for example: production by order or stock, outsourcing or insourcing, centralization or decentralization, and make or buy strategies, or strategies to produce or buy. On the other hand, according to the group of authors<sup>23</sup>, the logistics strategy determines the links in logistics chains, the configuration of logistics information systems, logistic functions, the organization, management, management and functioning of the forwarding company, the network of business units in the country and abroad, the type of logistics services, then influences the choice of forwarding, ie logistical capacities and the choice of technologies that enable goods flows and determines basic profiles of freight forwarders and all types of managers. Also, since the shipping companies of the transition countries in the shaping of their business policies are under the strong influence of the globalization and economic policy of the European Union, they should opt for a national, international, European, transit, overseas, partner or some other logistics strategy. Otherwise, in the literature, usually under different names, the following modern logistic trends are listed, which will be individually and briefly explained below:<sup>24</sup>

1. Push and pull logistics;
2. Logistic outsourcing;
3. Hub and gateway terminals;
4. Cross docking terminal;
5. Dry port and offshore terminals;

<sup>23</sup> See more at Deljanin, A. : *Logistics in Transport and Communications (Part I and Part II)*, Faculty of Transport and Communications, University of Sarajevo, Sarajevo, 2009. Available at <http://web.efzg.hr/doc/market/lectures/plbj11-12.pdf> (March 25, 2016)

<sup>24</sup> Zecevic, S. and Gojkovic, P. : *Logistic Trends, Proceedings I. International Scientific-Professional Conferences Logistics 2010*, Traffic Faculty Doboj, University of East Sarajevo, 2010. p. 1.-10.



6. Speedport container terminal;
7. Underground logistics systems;
8. Green supply chain;
9. Education of logistics experts. And similar!

### 2.1. Push and pull strategy

The push-to-load production is increasingly being replaced by a new pull-strain strategy that assumes the supply of customers, consumers and customers. This is a timely access to information from the point of sale (PoS)<sup>25</sup>, which enables the reengineering of the production and distribution process. Hence, the distribution of goods according to the production system for supply is based on inventory or pushed logistics, while distribution in the production system is on order basis based on trained logistics. In push products, products are pushed out of distribution plants based on sales forecasts, and stocks are held to satisfy estimated customer requirements, while the pull system involves the collection of market data and the product is delivered on the basis of actual customer requests. The pull strategy for the pull strategy is supported by integrative processes in the supply chain, that is, the emergence and development of new coordinators and logistics integrators<sup>26</sup>, whose task is to improve, optimize and rationalize supply chains.

While the push system involves a limited degree of integration of suppliers, manufacturers and distributors, the pull system integrates the system to achieve a higher level of efficiency. In practice, the most commonly combine strategies of pushed and drawn currents, and for (usually the initial) parts of the supply chain, flows can be guaranely oriented, and for other (usually end-to-end) parts of the supply chain, more often, the strategy of traction flows is used. This is achieved by the production of a larger product series in the

first stage, so that they are then distributed according to user requirements. The reverse cases are possible, when they are drawn in the initial stages, and in the final stages of the gurani

flows in the supply chain. A point in which the strategy of the pushed and drawn currents collides

known under acronyms of PPB<sup>27</sup> or I / OI<sup>28</sup>).

The decision on the border of pushed and towed streams and the choice of logistics strategy depends on several factors (product characteristics, specific delivery requirements, market conditions and other external influences). The choice of the strategy or the stock holding location affects operating costs, response time, demand, and flexibility to change requests. Distinguishing the strategies of pushed and traileed flows can be done on the basis of volume and level of predictable requirements.

The push flow strategy applies to commodity flows of larger volumes and less predictable requirements, while the strategy of traction flows is applied in conditions of realization of smaller volumes and a higher degree of predictability of requirements. Between these extremes there is a field of combined strategies.

### 2.2. Logistic outsourcing

Outsourcing is the shift of jobs that are outside the core business or the company's main competencies, or the use of specialized companies for the realization of jobs previously performed by own employees to internal resources. Thus, the parent company concludes long-term outsourcing cooperation with an outside company that will perform some logistical business processes for it. If a company performs logistic activities cheaper than when it leases someone else for their

<sup>25</sup> Point-of-Sale

<sup>26</sup> Logistic Outsourcing

<sup>27</sup> Push and Pull Boundary

<sup>28</sup> Inventory/Order Interface

realization, it should remain within the company, and it is designated as insourcing. However, if companies pay more to hire someone to carry out logistics activities, they need to opt for outsourcing.

In fact, outsourcing is the purchase of logistics services from specialized companies, or from external sources (out + source). Logistic service providers are called logistics providers, and they are now staff, material, technological, organizational, financial and in other ways sufficiently teamed and trained to provide a complete logistic service. The evolution of logistics outsourcing increases the number of services left to providers and the growth of logistics partnerships between clients and providers, that is, between logistics freight forwarders and users of logistics services. The trend is that freight forwarding companies, as carriers of logistics services, are taking more logistical activities from users within the outsourcing partnership. Otherwise, the development of the logistics provider itself is intensified, which was happening through several characteristic phases, as follows:<sup>29</sup>

■ **1PL - First party logistics, in-house logistics or insourcing logistics:** It is logistics in the home of the user, because the company itself carries out almost all logistic activity with the minimal engagement of the provider and has its own transport, storage, loading / unloading machinery and human resources for execution logistics activities.

■ **2PL - Second party logistics:** The company engages a provider that only realizes it traditional logistics functions - activities such as transport, shipping and storage,

and all in order to reduce costs or investments.

■ **3PL -Third party logistics:** Logistic activities or the entire logistic process for the company

is performed by the provider with whom the company signs the contract for a longer period of time, because the provider offers a broader range of services, and apart from the realization of logistics activities, the exchange of information, risks and benefits between providers and the company is emphasized.

■ **4PL -Fourth party logistics:** The provider manages the complete supply chain of the company over a longer period of time, which is a consequence of the association of 3PL providers with information technology and management companies and the management of business activities.

■ **5PL -Fifth party logistics:** It is a form of cooperation between the company and the provider, and it was developed for the needs of the e-commerce market of the company. As specialized providers of logistics services, providers take up an increasingly important place and

Greater participation in the logistics market. However, users expect the logistics services offer to be improved through the integration of different participants in the system of providing complete logistics services, so providers should have at least a range of basic services (transport, storage, packaging, etc.) with the aim of a complete logistic service, have to be oriented to certain economic sectors and areas, they must have good geographical coverage and all elements of the business infrastructure must be established, and they need to have modern logistic technologies that can be easily integrated into the user's business

<sup>29</sup> See Jusufrić, I.: Modern trends in transport, logistics and ecology in the function of sustainable development, Proceedings of the V. International Counseling: Modern Trends in Traffic, Logistics and Ecology in Function sustainable development (pp. 14-31), International University of Travnik and Faculty of Traffic Sciences of the University of Zagreb, Travnik, May

2014. Or in Deljanin, A. : Scripts from the Logistics in Transportation and Communications (I and II. Part), Faculty of Transport and Communications, University of Sarajevo, Sarajevo, 2009. Available at [http://web.efzg.hr/dok/trg/predavanja\\_pl\\_bj\\_11-12.pdf](http://web.efzg.hr/dok/trg/predavanja_pl_bj_11-12.pdf) (March 25, 2016)

system. Users expect constant improvement of logistics services, and the relationship towards providers that are initially viewed as providers or resource managers is changing, to be viewed by users as logistics strategists (distributive or transport strategists). This orientation to users and the potential satisfaction of their wishes, demands and needs is the application of a new concept of logistics. However, the increase in competition and the increasing demands of users, clients, forced the company to focus its attention on the complete supply chain. Accordingly, some companies today extend the boundaries of the traditional supply chain, in order to house activities beyond the scope of their control, and the so-called "MBM"<sup>30</sup>, such as:<sup>31</sup>

■ **JSC:**<sup>32</sup> This is a service company with a larger number of owners and managers. This business

The model is designed to transform large volumes of flows and demands, which is usually the case

includes two or more companies that function in a strategic partnership with several smaller partners in order to fulfill all the required requirements.

■ **VNC:**<sup>33</sup> The model is based on an agreement between companies in order to ensure a unique one value for a particular industrial requirement, so the supply chain is less linear and consists of a number of partnerships that can include financial services, insurance, and the like. The activities and interactions of companies in the network are based on a dynamic and flexible organization, and members can come out and enter again when they want to. The model assumes an efficient system for managing and measuring the

performance and performance of each entity in the network.

### 2.3. Hub and gateway terminals

Cargo terminals, freight transport, logistic centers and the like represent one of the important components of logistics networks. In order to realize the changing demands of commodity flows in urban, regional, national and international areas, there are structural, technical, technological and organizational changes in logistics centers. This results in greater use and development of different terminals, of which they are particularly interesting so-called. hub and gateway<sup>34</sup> terminals. The Hub terminal has a central location with many input and output connections, while a gateway usually involves switching from one mode to another (for example, from maritime to land), and therefore has a tendency to be intermodal, while the hub has a tendency to perform transmodal operations (in the same mode of transport).

■ **Hub terminal:** It is a node terminal, ie the location of the largest concentration of flows and the widest supply of logistics services. It transports between smaller terminals from the environment, but also transports between the region. The emergence and development of the hub terminal functions to reduce the number of direct economically unjustified connections. By consolidating and consolidating flows in nodes, multiple effects are achieved for all participants in logistic networks.<sup>35</sup>

■ **Gateway terminal:** This is actually a special type of hub and spoke system<sup>36</sup> where we have a continuity of circulation in

<sup>30</sup> New Business Models

<sup>31</sup> See more at Gattorne J. : Living Supply Chains, Prentice Hall, London, 2006.

<sup>32</sup> Joint Services Company

<sup>33</sup> Virtual Network Consortia

<sup>34</sup> The term hub can be translated as: center or node, and gateway as: passage or gateway

<sup>35</sup> See more at Zečević, S. : Robni terminali i robno transportni centri, Saobraćajni fakultet Univerziteta u Beogradu, Beograd, 2006.

<sup>36</sup> System of hubs and arms.

the transport system for servicing supply chains. It represents the connection between the different systems, that is, the gate or passage of a particular system. Observed through the network of terminals, gateway terminals are mostly peripheral hubs through which the goods flows enter or leave the observed network or space, region, land, continent.

#### 2.4. Cross docking terminal

The cross docking<sup>37</sup> terminal represents a transfer point between incoming and outgoing flows without long-term storage and retention of goods in order to reduce all manipulation and consolidation of goods flows from different shippers and their dispatch to recipients. Inbound flows from suppliers are directly transformed into supply flows for customers (customers), ie for storage, whereby the goods usually stay up to 24, often less than one hour. In this terminal, consignments are generally less than the car's cargo (so-called LTL<sup>38</sup>), so the goods are sorted and directly consolidated with goods from other suppliers for delivery to the customer and delivery generally represents a full load of vehicles (the so-called FTL<sup>39</sup>). In addition to the benefits for the client (reducing manipulation costs, reducing inventory, reducing the required storage space, delivery speed, etc.), the use of Cross Docking Technology brings benefits and operators, through economies of scale in outgoing flows (from centers to customers), realization of business revenues and optimal utilization of storage capacities. From the above, it is evident that the role of freight forwarders, increasingly, overlaps with the role of the logistics operator, and in the foreseeable future, it is possible to

expect the complete permeation of the functions of these subjects and their merging into the role of a single subject.<sup>40</sup>

#### 2.5. Dry port and offshore terminals

Dry port and offshore<sup>41</sup> terminals represent new concepts of dislocation of logistics subsystems from existing ports to the continent (on land, hinterland ports) or to the sea (towards the sea, the ocean). These new concepts are the consequence of the characteristics and requirements of logistics flows and the limitation of port systems, and above all the trend of growth in commodity flows, the size of container ships, the difficult access to the coast, limited spatial possibilities for the expansion of port systems, the increase in the capacity and structure of the subsystems traditionally evolving in ports, a large number of road transport vehicles on the approach to port complexes, increasingly stringent environmental protection requirements, and the like.

