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DEVELOPMENT POSSIBILITIES OF CROATIAN TRANSPORT SYSTEM - ANNIVERSARY OF EU MEMBERSHIP

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POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

ABSTRACT

The increase in population coupled with a rise in living standard has caused a growth in migration within and outside urban areas. The major problems facing cities today are related to public and private traffic. The traffic system limitations and excessive mobility of the population leads to traffic congestion, air and environment pollution, and other negative impacts. The necessity of mobility and social imperative in form of sustainable development has led to the reconciliation of these two opposite objectives. Like many European cities, City of Zagreb faces similar problems regarding traffic. One way to partly reduce negative traffic impacts is to develop functional bicycle network to provide foundation for development of greener mobility. This article proposes a detailed analysis of the current state of bicycle traffic in Zagreb along with the necessary infrastructural improvements that can be easily adapted to Zagreb and to other European cities.

KEY WORDS

bicycle network, green mobility, traffic congestion, air pollution

1. INTRODUCTION

The city is larger or smaller, dense and permanent, closed agglomeration, which implies the existence of active life relations and in external appearance, reflects the high degree of organization. From the traffic point of view, cities have through all history been the most important world transportation hubs and on those intersections of important transport and trade routes, major cities have developed.

Given that cities are located on the intersections of important transport and trade routes, and because they represent the economic, social and cultural centers, they attract population. The percentage of urban population is continuously increasing and according to the United Nations it is estimated that 60% of population will reside in cities by the year 2030.

In Europe, it is estimated that proportion of the population residing in urban areas will increase from 72 % in 2007 to 84 % in 2050[1].

With the growth living standards, the need for migration within and outside urban areas is rising. One of the biggest problems facing most urban areas is a certain degree of insufficient transport systems, both public and private. The shortcoming of the transport system and excessive mobility leads to traffic congestion, air and environment pollution and a number of other negative consequences. The necessity of mobility and social imperative in form of sustainable development has led to the reconciliation of these two opposite objectives.

Analysis of urban mobility showed a worrying trend of excessive car use for short journeys in urban areas. In Europe, more than 30% of car travelling distances are less than 3 km and 50% are less than 5 km[2].

Travelling distances of mentioned categories can be covered with bicycle within 15 to 20 minutes, and as opposed to passenger cars, bicycle is almost perfect solution for short urban journeys. Considering all its advantages bicycling can be an effective solution for part of problems regarding urban transport. Therefore, cities must develop and encourage the development of cycling to ensure sustainability of urban transport.

This paper focuses on analysis current bicycle traffic the in City of Zagreb. Based on the analysis, measures for infrastructural improvements of bicycle transport are proposed.

2. THE ROLE OF BICYCLE TRANSPORT IN URBAN AREAS

Looking from the community viewpoint, the problems caused by the increased car use are very serious. Problems are related to the loss of urban space, energy consumption and environment pollution. In addition to the air, water and land pollution, motorized traffis produces noise and the consequences of road accidents and congestion are the real problems of cities today.

When considering an alternative to cars in urban areas, public transport is usually first choice. However, public transport is not the only alternative. As mentioned before, in Europe, more than 30% of car travelling distances less than 3 km and 50% are less than 5 km which can be covered with bicycle within 15 to 20 minutes. In these distances (up to 5 km even more in the case of congestions) bicycles are faster than cars. Furthermore, they do not pollute the environment, are quiet, economical and accessible to use for different generations. Although bicycle transport is not the only solution to traffic and environmental problems in urban areas, it represents a solution which fits perfectly into today's trend of sustainable development.

In general it can be said that the main benefits of increasing bicycle transport in urban areas, and therefore the main arguments for its development are[3]:

- economic benefits (such as a drop in the share of the household budget devoted to the car, reduction of working hours lost in traffic jams, reduction of health costs thanks to the effects of regular exercise)

[1] Publications Office of the European Union, 2009. A Sustainable Future for Transport, Towards an integrated, technology-led and user-friendly system, Luxembourg: Publications Office of the European Union

[2] http://www.europa.eu.int/comm/environment/cycling/cycling_en.htm (03.03.2014.)

[3] European Commision: Cycling: The way ahead for towns and cities, 1999., ISBN 92-828-5724-7

- political advantages (such as a reduction in dependence on energy, saving non-renewable resources)
- social advances (such as the democratization of mobility, greater autonomy and accessibility of all facilities to both young and elderly people)
- ecological impacts (with a distinction between local, short-term effects — notion of the environment — and non-localized long-term effects — notion of ecological balance).

Main advantages are related to the ecological impacts. As shown in the Table 1., bicycle transport has the least primary energy consumption and air pollutions as well as the percentage of space consumption.

Table 1. Comparison of various transport modes from the ecological viewpoint

Comparison of various transport modes from the ecological viewpoint with a private car for an indential journey with the same number of people/km

	Car	Bus	Train	Bicycle
Space consumption	100	10	6	8
Primary energy consumption	100	30	34	0
CO2	100	29	30	0
Nitrogen oxides	100	9	4	0
Risk of accidents	100	9	3	2

Source: Marsh, P.C., Ritzau-Kjaerulff, T.: Barriers to the Creation of a Bike-City, 2012

As far as urban areas are concerned, the advantages of the bicycle for the community are mainly linked to the quality of life and environment and to long-term savings made through the following[4]:

- a direct reduction in traffic hold-ups through the falling number of cars in circulation
- an indirect reduction in traffic hold-ups through the increased appeal of public transport for commuters thanks to a combination of public transport and bicycle
- better fluidity of traffic, which is indispensable, with a lower pollution level
- space savings (on the road and in parking areas) and hence a reduction in investments in roadways and the possibility of making a different use of public space in order to increase the attractiveness of city centers
- a general improvement to the quality of life in cities (air pollution, sound pollution, public places, children's safety)
- less severe deterioration of historical monuments and reduced maintenance costs (less frequent cleaning, for example).

Despite the benefits of bicycle transport in urban areas, its acceptance depends largely on subjective and objective factors[5]. Subjective factors include: image, social acceptability, a sense of security, understanding of transport problems in urban areas, the financial power of citizens, etc., while the objective factors include: the topography of the urban environment, the climate, the existence of bike paths, general safety, etc.. In general it can be said that there are three main obstacles in the development of bicycle transport[6]:

[4] European Commision: Cycling: The way ahead for towns and cities, 1999., ISBN 92-828-5724-7

[5] Marsh, P.C., Ritzau-Kjaerulff, T.: Barriers to the Creation of a Bike-City, 2012

[6] Marsh, P.C., Ritzau-Kjaerulff, T.: Barriers to the Creation of a Bike-City, 2012

a) perception and awareness
b) space (or lack of it)
c) policy

From the above it can be concluded that for the realization of potential uses and benefits of bicycle transport basic conditions for the development of bicycle transport must be ensured. Measures for improvement of bicycle transport include the implementation of bicycle lines, construction of parking spaces, development of bicycle network, development of the bicycle rental system, traffic calming measures, education of all participants in traffic, police involvement in strict observance of the law and integration with other modes of transport.

3. POSSIBILITIES OF IMPROVING BICYCLE NEWTWORK IN CITY OF ZAGREB