■ **Dry port terminal:** It represents a complex of logistical activities and systems in the hinterland of the ports of the sea. The concept was developed in Spain, Italy, Portugal and France, and today it is present all over the world. The ports of the seas were once the central zones around which cities developed, and today they represent a major problem in terms of security, ecology, pollution, and space. In order to maintain high quality of service and meet the demands of ever-increasing goods flows, ports must be developed and expanded to new areas for the accommodation of facilities and equipment for loading, unloading, storage and other logistic activities, which conditioned the development of the terminal in the backyard that is connected with one or

<sup>37</sup> Cross docking

<sup>38</sup> Less Than Truckload

<sup>39</sup> Full Truckload

<sup>40</sup> See more in Zelenika, R. : Traffic Systems, Technology-Organization-Economics-Logistics-

Management, Faculty of Economics, University of Rijeka, Rijeka, 2001. p. 159.

<sup>41</sup> Dry port can be translated as: dry port, and offshore like: offshore or coast and near the coast.

more ports by rail and /or road connections. The task of these terminals is to collect goods for longer overseas transport and its local, regional and international distribution, and they provide some additional services (customs clearance, storage, pre-packaging, data updates, information services, etc.). Therefore, these terminals are multimodal-oriented and have all logistical services, facilities and equipment that are needed by shipping companies and freight forwarders from the seaports.

■ **Offshore terminal:** The capacity of container ships is rising, and the hinterland infrastructure is not able to serve all the streams, so large container ships serve over several ports, and each entry in the port creates additional costs and affects the extension of the ship's time. Therefore, maritime companies have a dilemma: market coverage or operational efficiency. The use of an offshore terminal on the open sea reduces the number of ports for the megabody service, and increases the frequency and flow rate of the nearby ports, which can receive and serve smaller ships on shorter routes, and the offshore terminal will become the hub terminator for conventional, offshore ports. Therefore, solutions should be sought in the development of the terminal on the open sea, on artificial islands, floating systems, pontoons, platforms. On offshore terminals, large container ships (from 15,000 to 18,000 TFEU<sup>42</sup>) are transhipped to smaller ones that can be effectively serviced at container terminals on land.

## 2.6. Speedport container terminal

Speedport<sup>43</sup> terminal is the terminal of the future and a significant technological shift and novelty in comparison to today's maritime terminals, which are not the right

technological solutions for the shipment of new generation ships (over 15,000 TFEU). Speedport reduces container handling times and makes it the fastest and safest system of manipulation in the world. In a simple straight-edged form, it has two port locations and two block container containers, and it can accommodate boats of varying sizes, as the construction of the pavement walls rises above the corner of the largest container ships. Transshipment of vessels, regardless of weather conditions, is enabled in the tunnel port. The warehouse block system of stacking of containers, without passage of transport manipulative mechanization and without roads, is threatened by walls and allows the container to be stacked into nine levels. Access road and railways, as well as cargo handling areas, are denervated, which prevents crossing and obstruction of container flows. The concept of a transshipment system is based on an idea that resembles a spider's network, that is, a series of moving transversal consoles that cover the entire terminal system, and a large number of independent transport and manipulative units called spiders<sup>44</sup>, which contain containers with special pliers, move on the network. The whole system is covered by a series of moving transverse consoles, so almost every row of containers on board can be operated simultaneously.

## 2.7. Underground logistics systems

Underground<sup>45</sup> logistic system is actually the concept of moving part of logistics activities, primarily transport, underground and the use of electric drives. This concept is perfected by all developed countries of the world, especially Japan, the Netherlands, America, Germany and China. Minimal negative impact on the environment (noise, pollution and gas

and is equipped with a spider for catching up to 40 t containers.

<sup>45</sup> Underground

<sup>42</sup> Twenty Foot Equivalent Units

<sup>43</sup> Speedport

<sup>44</sup> Spider is a simple vehicle, weighing 20 t, designed to lift and transport containers of different lengths,

emissions are reduced), street network relieving, congestion reduction, lower energy consumption and lower CO<sub>2</sub> emissions, increased safety, more rational use of space and so on, are just some of the benefits of using the underground logistic system of the Economic advantages of the underground system, however, include almost direct delivery, 24-hour service, low operating costs and a shorter implementation time for an individual request. Due to the fact that the system is closed, weather conditions do not affect the realization of the activities, and the dedicated infrastructure is suitable for the transport of dangerous goods. Since there is no access to the underground system during transport, there is less chance of damage to goods, which reduces the cost of insurance. Since the system operates underground or water silent and hidden, it is protected from the public, and vice versa. However, underground logistics systems require the construction of complete infrastructure, so large investments and a long implementation time are necessary. Otherwise, underground logistic systems in urban areas are used for the supply and delivery of goods to retail and catering facilities, clinical centers, various institutions and the like, which mainly relates to the transport of factory units of the size of the pallet. They are also used within or between industrial complexes, logistics centers and intermodal terminals, which mainly relates to the transport of intermodal units, containers.<sup>46</sup>

## 2.8. Green supply chain

Today we have more and more terms like: green logistics, green terminal, green logistic network, green logistic strategy and the like. A Green Supply Chain assumes an approach that minimizes the negative impact of product or service delivery on the

environment. It covers all stages of the product's life cycle, from extraction of raw materials, construction of the product, its distribution and use to its removal (processing, reuse, recycling). The choice of a logistics provider for the implementation of a particular service depends on several factors (price, flexibility, sustainability, safety, reliability), and according to trends, a very high value in the future will have a sustainability factor. The two groups of measures are the green logistic strategy: optimization of logistics organization (association for increasing vehicle loading factors, optimization of routes, reduction of total number of warehouses along the logistics chain, reduction of number of journeys, distance traveled, delivery times, etc.) and the use of less environmentally harmful types of transport (water, rail, combined and intermodal transport).

Green terminals are built to reduce energy consumption and CO<sub>2</sub> emissions by applying solar and wind energy and natural cooling systems, using geothermal energy, energy-efficient strips, innovative lighting systems, rainwater insulation and rainwater utilization, electric forklifts and the like. Logistic service users are offered tools that suggest alternative transport routes with a budget for all environmental impacts (value of pollution and consumed energy for global supply chains). However, as the logistics of the green environment are still far away, there are three approaches available: top-down (top-down approach, ie application of legal solutions, which is very necessary to reduce pollution and the environment), bottom-up (bottom-up approach, ie a situation where an interest in the environment comes from the industry itself) and a combination of top-down / bottom-up (a combination of the two

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<sup>46</sup> See more at Zečević, S. and Tadić, S. : City Logistics, Faculty of Transportation, University of Belgrade, Belgrade, 2006

previous approaches, and usually manifested by obtaining a certificate).<sup>47</sup>

## 2.9. Education of logistics experts

The field of logistics initiates the education of a special profile of experts with multidisciplinary knowledge to solve the problem of realization of logistics flows in logistic networks. Educational logistic modules aim to familiarize participants with a logistic concept and essential differences in relation to the traditional approach to the realization of commodity flows, with the structure, strategies, technologies, functions and performances of various logistic systems, with methodology and models of planning, management, control and analysis of the intermodal system transportation chains, city logistics, logistics centers, supply chains, logistics return and waste materials, warehouse systems and industrial logistics, with the structure of logistics controlling, providers and freight forwarding companies, and with basic performance and methods modeling of modern transloading and other logistics processes and services in realization of robotransport flows.

Logistics engineers, considering the interdisciplinary knowledge they acquire during their education, work in various companies, organizations and institutions in the social and private sector (production, trade, distribution, forwarding and transport companies, logistic providers, logistic centers, transport terminals, public institutions, service activities related to the realization of logistics processes within the scope of goods flows, etc.). Logistics engineers are engaged in research,

planning, design, organization, management, analysis and control of logistics flows, processes and systems. Research on employment of over 600 engineers of logistics, who graduated from the Logistics Department of the University of Belgrade, Faculty of Transportation, shows that most of them work in trade, transport, industry and freight forwarding, but also present in state institutions, design institutes, education, services to companies and the like.<sup>48</sup>

## CONCLUSION

Client, or user of logistics services, has a growing demand in terms of the quality of delivery of goods and lower logistics costs, while reducing the harmful impact on the environment, which are the reasons for constant changes in all components of the logistics system. Consequently, new concepts and technological solutions are being developed today in all areas of logistics. It is almost impossible, in one work, to expose all logistical trends at all institutional levels. In literature, usually under various titles, there are numerous trends, for example: push and pull logistics and outsourcing, then hub, gateway, cross docking, dry port, offshore and speedport terminal, underground logistic systems, green supply chain, education of logistics experts and the like. You and others, complementary trends (in the form of concepts, strategies and solutions), emerge independently and in combination with each other, depending on a number of concrete logistical circumstances. Starting from the purpose of this paper and

<sup>47</sup> Adapted to Jusufrić, I.: Contemporary Trends in Traffic, Logistics and Ecology in the Function of Sustainable Development, Proceedings of the V. International Counseling: Modern Trends in Traffic, Logistics and Ecology in the Function of Sustainable Development (pp. 14-31), International University of Travnik and Faculty of Traffic Sciences, University of Zagreb, Travnik, May 2014.

<sup>48</sup> See more at Deljanin, A.: Logistics in Transport and Communications (Part I and Part II), Faculty of Transport and Communications, University of Sarajevo, Sarajevo, 2009. Available at <http://web.efzg.hr/doc/market/lectures/plbj11-12.pdf> (March 25, 2016)

space constraints, in the work we tried, kept and managed, all of the listed trends individually and briefly explicit.

## LIST OF CERTIFIED SOURCES

- [1] Deljanin, A. : Script in Logistics in Transportation and Communications (Part I and Part II), Faculty of Transport and Communications, University of Sarajevo, Sarajevo, 2009. Available at <http://web.efzg.hr/doc/market/lectures/plbj11-12.pdf> (March 25, 2016)
- [2] Ivaković, Č. and Šafran, M. and Stanković, R. : A review of the operations of the international freight forwarder in the European Union, Transport & Logistics, a bi-monthly magazine for transport and logistics, year 2005. number 3.
- [3] Jusufrić, I. : Contemporary Trends in Traffic, Logistics and Ecology in the Function of Sustainable Development, Proceedings of the V. International Counseling: Modern Trends in Traffic, Logistics and Ecology in the Function of Sustainable Development (pp. 14-31), International University of Travnik and Faculty of Traffic Sciences, University of Zagreb, Travnik, May 2014
- [4] Jugović, T. and Jurčić, J. : o Logistics Freight Forwarding Operator as

Perspective of the Classical Freight Forwarder, Pomorski zbornik, year 43 (2005) number 1. p. 151.-163.

[5] Zečević, S. : Robni terminali i robno transportni centri, Saobraćajni fakultet Univerziteta u Beogradu, Beograd, 2006.

[6] Zečević, S. and Gojković, P. : Logistic Trends, Proceedings I. International Scientific Conference of Logistics, 2010, Faculty of Transportation Dobož, University of East Sarajevo, 2010.

[7] Zelenika, R. and Pupovac, D. and Rudic, D. : Freight Forwarder in Function of Logistic Operator (abstract), Maritime Code, Rijeka, No. 38 (2000) 1, p. 143.-157.

[8] Zelenika, R. : Traffic Systems, Technology-Organization-Economics Logistics Management, Faculty of Economics, University of Rijeka, Rijeka, 2001.

## THE IMPACT OF ECO-EFFICIENCY IN THE BUSINESS EFFICIENCY OF THE COMPANIES WITH SPECIAL EMPHASIS ON BOSNIA AND HERZEGOVINA

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**Abstract:** *Bosnia and Herzegovina is a country with relatively poor ecological awareness, the environment on one hand and business efficiency and sustainable development on the other. The correct combination of these concepts can lead to stimulation of business solutions and improvement of the environment. Eco-efficiency is an important factor for sustainable development as long as the companies are using eco-efficiency as an integral part of business policy. It is important to note that Bosnia and Herzegovina is rich in natural resources to be used in the best way but also needs to have a strategy for the regeneration of natural resources. Eco-efficiency is one of the potential employment opportunities for a large number of people, which directly affects the country's economic development. The aim of this study is to show the link between eco-efficiency on one hand and business efficiency and sustainable development on the other, as well as the sole purpose and essence of eco-efficiency, displaying their mutual relationship and reflection on the environment and economic development of the country.*

**Keywords:** *eco-efficiency, business efficiency, sustainable development, opportunities, Bosnia and Herzegovina*



## 1. INTRODUCTION

The concept of eco-efficiency is a combination of ways of thinking about ecology, the environment, the environment on the one hand, and business efficiency and sustainable development on the other. Combining these concepts can lead to the promotion of business solutions and environmental improvements. In the past, eco-efficiency was seen as a source of problems and risk factors. Today, eco-efficiency is one of the valid factors for sustainable development, while companies and companies management uses eco-efficiency as an integral part of business policy. Although eco-efficiency for the ultimate goal of reducing pollution and pollutant<sup>49</sup> emissions, its timely and appropriate application in an individual company can have the goal of reducing costs, increasing competitiveness and achieving higher profits. In the following, explaining the topic of eco-efficiency as an indicator of business success, besides various definitions, key events in the acceptance and implementation of eco-efficiency are presented. Also, the explanation for five aspects of eco-efficiency as a strategic element in business as well as the way of implementing eco-efficiency through four areas (suppliers, customers, production process, and neighborhood industries) is given. Method of measuring eco-efficiency and selection of key indicators it is important for the enterprise itself, and only monitoring and public reporting of eco-efficiency is a way to inform the public about the key element of the company's success in terms of applying a sustainable development philosophy, including investors, insurance companies, consumers and the local

community. With its regulation, through the imposition of various taxes and taxes, the issuing of environmental licenses directs actions towards improvement of the environment, supports the initiative of improving eco-efficiency - upgrading with the leading companies (big companies) and the pressure on those lagging behind (small and medium enterprises). By example from practice, I tried to point out the importance of implementing eco-efficiency in the company itself, as well as a significant impact on the environment, through the reduction of NOx emissions.<sup>50</sup>

### 1.1 Concepts of eco-efficiency

Eco-efficiency is: "combining business efficiency and environmental efficiency goals and creating relationships through which corporate behavior can support sustainable development".<sup>51</sup>

Development Concept: Eco-Efficiency is a management philosophy that encourages business solutions that seek to improve the environment and result in a parallel economic benefit. It focuses on business opportunities and enables companies to become more environmentally responsible and profitable. This is the key business contribution to a sustainable society. As defined in the World Business Council for Sustainable Development (WBCSD), "Eco-efficiency is achieved through the use of competitive prices of goods and services that meet human needs and bring quality to life, while progressively reducing environmental impact and resource use during the life cycle of the product to at least in accordance with the estimated Earth's carrying capacity. "In short, it deals with the creation of more economic value with less environmental impact.

<sup>49</sup> Generally, any substance introduced into an environment that has a negative impact on the resource. (<http://www.igman.com/biološki-rječnik/P/Polutant.html>) accessed on April 1, 2016

<sup>50</sup> NOx is a general form for mono-nitric oxide (<http://sr.wikipedia.org/NOx>) accessed on April 1, 2016

<sup>51</sup> Bjorn Stigson, President of WBCSD, according to (Eco-efficiency LEARNING MODULE, WBCSD - Five Winds Internacional page 3)

Eco-Efficiency in Practice: Great progress has been made in applying the principles of eco-efficiency in practice. Industries, for example, have had significant success in reducing pollution and emissions, and removing hazardous materials from the production process. In the past, the economy looked at the environment and sustainable development as sources of problems and risk factors. And today they are also considered as a source of opportunities for improving economic efficiency and growth. Eco-efficiency is to a large extent responsible for the changes that have taken place in the environment of the economy towards the environment and sustainable development. Basically, it's about: to use more resources to deliver higher value. For example, if energy is saved, we reduce costs while at the same time reducing unwanted consequences of emissions. Eco-efficiency is not limited to making incremental improvements in efficiency in existing practices and habits. This should encourage creativity and innovation in search of new production methods. Eco-efficiency is not limited to areas of activity within the company, such as production and management. It also applies to activities upstream and downstream from the production plant and includes procurement and production value chains. As a consequence, this can be a major challenge for engineers, customers, managers, marketing professionals, and even finance and supervision. Computing can use eco-efficiency as an integral element of their business policy and financial statements. They can also set eco-efficiency targets for their ecological or integrated management systems. And this is a useful tool for tracking and reporting, as well as helping companies to communicate and dialogue with stakeholders. The opportunities for eco-efficiency can appear at any point during the life-cycle of the

product. This means that employees have to understand what is eco-efficiency, the value that can be brought to the company and how to do it. This nevertheless requires the building of skills and understanding to integrate eco-efficiency through business and business, and allow space for innovation and creativity.

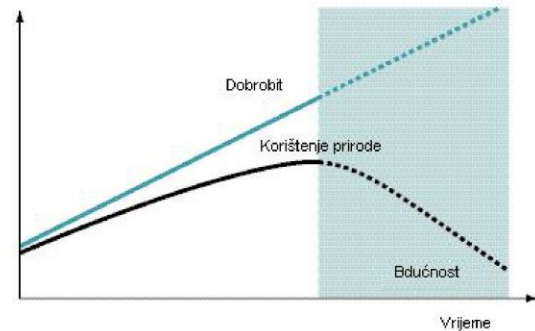


Figure 1. More benefits with less use of nature

The European Environment Agency (EEA) defines eco-efficiency as: "creating greater value (benefits) than less-used nature" (Figure 1).<sup>52</sup>

## 2. THE TERM OF ECO-EFFICIENCY IN THE ENTERPRISE

The business explanation for eco-efficiency is clear: in business terms, it seems good move. Eco-efficiency improves business and environmental impacts and helps companies to penetrate the market and meet new regulatory trends in order to reduce costs and gain a competitive advantage and to ensure long-term profitability and sustainability. Being effective is always a high priority for every company. But if this involves creating economic value and reducing environmental impacts and reducing resource use at the same time, value added becomes even more important. The eco-efficiency process refers to every area of activity within the company - from eliminating risks and finding additional

<sup>52</sup> Eco-efficiency LEARNING MODULE, WBCSD- Five Winds International p.16.

savings to identifying new market opportunities. Five aspects of eco-efficiency are recognized and make an indispensable strategic element in business (Figure 2).<sup>53</sup>



Figure 2. Five aspects of eco-efficiency

## 2.1. Advantages of a gradual increase in eco-efficiency

Gradual increase in eco-efficiency according to the needs of people who fully understand the concept and its potential. This should not be limited to the development of incremental improvements in efficiency in existing practices and habits. Instead, they should encourage creativity and innovation in search of new ways of doing things. Second, it is not limited to areas within the company's boundaries, such as production and management, but equally valid for the entire supply chain and consumption. Flexibility of eco-efficiency seems to be beneficial for all companies at any given time. Customer needs are changing, and thus their concern for the environment and the extent of eco-efficiency. New risks come to the surface, such as climate change, and the existing ones are more pronounced. The ever-increasing pressures of economic growth and population growth make some challenges - such as the

availability of clean water - more and more serious. This is an increasing reason to focus on eco-efficiency as a "trip" rather than a "destination", that is, a process rather than a panacea.<sup>54</sup>

## 2.2. Competitive advantage

Financial markets began to look at the aspects. Long-term analysts predict that companies that have implemented eco-efficiency as a business concept will significantly outperform their competitors. From a macroeconomic point of view, eco-efficiency helps richer countries in their development more qualitatively than quantitatively - by providing more services, functions and values rather than converting materials into more energy and waste. Eco-efficiency also allows developing countries to evolve in a quantitative way, but with more efficient use of resources and environmental impacts. Given that the concept of producing more from less resources (as well as reducing pollution), this means that the poor countries will benefit greatly, especially poor countries where consumer goods are expensive such as oil, and some of the natural resources, such as wood and water are poorly represented. In fact, improvements in the efficiency of such production can be the only way in which many of the world's developing companies will be able to compete in the global market.

<sup>53</sup> Eco-efficiency LEARNING MODULE, WBCSD- Five Winds International p.16.

<sup>54</sup> DeSimone, L. and Popoff, F., Eco-Efficiency: The Business Link to Sustainable Development, Boston: The MIT Press, 1997, by Eco-efficiency LEARNING MODULE, WBCSD- Five Winds

Internacional, p. 21), the panacea is hypothetical a medicine that would treat all the diseases, downloaded from <http://sr.wikipedia.org/wiki/panacea> accessed 25.03.2015.god

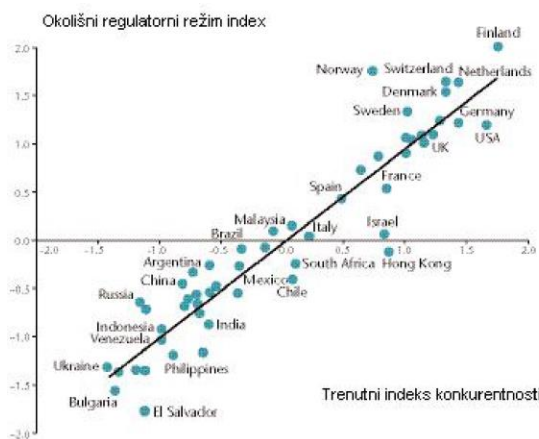


Figure 3. Environmental protection, regulation and competition

(Figure 3)<sup>55</sup> shows that countries with a stricter regimen of environmental regulatory mechanisms are more competitive in general. This disproves the theory that it is a "race to the bottom", that is, that investments will go to countries with less stringent environmental standards.

### 2.3. Implementation of eco-efficiency

Eco-efficiency can be carried out through the whole chain of production or service value, and not only within the boundaries of the physical plant. For some companies, the most harmful impacts on the environment they are related to actually occur outside their fence - either in the raw material stage and at the supplier's processing stage, or in failure to use the product or its disposal as waste. In light of this, ecological efficiency can be achieved through seven key approaches:

- Reduce the use of material
- Reduced amount of energy consumed
- Reduced dispersion of toxic substances
- Take recycling

<sup>55</sup> Source: Esty, D.C. and Porter, M.E., "Measuring National Environmental Performance and its Determinants", The Global Competitiveness Report 2000, Geneva: World Economic Forum, prema (Eco-efficiency LEARNING MODULE, WBCSD-Five Winds International p. 22.)

- Main support for the use of renewable sources
  - Extend the product's durability
- Increased utilization

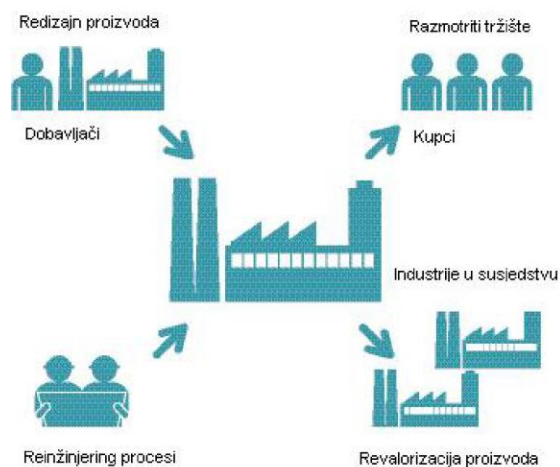


Figure 4. Four areas of eco-efficiency

Figure 4)<sup>56</sup> shows four main areas that provide opportunities to increase eco-efficiency. This can help businesses recognize various options, and who will be in charge of their exploitation inside and outside the company. As Figure 4 explains, all departments within the company can contribute to increasing eco efficiency: operations, procurement, R & D, sales, marketing and management, and each of them has its impact. By recognizing this, many companies have made eco-efficiency part of their overall business strategy. They realized that key eco-efficiency opportunities lie not only in their production but also along the entire supply chain, as well as in the use of their products and services. Eco-efficiency for them has become the main driver of innovation and progress, "vehicle" that helps them meet their economic and environmental goals. The WBCSD believes it is vital that the company's top management accepts the

<sup>56</sup> Eco-efficiency LEARNING MODULE, WBCSD- Five Winds International p. 23.

concept of eco-efficiency. Those corporations where eco-efficiency is on the CEO's agenda have been able to make real progress. Their effectiveness is not limited to several improvements in just some aspects. Instead, they start skipping eco-efficiency with innovative products, new services and a focused business strategy towards sustainability.

### **3. ECO-EFFICIENCY CONCEPTION: SPECIFICS IN SMALL AND MEDIUM ENTERPRISES**

Multinational corporations have staff and cash flow to explore and benefit from eco-efficiency. However, many small and medium-sized enterprises feel they do not have time or money for anything other than the mere survival of the market. In practice, small and medium-sized enterprises can also benefit from eco-efficient activities. In Latin America, to prevent a decline in trade, businesses need to be more competitive in order to survive. This is especially true for small and medium enterprises, which include 90% of industrial enterprises. These enterprises produce less than half of industrial output and are characterized by disproportionately high pollution levels in relation to larger companies. However, Latin American companies compete in global circumstances in which eco-efficiency forms an integral part of the leading business strategy. But they also work within Latin American circumstances, defined by the pressures of social needs, fundamental environmental and public health problems, regulations and limited regulatory implementation of macroeconomic policies that favor eco-friendly practices, and limited

environmental infrastructure. Where savings do not do so, then investing entrepreneurship in eco-efficiency depends on the power of government institutions and market demand.

This latter is often non-existent. Companies in the region need information on local sources of funding for cleaner products. However, these challenges can create opportunities: to benefit from the experience of other countries, in leap-frog technology, to avoid costly mistakes, to develop an approach to environmental management that takes into account specific cultural needs and opportunities.<sup>57</sup>

#### **3.1. Creating an eco-efficiency market**

Currently, there is a small eco-efficiency market and governments realize that they must help create this market. For example, the certification price by an accredited certification service such as ISO is too high for most SMEs. In many cases, the greater the problem is management, rather than technical problems. They have environmental problems the tendency to be generated by the lack of good governance in all areas, so you problems can not be solved by technical changes. Some big companies are working with smaller, so that everyone can benefit from eco-efficiency. Strengthening government institutions and business organizations, creating regulations, certification process and widely available systems environmental management, education and training, and more demonstration projects will help in creating a market.

<sup>57</sup> Environmental Investment Strategy, Inter-American Development Bank, Multilateral Investment Fund, [www.iadb.org](http://www.iadb.org), accessed

November 2001, prema (Eco-efficiency LEARNING MODULE , WBCSD- Five Winds International p. 36.)

### 3.2. Improving SME eco-efficiency

Eco-efficiency solutions must be adapted to local, cultural, and economic conditions.. This means that work with good practice and routine often yields greater success than a major technological transfer and implementation of an environmental management system (EMS). The informal nature of many SMEs is another significant obstacle to the further adoption of eco-efficiency. They often do not pay taxes, they do not acquire water and energy legally, which gives them a lower price than the competitor. There are several steps to improve eco-efficiency:

- Small and medium-sized enterprises can work with the supply chain, the neighboring companies, non-governmental organizations in order to create and improve the environment, and generate data that enable small and medium-sized enterprises to show improvements in the market (eg ISO 14001)
- Industry and government must generate a demand for domestic countries by encouraging environmental technology that anticipates market requirements and needs
- Incorporate community and workers In the OECD countries, the availability of public information on the environmental performance of the company associated with the local activism community was the main driver of efficiency improvements.
- Funding of institutions and insurers may require improvement of environmental protection effectiveness and make available support.

Mexican SMEs have found a major source of savings in reducing social security payments when reclassification of a non-hazardous workplace has been carried out. Also, companies will want to improve performance if they meet realistic rules and are publicly recognized for their efforts. The necessary infrastructure is another important problem. If there are companies for the separation and management of hazardous waste, there must be places for

the sale, processing, or treatment of waste. Additional steps on the road to eco-efficiency for small and medium-sized enterprises include additional training and assistance, greater access to information, effective certification systems.

### 4. CONCLUSION

Although the term "eco-efficiency" has been in use for more than a decade, it is more seriously accepted by the wider business community in the past few years. Significant progress has been made in applying the principles of eco-efficiency in practice. For example, in the industry, significant success in reducing pollution and emissions, and removing hazardous materials from the production process, as well as reducing production costs and increasing the efficiency of the company. Global trends in the application of eco-efficiency indicate that the West and industrialized countries have a higher degree of eco-efficiency implementation, while developing and transitional countries are less or less. Reasons should be sought in inappropriate implementation of the law, insufficiently developed awareness of the social community and the economic problem that these countries are burdened with. Our conclusion is that the implementation of the eco-efficiency concept should be accepted at the level of the organization / company.

Companies need to use their marketing skills by informing consumers in order to be aware of the urgency and need for sustainable production and consumption. The state, non-governmental organizations and public opinion should continuously exert pressure, but also offer concrete solutions in order to reduce environmental pollution and encourage sustainable development. Eco-efficiency solutions must be adapted to local conditions, both culturally and economically. A concrete example for Bosnia and Herzegovina are:

Tuzla Canton (Tuzla and Lukavac municipalities) and Zenica-Doboj canton (Zenica and Kakanj municipalities) that have a relatively higher degree of air pollution compared to other municipalities in the Federation. Experience shows that the reasons for which companies are not broader introduced the concept of eco-efficiency are:

- Company headquarters or country of origin (developed industrial countries, ZUR, transitional countries)
- Organizational profile of the company (size and activity of the company, ownership)
- Lack of management's will (lack of information or lack of understanding of how to accept the eco-efficiency process and its effectiveness)
- Costs of eco-efficiency implementation (transition from obsolete to sophisticated and complex technologies, introduction and training of employees through workshops and seminars)

Possible measures for encouraging faster and wider implementation of the concept of eco-efficiency in business processes:

- State regulation (establishing a system for issuing environmental permits, imposing eco-taxes and taxes, and the goal of the state is to reduce adverse ecological impact, without deteriorating the economy of the state, the company, and the budget of the community)
- Strengthening government institutions, creating regulations, certification process, more demonstration projects.
- Innovation as a key guide to advancing the application of the eco-efficiency process
- Protecting existing ecosystems, optimizing resource management, raising public awareness and media awareness by promoting responsible ecological behavior.

## LITERATURE

- [1.] Eco-efficiency LEARNING MODULE (Five Winds International, World Business Council Sustainable Development) ([http://www.wbcd.org/DocRoot/UROf8cWqw37ZpR3wrDm6/ee\\_module.pdf](http://www.wbcd.org/DocRoot/UROf8cWqw37ZpR3wrDm6/ee_module.pdf))
- [2.] Business and Sustainable Development ([http://www.bsdglobal.com/tools/bt\\_eco\\_eff.asp](http://www.bsdglobal.com/tools/bt_eco_eff.asp))
- [3.] Environmental management (Tanja Radić, Živana Lambaša Belak Šibenik, 2006)
- [4.] Market Structures and Economic Efficiency (Kasim Tatić, Faculty of Economics in Sarajevo, 2003.)
- [5.] Sustainable Development at Pliva-Croatia d.o.o ([http://www.hrpsor.hr/upload/PLIVAHrvatska\\_KrunoKovacevicOdrziviRazvoj.pdf](http://www.hrpsor.hr/upload/PLIVAHrvatska_KrunoKovacevicOdrziviRazvoj.pdf))
- [6.] <http://www.igman.com/biologskirjecnik/P/Polutant.html>
- [7.] <http://www.fmoit.gov.ba>
- [8.] <http://sr.wikipedia.org/wiki/panacea>

## GREAT CIRCLE SAILING AND GREAT CIRCLE SAILING APPROXIMATION BY USAGE OF TRIGONOMETRIC FUNCTIONS

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***Abstract:** Trigonometry was, as a part of mathematics, until the renaissance almost exclusively used in astronomy, and not as a mathematical theory. Plane trigonometry was used just as much as needed for spherical trigonometry. There are many uses of trigonometric functions today. One of these uses is visible in marine, specially in navigation. Numerical calculation of the shortest way between starting position and destination position, ie. great circle, and approximation methods are the backbone of this paper. Paper does, at least partially, show us huge role of trigonometric functions in great circle sailing, and in marine in general.*

***Keywords:** mathematics, trigonometric functions, great circle sailing, approximation.*

### 1. INTRODUCTION

The orthodrome is part of the main circle, and the shortest route between the departure position and the arrival position. In practice, it rarely sails in the orthodrome, because then the helmsman should constantly change course, which is unacceptable in navigation. Only when navigating the orthodrome is when the helmsman manages the vessel by navigating not according to the devices, but towards some marvelous maritime navigation object. All of the above implies that the Earth is a ball. [2, 12] In navigation, the Earth is indeed considered a ball, but for theoretical reasons it is desirable to approximate the Earth's geoid with the rotational ellipsoid [1, 4, 7] that is closer to the Earth's appearance than the ball. If a normal passing through the point Td is laid on the ellipsoid at the point of departure Tp, then this plane cuts the rotation ellipsoid with a normal cross-section at the point Td. However, at point Td this is no longer a

normal cross section. Thus, on the rotational ellipsoid, a normal cross-section can not be established by the points Tp and Td, which would mean that these two points can not be withdrawn by the geodetic line as a normal cross-section of both points. The angle between the normal section by the point Tp, passing through the point Td and meridian, is called the astronomical azimuth of the point Td because it is determined by astronomical observation. The angle between the plane of the daybreak, the point Tp, and the geodetic line by the points Tp and Td of the rotating ellipsoid is called the geodetic azimuth of the point Td. The difference on the rotational ellipsoid of these two azimuths at a distance of 450 km is in the part of 15.43 m, and at distances less than 100 km, it practically disappears. The difference in the distance of the geodetic line by the points Tp and Td and the normal cross sections by either the point Tp (and passing through the point Td) or by the point Td (which passes

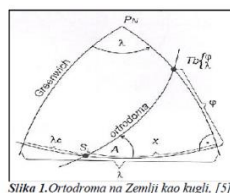


through the  $T_p$ ) are so small that they disappear. In this paper numerical calculations of the orthodrome elements and methods of approximation of navigation by orthodrom will be shown.

## 2. CALCULATION OF THE ORTHODROME SURFACE ELEMENTS

The equation of the orthodrome on the ball is obtained from Fig. 1 according to Napier's rule [6]:

$$\begin{aligned} \sin x &= c \cdot \operatorname{ctg} d \cdot \tan \varphi, \\ \tan \varphi &= \tan A \cdot \sin x, \\ \tan \varphi &= \tan A \cdot \sin (\lambda - \lambda_c). \end{aligned} \quad (1)$$



Slika 1. Orthodroma na Zemlji kao kugli. [5]

Since the orthodrome is part of the main circle, the two-point connector on Earth is closer to the earth's poles than the rhumb line. The coupling of two points with  $\Delta\lambda = 180^\circ$  passes through half. When traveling by boat, parts of the land or the eternal ice obstacle are navigating. Similarly, discarded ice pieces - ice dunes and boulders - pose a threat to navigation. In large latitudes, poor meteorological conditions hinder or limit navigation.

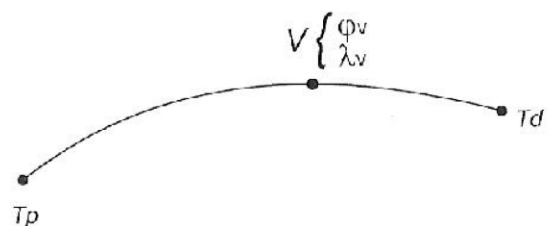


Figure 2. Tip (vertices) of the orthodrome on Earth as a ball, [5]

Therefore, it is of critical importance in choosing the route by which the ship will sail, to determine the maximum latitude to which the orthodrome will lead, which is the vertex orthodrome (Figure 2). After that, the navigator will study navigation manuals, pilot charts, marine

ads, and follow the boat to this orthodrome only if it is not closer to the equator than the forbidden navigation areas. If the orthodrome sets too close to the half of the permitted, it will use combined navigation; will sail part of the road by the orthodrome, part by comparison, and the part will be re-entered by the orthodrom. Whether the boat sails by orthodrome or rhumb lines, depends on how much the orthodrom is shorter than the distance between the point of departure and the point of arrival. The orthodromic distance to (Figure 3) is determined according to the cosine instruction for the sides of the scuffed spherical triangle. [8,9]

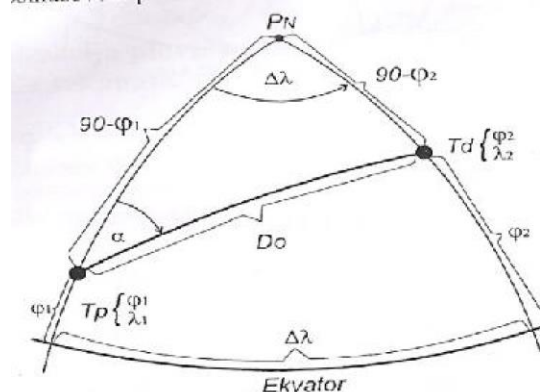


Figure 3. Orthodromic distance on the Earth as a sphere, [5]

$$\begin{aligned} \cos D_0 &= \cos(90 - \varphi_1) \cdot \cos(90 - \varphi_2) + \sin(90 - \varphi_1) \cdot \sin(90 - \varphi_2) \cdot \cos \Delta\lambda \Rightarrow \\ &\Rightarrow \cos D_0 = \sin \varphi_1 \cdot \sin \varphi_2 + \cos \varphi_1 \cdot \cos \varphi_2 \cdot \cos \Delta\lambda. \end{aligned} \quad (2)$$

The initial Kpč course is defined by an orthogonal angle  $\alpha$ . The orthodromic angle  $\alpha$  is determined from the orthodromic triangle shown in Figure 3, according to the sinus instruction [11]

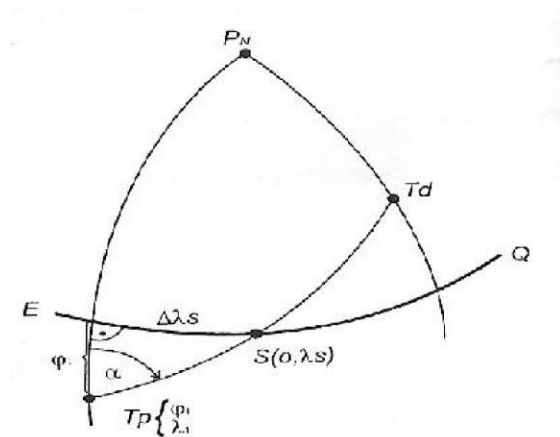
$$\sin \alpha : \sin \Delta\lambda = \sin(90 - \varphi_2) : \sin D_0 \Rightarrow \sin \alpha = \frac{\sin \Delta\lambda \cdot \cos \varphi_2}{\sin D_0} \Rightarrow \alpha = \arcsin \frac{\sin \Delta\lambda \cdot \cos \varphi_2}{\sin D_0}. \quad (3)$$

According to this great circle course the ship usually does not start the journey. If the helmsman kept the course for a long time (then sailed along a rhumb line with an initial orthodromic course), he would move on the tangents at the orthodrom, which would lead him to excessive latitude. The

ship will sail along the loxodrome tendon, and then follow the orthodrome from the intersection to intersection. [3] From a rectangular triangle whose one cathete is a daybreak of the point of departure, the other half of this to the intersection of the orthodrome with the hemisphere, and the hypotenuse of the arc of the orthodrome, is as follows:

$$\begin{aligned} \cos(90 - \varphi_1) &= \text{ctg}(90 - \Delta\lambda_s) \text{ctg}\alpha \Rightarrow \\ \Rightarrow \sin \varphi_1 &= \text{tg} \Delta\lambda_s \text{ctg}\alpha \Rightarrow \Delta\lambda_s = \text{arctg}(\sin \varphi_1 \cdot \text{tg}\alpha). [10] \end{aligned}$$

Figure 4. Crossing of orthodrome with the equator, [5]

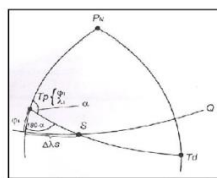


If the position of the orthodrome is in Figure 4, then:

$$\begin{aligned} \cos(90 - \varphi_1) &= \text{ctg}(180 - \alpha) \cdot \text{ctg}(90 - \Delta\lambda_s) \Rightarrow \sin \varphi_1 = -\text{ctg}\alpha \cdot \tan \Delta\lambda_s, \\ \tan \Delta\lambda_s &= -\text{tg}\alpha \cdot \sin \varphi_1 \Rightarrow \tan \Delta\lambda_s = \text{arctan}(-\tan \alpha \cdot \sin \varphi_1). \end{aligned} \quad (5)$$

Geographical length of point S (orthodrome node) will be:

$$\begin{aligned} \lambda_s &= \lambda_1 + \Delta\lambda_s, \\ \lambda_1 + \lambda_s &= 180^\circ. \end{aligned} \quad (6)$$



Slika 5. Određivanje čvora ortodrome. [5]

### 3. APPROXIMATION OF SAILING ALONG THE ORTHODROME

Considering the fact that orthodromic navigation has been postponed so that in practice it is practiced just like that, and if there is a higher fuel cost if it is sailed by the marathon, special navigation cases have been developed, which is based on the approximation of sailing along the orthodrome. The goal of approximation of navigation by the orthodrome is to save time and fuel at least approximately to that achieved by navigating through a pure orthodrome, and at the same time, to facilitate the orthodromic sailing to the helmsman so that the course should not be constantly changed. The approximation is done by calculating certain points of contact on the path of the orthodrome, and the ship between the same sail along the rhumb line, therefore, without the change of course. The most common methods of approximation of navigation by orthodrome are the method of approximation by secants, and the method of approximation by means of tangents.

#### 3.1. Approximation with the secant method

Approximation by the method of secants is carried out in such a way that through the orthodrome a secant passes through arbitrarily selected intermediate points, and then the ship between the paths sails along a rhumb line. The waypoints of the orthodromes are determined so that their lengths differ by 5° or 10°, and the division starts from the top, i.e. if it is between the position of departure and the arrival position, and if the orthodrome head is located outside the coupling of the position of the departure and the position of arrival, the orthodromes can be defined from the departure position.

If the division starts from the scalar, the relations are derived from Figure 6. Namely, let the geographical length difference be sought for which the intermediate points  $\psi$  are sought, and the T-point of the day is given by the coordinates  $\phi_T$  and  $\lambda_T$ . [3] The navigator selects the geographic length of the intersection, i.e.

$$\lambda_T = \lambda_v - \psi. \tag{7}$$

Latitude obtained from a right triangle  $\Delta PNTV$  [11]:

$$\begin{aligned} \cos \psi &= \text{ctg} [90 - (90 - \phi_v)] \text{ctg} (90 - \phi_T) \Rightarrow \cos \psi = \text{ctg} \phi_v \cdot \tan \phi_T \Rightarrow \tan \phi_T = \tan \phi_v \cdot \cos \psi \Rightarrow \\ &\Rightarrow \phi_T = \arctan [\tan \phi_v \cdot \cos \psi]. \end{aligned} \tag{8}$$

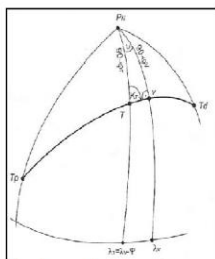


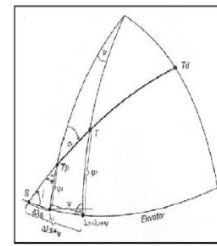
Figure 6. Determination of the coordinates of the orthodrome by the method of the secant, [5]

If the orthodrome has no scalp, it is necessary to first determine the inclusion of the orthodrome according to the equator. Inclination is the angle under which the orthotorm shaves the earth's equator, and is derived from the rectangular triangle of the point of departure. According to Napier's rule [6]:

$$\cos i = \sin (90 - \phi_1) \sin \alpha \Rightarrow \cos i = \cos \phi_1 \sin \alpha \Rightarrow i = \arcsin (\cos \phi_1 \sin \alpha). \tag{9}$$

If the coordinate  $\lambda_s$  of the orthodrome cross-section with the equator S is defined earlier, and in the rectangular triangle  $\Delta SAT$  the known catheter at the equator ( $\Delta \lambda_s + \psi$ ) and the inclination angle  $i$ ; from the  $\Delta SAT$  triangle follows:

$$\begin{aligned} \cos [90 - (\Delta \lambda_s + \psi)] &= \text{ctg} \cdot \text{ctg} (90 - \phi_T) \Rightarrow \sin (\Delta \lambda_s + \psi) = \text{ctg} \cdot \tan \phi_T \Rightarrow \tan \phi_T = \sin (\Delta \lambda_s + \psi) \cdot \tan i \Rightarrow \\ &\Rightarrow \phi_T = \arctan [\sin (\Delta \lambda_s + \psi) \cdot \tan i]. \end{aligned} \tag{10}$$



Slika 7. Inklinacija ortodrome. [5]

Other Waypoint great circle shall be determined for every 5 (or 10) degrees to the left or right of the scalp, and the advancement of the point of departure (when there is no great circle vertex) on the same terms as above, only the angle  $\psi$  every time increases. Lochschord intermediate is calculated from the loxodromic triangle [11]

$$\tan K = \frac{\Delta \lambda}{\Delta \phi_M} \Rightarrow K = \arctan \frac{\Delta \lambda}{\Delta \phi_M}. \tag{11}$$

The first course K1, after which the navigation will be started at the orthodrom at the point Tp (Fig. 8), will be obtained on the basis of the  $\Delta \lambda$  point of departure and the T1 point of the difference between Mercator's widths of these two points. The second course K2 at the point T1 will be obtained on the basis of analog  $\Delta \lambda$  and  $\Delta \phi_M$  points T1 and T2 and thus all courses in a row.

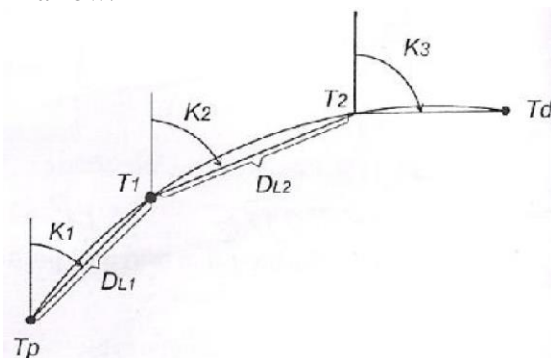


Figure 8. Approximation of orthodrome navigation by secant method, [5]

In order for a navigator to know when a course change is needed in a course in individual points of view, or the time it will arrive at a particular point of departure, the locomotor distance should be determined. It follows from the loxodromic triangle

$$D_L = \frac{\Delta\varphi}{\cos K} \quad (12)$$

In this case, the DL should be determined  $\Delta\varphi$  points T1 and Tp and the course K1, for DL2 points T2 and T1 and so on. [3]

### 3.2. Approximation by tangent method

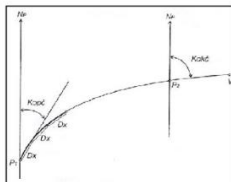
In this case, instead of the secant which are determined by waypoints, navigating to the tangent great circle which is determined as follows: Calculate the initial great circle course at an initial position (P1) - K<sub>opc</sub> and final orthodromic course to the destination position (P2) - K<sub>okc</sub>, and the following values are calculated:

$$x = \frac{K_{okc} - K_{opc}}{\Delta K} \quad ; \quad D\alpha = \frac{D_o}{x} [M] \quad (13)$$

za  $\Delta K = 1^\circ \Rightarrow D\alpha = \frac{D_o}{K_{okc} - K_{opc}}$

gdje je:

- X – ukupna vrijednost promjene ortodromskog kursa,
- $\Delta K = 1^\circ, 2^\circ, 3^\circ, \dots$  po volji odabrana jedinična vrijednost promjene ortodromskog kursa,
- $D_o$  – ortodromska udaljenost u nautičkim miljama između dviju odabranih pozicija ( $P_1$ ) i ( $P_2$ ) na ortodromi,
- $K_{opc}$  – početni ortodromski kurs u ishodišnoj poziciji ( $P_1$ ),
- $K_{okc}$  – završni ortodromski kurs u određenoj poziciji ( $P_2$ ) i
- $D\alpha$  – „jedinična ortodromska“ udaljenost u nautičkim miljama koju brod treba prijeći u određenom kursu da bi nastala promjena u ortodromskom kursu od  $\Delta K$  stupnjeva.



Slika 9. Aproximacija plovidbe po ortodromi metodom tangenata. [5]

## 4. CONCLUSION

Seafaring, as a branch of the world economy, is the most cost-effective form of transporting people and goods over long distances. With the development of maritime transport, and the introduction of new technologies in maritime transport, the maritime world's share of the world economy is increasing every day, but at the same time it improves seafaring as such. Throughout history, people have changed travel routes and ways in which ships sail in accordance with the scientific discoveries

of the time. Today, the most cost-effective way of navigation is to navigate the orthodrome. Orthodrome sailing greatly disturbs the distance, and saves time and money to shipping companies. Horticultural navigation in practice is not entirely feasible because it would require a constant change in the course of the ship, and it depends on the weather, geological and other conditions of the sea in which the ship sails. Therefore, orthodromic navigation is approximated. By approximating, the paths to the nearest orthodrome are obtained, and significant savings are achieved in relation to the rossoceanic sailing. The approximation of orthodromic navigation is done by mathematical calculation of elements through trigonometric functions. Trigonometric functions are used in every segment of orthodromic navigation, starting from the calculation of courses and distances, by calculating geographical coordinates of positions and intermediate positions, to various methods of approximate orthodromic navigation. Also, trigonometry is also used in the development of navigation maps and electronic navigation systems. Given the widespread use of trigonometric functions in Orthodromic navigation, the same is not conceivable without trigonometry. Trigonometry and trigonometric functions are closely related to maritime and orthodox sailing, and the development of maritime and navigation largely depends on the further development of trigonometry.

## LITERATURE / References

- [1] Bomford, G., (1952), Geodesy, Oxford: Clarendon
- [2] Claire Voisin, Artist of the Abstract, cnrs.fr., URL: <http://www2.cnrs.fr/en/1402.htm> (13.10.2013.)
- [3] Đula, J., (2014), Application of trigonometry in Orthodromic navigation,

graduation thesis, Faculty of Maritime Studies in Split, Split

[4] Elements of trigonometric spheric gears of method of plus grands and plus petits, URL:

[http://books.google.com/books?id=QIIfA AAAYAAJ&pg=PA258&redir\\_esc=y#v=onep](http://books.google.com/books?id=QIIfA AAAYAAJ&pg=PA258&redir_esc=y#v=onep)

age & q & f = false (09/15/2014)

[5] Kos, S., Zorović, D., Vranić, D., (2010), Terrestrial and Electronic Navigation, Faculty of Maritime Studies Rijeka, Rijeka

[6] Napier, J., (1614), Mirifici Logarithmorum Canonis Constructio

[7] Newton, I., Motte, A., Chittenden, N. W., (1948), Newton's Principia: The Mathematical Principles of Natural Philosophy, New York: Daniel Adee

[8] Oriani, B., (1806), Elements of trigonometria spheroidica, Pt. 1, Bologna: Istituto Nazionale Italiano

[9] Oriani, B., (1833), Nota aggiunta agli elementi della trigonometria sferoidica, Milan: Dal'Imp Regia Stamperia

[10] Spherical trigonometry, [http://en.wikipedia.org/wiki/Spherical\\_trigonometry](http://en.wikipedia.org/wiki/Spherical_trigonometry) (15/09/2014)

[11] Todhunter, I., (1886), Spherical Trigonometry, 5th ed., Cambridge: St John's College

[12] Turner, M., Blackledge, J., Andrews P., (1998), Fractal geometry and digital imaging, Academic Press

## PARENT EDUCATION AND TEACHER AS A FACTOR ROAD SAFETY

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**Abstract:** This paper is particularly emphasized another aspect is very important for the formation of attitudes in traffic and the development of personality and its relationship to traffic starting from children as the most vulnerable participants in traffic to the parents and teachers of children who mainly learn the most and depend on in life. Education of all groups of traffic participants that reason is an important part of traffic safety which unfortunately in our country is still not understood seriously enough, nor indeed the mere possibility of traffic management. The paper analyzes the quality of education of children, parents and teachers to acquire knowledge of the traffic on the knowledge of traffic and identification of measures that are important for the preservation of life in traffic. Based on the research have been proposed and corresponding measures to improve this aspect of traffic safety because it is clear how education is important in building positive attitudes and increase awareness of the dangers.

**Keywords:** education of parents, children and teachers

## 1. INTRODUCTION

The development of traffic safety measures is based on two aspects: measures (traffic safety), and measures related to the prevention and reduction of the consequences of traffic accidents (passive traffic safety). From birth to the rest of his life, man is relying on other people, living in communion with other people, learning from other people, working among other people, and by itself, 'condemned' to interact and cooperate with other people. The education of road users is precisely based on the interrelationships between people, on our example of the relationship between children and parents, and also of children and teachers, and, ultimately, of the training and responsibility of parents and teachers.

## 2. RESEARCH METHODOLOGY

The scientific method can be defined as the universality of scientific and technical procedures that acquire or systematise new knowledge about a subject of research. In a narrow sense, it is a thought process that allows you to get to know the subject of the research. The subject of science is completely separated by its method, i.e. the way in which the subject finds out. General and specific methods can be distinguished. The most common special scientific methods in the area of traffic safety are: statistical method, experiment method, observation method, survey method and method of interview, comparison method and analogy method. The methodology defines and describes methods of knowledge, studies their design, efficiency, advantages and disadvantages, values in the field of application. The methodology should help select the method of research. The choice of optimal research methods makes it easier to do research.

### 2.1. Subject research

With the emergence and development, traffic has brought many benefits to life and has made life easier. Traffic began to develop very rapidly, so today it has become dominant in all areas of life of every person from the youngest children to the oldest participants. Today, with reason, we can say that a man is increasingly endangered by the negative effects of traffic. It is therefore very important to have a good system of protection and to manage traffic safety. Large funds are invested in prevention in traffic protection, but unfortunately such a case is not with us. There is a lot of investment in projects of importance for improving security in the world. In this sphere of projects include programs for prevention and education of participants in traffic. Particular importance for us is the education of the youngest in wards in traffic, their parents and teachers, which is also the topic or subject of research of this paper. We dealt with this problem in the territory of the municipality of Laktasi, where we examined the education of children, parents and teachers. We will study the level of education and knowledge of traffic in the youngest participants (children under the age of 8), then the level of knowledge of parents and teachers.

### 2.2. Hypotheses

Children are victims in every third traffic accident, that is, every four minutes a child dies in the world. The most risky places for children are in settlements, when crossing a carriageway and at pedestrian crossings, places with reduced visibility and places where cars are parked. It is especially important to highlight three aspects of vulnerability, that is, children suffer as cyclists, pedestrians and car passengers.

### 2.3. Research Area

The research was carried out on the territory of the Municipality of Laktasi. The municipality of Laktasi borders with the municipalities of Celinac in the south, Prnjavor in the east, Srbac in the northeast, Gradiska in the north, and with the City of Banja Luka in the west and south. Through the municipality of Laktaši, the Gradiška-Banja Luka highway connects Banja Luka with the Zagreb-Belgrade highway. The construction of the Banja Luka-Doboj highway is under way, which will be connected with the Mahovljani loop in the municipality of Laktasi with the built motorway. Through this municipality, significant highways such as Gradiška - Banja Luka, Klačnice - Prnjavor and Klačnice - Srbac, as well as numerous regional and local roads, pass through important municipalities.

### 2.4. The aim of the research

The aim of this research is to analyze the level of knowledge of children in the 1st class on knowledge of traffic, then analyzing the education of parents and teachers about traffic. The analysis was carried out on the territory of the municipality of Laktasi. The ultimate goal is to protect children from the negative consequences of traffic, then to emphasize their inadequate education and elemental ignorance of traffic. It is children's education

one of the important aspects of building personalities and positive attitudes in traffic, and one of the ways of adapting and integrating children into a complex transport system. With proper and timely education of preschool children we will reduce the percentage of children's participation in traffic accidents and create the necessary preconditions for building the correct attitudes and behaviors later on in traffic.

### 2.5. Research time

The research period covered the period of September and October, in the area of Laktaši municipality. The time of observation and anchoring of traffic accidents covered the period from 2010 and 2014. Observations included children of the first grade of elementary schools. The interview was conducted in the period from 14.09.2015 to 18.09.2015.

### 2.6. Method of research

The method is the process by which a predetermined goal is achieved. The method is a deliberate and planned action in order to achieve a goal. The scientific method can be defined as the universality of scientific and technical procedures that acquire or systematise new knowledge about a subject of research. General and specific scientific methods can be distinguished. General methods are: analysis, synthesis, abstraction, generalization, induction, deduction, etc. The most common special scientific methods in traffic safety are: statistical method, method of experiment, observation method, survey and interview method, comparison method and analogy method. In this paper, a survey method was used. Survey is a scientific method that consists in examining the circumstances of individual cases. The following techniques are used: questionnaire, interview, scales of assessment, tests.

## 3. EDUCATION OF PARENTS AND TEACHERS

When analyzing the risks that children face in traffic and their environment, it is very important to identify those who are responsible for risk creation and risk management. It is best to match the system so that education includes parents, teachers, educators and children. In addition, we need to educate drivers, especially younger

and inexperienced about the abilities and characteristics of children, that is, to raise awareness among people about the limited abilities of children. In order for the entire traffic education system to function, it is necessary to implement measures in order to acquire the knowledge, skills and habits necessary for safe participation in traffic.

In gaining knowledge, abilities and attitudes in traffic, they have:

- Family, or habits and attitudes that come to life from the earliest days in the family, which includes traffic,
- Cantonal, entity and state bodies responsible for childcare, and the adoption of programs and measures for education of children and the conduct of educational activities, Bodies responsible for internal affairs in terms of realization of the education programs and education programs starting from preschool institutions to secondary schools, work of school traffic patrols and patrols of citizens
- The institutions and authorities in charge of the health of citizens who will provide education on safe participation in traffic with this aspect
- Agency for Traffic Safety,
- Local self-government and authorities at that level that can also support the planning and implementation of measures to improve education and security at the local level, that is, protection in more intricate zones,
- Pre-school institutions, primary and secondary schools that can realize and devise programs within their competencies,
- Professional and scientific organizations that are directly or indirectly engaged in education and traffic,
- The media and other public information that can actively participate in the education and formation of positive attitudes,
- Associations, groups of citizens and non-governmental organizations that can

encourage discussions on these topics and launch many projects and initiatives

We currently have poor traffic education starting from preschools up to high school, because very little is invested in education, especially in traffic education. Plans and programs of education of children must contain literature, subjects and chapters on transport education and education. Regulations on the content of curricula related to the education and safety of children in traffic are issued by the Minister responsible for education. In the case of trainees or candidates for drivers, every legal entity that conducts training of candidates is obliged to access this job in such a way as to provide the candidate with basic theoretical and expert knowledge, i.e. the practical skills they are necessary for self-management of the vehicle in traffic.

### 3.1. Teachers

Teachers play a very important role and after parents who are first in touch with children, the most important task in the education of children. Their task, in addition to the experiences in traffic, introduces children in a very complex system in order to teach them adequate behavior. It is especially important to upgrade knowledge that has been achieved in the family, trying to achieve maximum results. Traffic education is required to work continuously throughout the year, to acquire new knowledge, to expand existing ones, to improve the good habits and abilities necessary for the safety of children as pedestrians, in-car passengers or cyclists.

Teachers should pay attention and educate children to adhere to those rules that are absolute and lasting, and as such do not suffer exceptions. Such examples are that they always have to stand at a pedestrian crossing, turn to help an elderly person and a policeman, move away from the curb, not



run into the street, not cross the street, not stand between the vehicle and the door of the vehicle, etc. In addition, they must teach children the dangers they threaten on the street from vehicles and traffic. In doing so, care must be taken to avoid the fear of children who will paralyze them in thinking about reactions and judging. In addition to theoretical instruction, it is very useful for children to teach on concrete examples in practice by showing concrete examples of how to walk with a sidewalk, a view to the left right before crossing the street, a place where we are crossing the street, etc.

Children learn a lot of things through the game, so we should try to get them closer to traffic through more interesting ways of teaching or listening. We can achieve this by means of traffic polygons and by creating a model. Thus, the educator will regulate the child's experiences. The model can be made on the table and on the floor with the help of the prepared intersection strips, figure of people and children, vehicle model and traffic signs. The educator thus engages children and encourages thinking by giving them picturesque examples in order to better understand and create a picture of what is in traffic.

In many countries, the subject of traffic safety is part of the training of teachers and teachers.

Especially for younger children together with their parents, they should serve as a role model. It is therefore important to adjust the strategies that are being taught, then parents and teachers need to provide children with uniform information and behavioral rules. The school may also be an intermediary providing information to parents on road safety, on the road from home to school, in school zones. The school can also coordinate traffic around the school in cooperation with the police and security authorities in order to, for example, reduce the level of driving and parking around the school. Schools can organize

parents' associations in order to discover problems and shortcomings on specific examples of parents' problems. In some countries, the role of teachers in transport education is strongly supported by the police who are actively committed to working with schools and children. In our practice, most of the teachers have not received any education from traffic safety, nor are they

it will give methodological approaches and know how to treat these topics in dealing with children. Developing and acquiring a traffic culture in children and young people, in preschool and school institutions, may be the only organized and acceptable ways of acquiring appropriate and adequate habits in traffic. Most of the school institutions carry out the basics and knowledge of traffic and acquire a traffic culture through traffic sections, which is insufficient. Teaching disciplines, such as traffic education or traffic culture, should be the basis for curricula that will be an obligation for all elementary schools and an integral part of the selected chapters in secondary schools. Well-prepared primary school students and warned high school students could deal with

problems from traffic. If they remain in the category of pedestrians, they will no longer have the possibility of traffic education, unless they begin to develop in the direction of secondary schools and faculties in the field of transport, which is certainly a small number of the population. Certainly, the mentioned fact should be taken into account by the society and that it is necessary to develop programs that could be implemented even after this age, which relate to traffic education, because in traffic, it is too often too often to be left to the case and unorganized development. The basic program contents, which relate to the development of the traffic culture in preschool and school age, should be determined in accordance with the following pedagogical requirements:

- pre-school children should only be given the knowledge that is available to his / her intellect, i.e. age, and any introduction into the traffic culture should be gradual and based on the existing fund of words and concepts that are gradually expanding,
  - developing personal skills such as autonomy, cautiousness, manageability, visibility,
- ie. everything that a child can use both as a pedestrian and as a traveler,
- the child should be directed to the consistent execution of what was said in the field of traffic behavior in order to fully comply with traffic rules and traffic regulations.

The assumption, from which adults leave, that children need to acquire a certain amount of traffic knowledge and that this will reduce the number of traffic accidents, is in any case the wrong basis for the development of a traffic education program. The didactic approach to "stand, look, listen, thoughts" proved inappropriate because traffic situations are complex and unpredictable. We can not expect children to sit in school benches in a "safe" environment, passively listen to teachers, learn random traffic rules and signs and, consequently, succeed only in "insecure" external roundabouts, i.e. on the street. So, children need to experience certain traffic situations, see realistic traffic relationships and train them how to cope with them. Research has shown that some children do not even understand the verbal instructions on the traffic that parents or teachers give them, e.g. "Be careful", "be careful", "watch more", "we must cautiously cross the street", "you have to consider and look when you are on the street", "many children are killed in many traffic accidents", etc. All of these guidelines are generalized and the question arises as to whether children are perceived and understood by them in the context of traffic behavior in the way adults think they have transmitted the instructions to the child. Many children,

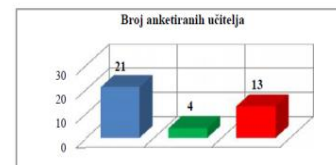
especially younger ones, have no idea about terms such as: sidewalk, pedestrian, etc.

### 3.2. Analysis of the teacher's survey

A total of 38 teachers were interviewed by the fourth grade at the elementary school "Georgios A. Papandreu" Aleksandrovac, Elementary school "Desanka Maksimović" Trn and elementary school "Mladen Stojanović" Laktaši. The questionnaire contained 9 questions with the answers provided, where one of the offered answers had to be circled.

Tabela 1. Broj anketiranih učitelja po Osnovnim školama na području opštine Laktaši

Redni broj	Naziv škole	Adresa	Broj anketiranih učitelja po osnovnim školama
1.	OŠ „Georgios A. Papandreu“	Gradiška cesta 55, Aleksandrovac	21
2.	OŠ „Desanka Maksimović“	Dositejeva 34, Trn	4
3.	OŠ „Mladen Stojanović“	Karadordeva 105, Laktaši	13
Ukupan broj anketiranih učitelja			38

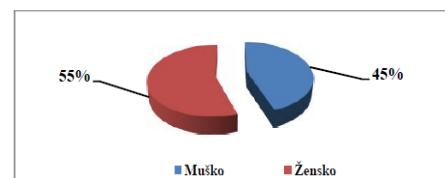


Dijagram 1. Broj anketiranih učitelja po Osnovnim školama na području opštine Laktaši

Broj ispitanika po polu:

Tabela 2. Broj anketiranih učitelja po polu

Muško	Žensko
17	21

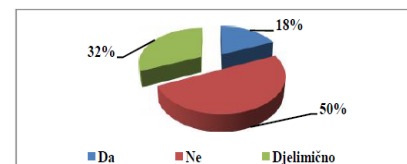


Dijagram 2. Ukupan broj anketiranih nastavnika po polu

1. Da li djeca imaju dovoljno znanja prije dolaska u školu?

Tabela 3. Da li djeca imaju dovoljno znanja prije dolaska u školu

Da	Ne	Djelimično
7	19	12



Dijagram 3. Da li djeca imaju dovoljno znanja prije dolaska u školu

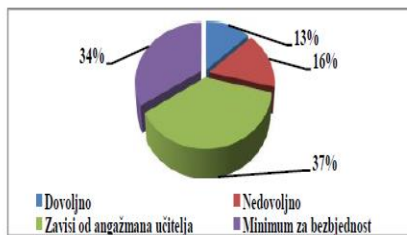
When asked: "Do you have sufficient knowledge before coming to school," according to the assessment of teachers, 32% of them think that children have partially knowledge of traffic, 50% think that children do not have enough

knowledge about traffic, while 18% think that children have enough the knowledge that she would participate in traffic safely, that is, from home to school and back.

## 2. How much knowledge about school traffic safety is provided to students?

Table 4. How much knowledge about traffic safety of schools provides students

Dovoljno	Nedovoljno	Zavisí od angažmana učitelja	Minimum za bezbjednost
5	6	14	13



Dijagram 4. Koliko znanja o bezbjednosti saobraćaja škola pruža učenicima

By analyzing the question: "How much knowledge on traffic safety schools provide students", it was concluded that 34% believe that school provides a minimum knowledge to children about traffic, 13% believe that the school provides enough knowledge to children about traffic, 16% believe that school insufficiently provides knowledge of children on traffic, 37% think that the knowledge of children depends on the teacher's personal engagement.

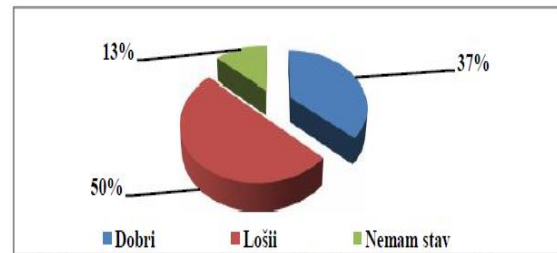
## 3. How do you evaluate the quality of textbooks and materials for education of children?

Table 5. How do you evaluate the quality of textbooks and materials for education?

3. Kako ocjenjujete kvalitet udžbenika i materijala za edukaciju djece?

Tabela 5. Kako ocjenjujete kvalitet udžbenika i materijala za edukaciju

Dobri	Loši	Nemam stav
14	19	5



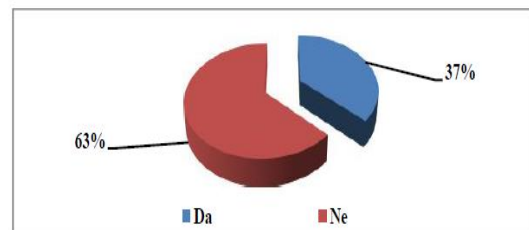
Dijagram 5. ocjenjujete kvalitet udžbenika i materijala za edukaciju

When asked: "How to evaluate the quality of textbooks and materials for education", 50% answered that textbooks do not have the necessary quality for education of children in traffic, 37% think that textbooks provide a high quality education, while 13% have no opinion on this issue.

## 4. Do you use additional literature in working with children?

Table 6. Do you use additional literature in dealing with children

Da	Ne
14	24



Dijagram 6. Da li koristite dopunsku literaturu u radu sa djecom

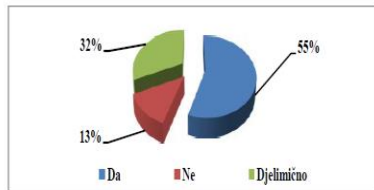
Based on the question: "DO YOU USE A SUPPLEMENTARY LITERATURE IN WORK WITH CHILDREN", 63% answered that they do not use supplementary literature, and 37% said they use supplementary literature but did not say which one.

## 5. Would teacher education help children's education?

Table 7. Would teacher education help children's education?

Da	Ne	Djelimično
21	5	12

Analizom pitanja: „DA LI BI EDUKACIJA UČITELJA POMOGLA U EDUKACIJI DJECE“ može se zaključiti da 32% smatra da bi edukacija učitelja djelimično postakla rad sa djecom u saobraćaju, 55% se izjasnilo sa DA, 13% se izjasnilo sa NE, da edukacija učitelja ne bi dala pozitivne rezultate.

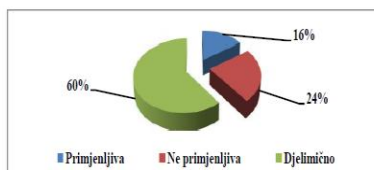


Dijagram 7. Da li bi edukacija učitelja pomogla edukaciji djece

6. Koliko su praktično primjenjiva znanja koja učenici stiču saobraćaju u osnovnim školama?

Tabela 8. Koliko su praktično primjenjiva znanja koja učenici stiču saobraćaju u osnovnim školama

Primjenjiva	Ne primjenjiva	Djelimično
6	9	23



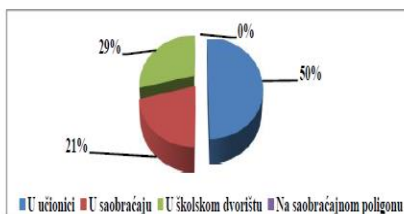
Dijagram 8. Koliko su praktično primjenjiva znanja koja učenici stiču saobraćaju u osnovnim školama

When asked: "WHAT ARE THE PRACTICAL APPLICABLE KNOWLEDGES WHICH PUPILS ARE ON TRAINING IN PRIMARY SCHOOLS, 60% think that traffic knowledge is partially applicable, 16% think that children who acquire knowledge in school about safety participation in traffic are applicable, 24% believe that the acquired traffic knowledge is not applicable.

### 6. Where do you work with children when learning about traffic behavior?

Table 9. Where do you work with children when learning about traffic behavior?

U učionici	U saobraćaju	U školskom dvorištu	Na saobraćajnom poligonu
19	8	11	0



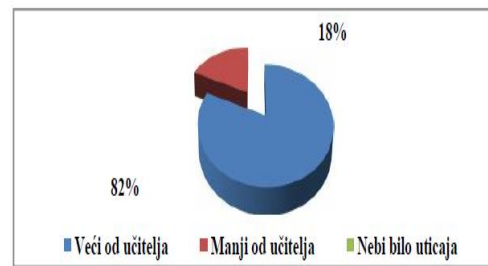
Dijagram 9. Gdje obavljate rad sa djecom kada ih učite o ponašanju u saobraćaju

When asked "WHERE DO YOU WORK WITH CHILDREN WHEN YOU LEARN ABOUT TRAINING IN TRAFFIC" 50% of the teachers answered that they work with children in the classroom, then 21% of teachers with children work in traffic, and 29% in the school yard. It should be noted that there is no traffic education field for children in the municipality.

### 7. What is the importance of a traffic police officer in the education of children?

Table 10. What is the importance of a traffic police officer in the education of children?

Veći od učitelja	Manji od učitelja
31	7



Dijagram 10. Kakav je značaj saobraćajnog policajca u edukaciji djece

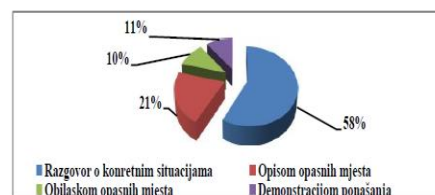
By analyzing the questions: "What is the significance of a traffic policeman in education of children", 82% responded that the impact on children large, while 18% answered that the influence of teachers on children higher or so children learn more.

### 8. How do students learn about traffic hazards?

Table 11. How to get to know students about traffic hazards

Tabela 11. Kako učenike upoznajte sa opasnostima u saobraćaju

Razgovor o konkretnim situacijama	Opisom opasnih mjesta	Obilaskom opasnih mjesta	Demonstracijom ponašanja
22	8	4	4



Dijagram 11. Kako učenike upoznajte sa opasnostima u saobraćaju

On the basis of the "HOW TO INTRODUCE STUDENTS THE DANGERS IN TRAFFIC" questions, 58% have spoken with students about concrete situations in the classroom, 21% describe the dangerous places they encounter on their way from home to school; 10% teach children by visiting dangerous places, and finally 10% demonstration of proper movement (along the sidewalk, pedestrian crossings, etc.)

#### 4. CONCLUSION

The survey examined the views and opinions of the teachers. From this we can conclude that there is much room for improvement because children do not have a satisfactory level of knowledge of traffic regulations. Teachers do not have the necessary knowledge and support in order to successfully work with children, and parents also have no developed awareness of the importance of traffic education. We also have a group of irresponsible parents who are not aware that a bad example teaches a child to behave in the same way. In addition, they consider that education and learning is not their obligation, but the obligations of teachers and other teaching staff. This attitude is disastrous, as are the bad attitudes of drivers who have no understanding of the children. Schools also do not have adequate support in work and equipment. Children most often learn uninteresting lessons and lessons that can not be understood and from which at the end of time nothing remains. It is therefore necessary to adapt the knowledge acquisition system in such a way that there are as many practical examples and demonstrative learning in the field, in traffic, in the yard and in the traffic field. The competent state institutions, primarily the Ministry of Education, as well as the institutions of local self-government, must, within their competencies and possibilities, intensify their preventive work on the safety of traffic through the education of the

population (especially children, but also adults, primarily parents and teachers) in the form of campaigns and similar activities.

#### LITERATURE

- [1] Berić, F. (2013), Safety of children in traffic in the primary school, (graduate work), University of East Sarajevo, Traffic Faculty Doboj, Doboj,
- [2] Đurić, T. (2009), Traffic education and education of children in traffic as factors of traffic education, II International Scientific Conference "New Horizons of Traffic and Communications", Doboj,
- [3] Lipovac K. (2008) Traffic Safety, Public Enterprise Official Gazette of FRY Belgrade
- [4] Jović, J. : (2013) The safety of children in traffic in the municipality of Teslić, (graduation work), University of East Sarajevo, Traffic Faculty Doboj, Doboj,
- [5] Nedić, S. : (2014) Campaign for the Safety of Children of Pedestrians, (master work), University of East Sarajevo, Traffic Faculty Doboj, Doboj,
- [6] Despić, K. : (2010) Learning of traffic signs of children with special needs, (graduate work), University of East Sarajevo, Traffic Faculty Doboj, Doboj,
- [7] Law on the Basis of Traffic Safety on the Roads of Republika Srpska, Official Gazette of the Republic of Srpska, number: 01-020-1470/11
- [8] Đurić, T. (2009) Types of traffic accidents in which children are suffering and mistakes that lead to the suffering of children in traffic, II International Scientific Meeting "New Horizons of Traffic and Communications", Doboj.

## MOBILITY AND PASSENGER TRANSPORT IN CITIES

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**Abstract:** Bosnia and Herzegovina is a small country with very few large urban agglomerations that are especially demanding in the area of public transport, especially in the segment of high capacitive mass transportation (tram, metro or lakošinski systems). Of the cities in Bosnia and Herzegovina that have public transport are: Sarajevo (around 480,000 inhabitants), Banja Luka (around 230,000 inhabitants), Tuzla (around 131,000 inhabitants), Zenica (around 128,000 inhabitants), Mostar (about 112,000 inhabitants), Bijeljina (around 108,000 inhabitants, Prijedor (about 95,000 residents) and Brcko (about 76,000 inhabitants. of the listed cities in Bosnia and Herzegovina in Sarajevo only works with four different modes of urban transport: bus, tram and trolleybus see transportation. Cities the future should be to increase alternative modes of transport and transport, modernizing existing infrastructure, increase the level of safety of road users. Innovative ideas should be in the cities for better comfort and safer life. Cycling as a mode of transportation in urban areas becomes a determinant of cities as a new way of thinking of many citizens in most developed cities.

**Keywords:** traffic, transport, organization, mobility, technologies

### 1. INTRODUCTION

Accelerated industrial development begins with the arrival of the Austro - Hungarian authorities in Bosnia and Herzegovina. New technical and technological achievements are being applied, infrastructures were being built more and more. The construction of the first railway line begins the development of public city traffic (JGP) in Bosnia and Herzegovina. From horse tram to modern means of transport. All this indicates that a man has been striving for great mobility and the ability to transfer large quantities of cargo to large distances from his post. As time went by, the first companies whose activity was public transport of passengers started to emerge as well. Many wars, and so the last one that took place between 1992 and 1995 slowed down the development of public urban transport, and largely reversed it. By destroying the transport infrastructure, the means of transport created a huge cavity in the organization of public transport, which was difficult to return to its original state.

Nevertheless, in spite of all these difficulties, the public transport city of every city and every country. Well-organized public city transport leads to the development of both cities and the country. It is known that every country that has a well-built transport infrastructure and well-organized public transport is developing rapidly.

### 2. PUBLIC TRANSPORTATION OF PASSENGERS

Public city transport of passengers serves to transport the population in the city territory by regular routes and driving directions, and under certain prescribed conditions it can be used by every citizen. It can be organized as a public regular and public van liner. The most important characteristic of public transport is the fact that carriers put public transport use of transport capacity on to all potential users of transport services with the payment of services rendered, where carriers carry out transport permanently, in the form of permanent occupation and in within its own registered

activity. Public transport services are characteristic of larger urban areas with high densities, while for suburban areas this type of transport is expensive and irrational. Public urban passenger transport is becoming an increasingly important means of ensuring mobility and accessibility within urban agglomerations. The choice of type and type of vehicle depends on many factors:

- the need of passengers
- availability of the type of transport
- price
- speed of transport
- security
- service reliability.

Public urban transport is in the function of mobilizing mobility for all social categories of the population. Its efficiency is based on the transport of a large number of passengers and acceptable economic rationality. Public urban transport is also in the function of increasing the mobility of economic and environmental resources of a given area. It includes subsystems such as:

- buses
- Taxi
- vehicles
- trams
- trolleybuses

### **3. MOBILITY AND TRANSPORT OF PASSENGERS IN TOWNS**

Mobility is the basic characteristic of economic activities by meeting the basic needs of moving from one location to another. A need that is the basis for both people and goods and for information. The basic guidance in planning traffic arrangements is good access to key services while reducing the negative effects of motor transport on society and the environment. Improvement of mobility is obtained by planning the transport system, without neglecting the connection with spatial planning and socio-economic factors. Regional traffic connections:

Planning of regional traffic connections positively influences the development possibilities of the total space. By considering all factors (ecological, demographic, economic, spatial and traffic), such traffic corridors are planned, which, with the opening of spatial and development possibilities, represent the minimum load in the space. Traffic regulation of urban areas: With measures of road network regulation, landline traffic and measures in the area of parking, overall urban traffic, PPP, cycling and pedestrian traffic, which are closely connected with the overall urban concept of the city, the entire traffic arrangement of cities is being developed. The problem of cities is daily migration and transit traffic, which is a key measure for motivating the use of public transport modes by the introduction of a high-quality PPP system, with the aim of making PPP vehicles better connect parts of the city as well as individual settlements in the narrower (local) and wider (regional) area. By taking the necessary activities for monitoring data on public transport of passengers and traffic trends, it is used to establish organizational structures for harmonization of transport and transport requirements and the need for upgrading public transport of passengers. Establishing a transport network in accordance with the needs of the users depends to a large extent on the way in which the various forms of transport or transport have been integrated. The main reference spheres in the transport system of cities and regions should be seen in the integration of individual and public transport as well as the integration of public transport of passengers. The basic guideline in the planning of traffic arrangements is good accessibility to key services while at the same time reducing the negative effects of motor transport on society and the environment. Improvement of mobility is obtained by planning the transport system, without neglecting the connection with spatial planning and socio-economic factors. Sustainable mobility implies active

commitment to change the mode of transport, habits and behavior of passengers in order to reduce the negative consequences of transport to society, ecology and the economy, such as:

- air pollution, which results in climate change,
- noise,
- traffic congestion,
- traffic accidents,
- degradation of urban areas (reduction of pedestrian space due to increase in number of vehicles),
- land exploitation (increasing construction of roads and infrastructure).

#### **4. MOBILITY AND ORGANIZATION OF PASSENGER TRANSPORT IN BOSNIA AND HERZEGOVINA**

In Bosnia and Herzegovina, there is no equal regional development and integration, especially in the segment of transport / transport and transport development, and the dynamics of development and transport and transport infrastructure are not evenly distributed in the region. The mobility of passengers is not in the function of the advantages of individual transport as an integrative factor and modes of transport, and partly because of the lack of information or inadequate information about transport between cities in Europe, Bosnia and Herzegovina and in the area of cities in order to simplify and complete the planning of the destination and starting point. Improving the quality of public transport services implies a holistic and integrated approach that seeks to improve the efficiency of the transport and transport system, which can greatly enhance the mobility of passengers in the context of the sustainable development of the public transport. In every country, what are the attitudes of the EU, and especially in the

last twenty years, that transport and energy are prerequisites for other economic and social development, especially transport, which is the main supporter of the development of tourism which in the last decade has recorded the highest growth in Europe, BiH and wider. The global directions of city development in Europe, in the period up to 2023, have the ultimate goal of quality, comfortable, safe and reliable transportation, which will be maximally adjusted to the requirements of passengers. According to the above plans, the planned development of the public passenger transport system will be based on the involvement of the railway in the public transport system of passengers, as well as the transformation of the existing tramway transport of passengers into the system of easy passenger transport (LSP). Such plans existed 30 years ago and exist and are planned for the next 30 years, and the city is now "problematic" from the security and ecological aspect, since some plans have not been fully realized as planned, especially they did not contain a sustainable development segment, which is today a priority. In such an environment, a great period in today's technology development is waiting for the next thirty years for these plans to be achieved or not realized in the strategy papers. It is necessary to react quickly and adequately, and it is only possible through innovative and "fresh" solutions that must experience their valorisation in cities. Most of Europe's developed cities have action plans and established strategies for the development of sustainable transport and are working intensively to inform and educate residents about the need to move from the current mode of transport to a sustainable one. The experiences of cities that have undergone initial project implementation phases show that population education is the first step in realizing such a project. Some of the advantages of sustainable transport are: healthier lives of citizens, less noise, less pollution, a more beautiful city, it makes no



sense if the inhabitants are not familiar with it and if they do not accept it as their own, for the sake of a humane and safe life. First of all, adequate traffic infrastructure must be built in the segment of designated motorways, especially in the segment of planned and new plans for non-motorized transport and transportation. Without the completion of the planned roads, it is impossible to expect significant breakthroughs, as growing traffic in cities does not allow for any deadlock for a month, let alone the construction of a traffic infrastructure, let alone. Other activities related to mobility of passengers such as traffic management models, alternative modes of transport, ecologically pure modes of transport will only then get real significance and place the cities of comfortable living and sustainable transport or transport.

## CONCLUSION

When society grows, there is a rise in public transport in support of the development of the economy and the improvement of the quality of life in cities. With enriched views on the entry and importance of public urban passenger transport (JGPP), transport systems will grow within the community and make public transport more efficient. Therefore, public transport services will face many challenges in the future as urban transport plays a major role in mobility in the 21st century. This affects everyone, including people who today do not consider themselves as users of public transport. The reason is very simple. Many cities around the world reach the peak of the capacity of private car acceptance, so the effects of congestion and pollution become a major problem for everyone. Multi-road construction is not the right answer, so new solutions must be found to ensure that people have the level of mobility they expect. This can best be achieved if public transport is integrated into the urban environment so that people have the

freedom to move wherever they want to. The growing economy requires mobility, and this can be achieved only in the urban environment and in the greater integration of public transport. Free circulation of people and goods is possible only if well-developed public transport is available. Transport is also a factor in the reduction of emissions of harmful gases and environmental protection, and therefore new technologies and techniques need to be further developed to make the mass transit system more efficient and attractive to travelers in order to fit better in protecting the environment. The growing range of innovation solutions must be developed if public transport wants to conquer the passenger transport market. These solutions must match the urban environment and the different needs of users. The future of cities depends on the policy of town planning and mobility that is developing today. In the field of planning, "service planning" is a special place. Planning should be based on trip data and modeling and management software that will analyze them.

## LITERATURE

- [1] prof. dr Ibrahim Jusufrić, "Fundamentals of Road Traffic", Travnik 2007.
- [2] prof. dr Ibrahim Jusufrić, Public City Transportation of Passengers, Sarajevo 2003.
- [3] doc. dr. Aleksandra Vasilj, "Development of traffic and city development" University Josip Juraj Strassmayer in Osijek, Faculty of Law, Osijek
- [4] Internet source - [https://en.wikipedia.org/wiki/Public\\_and\\_Privacy](https://en.wikipedia.org/wiki/Public_and_Privacy)
- [5] Internet source - <http://book.tsp.edu.rs/mod/page/view.php?id=642>



[www.iu-travnik.com](http://www.iu-travnik.com)  
[www.iut.edu.ba](http://www.iut.edu.ba)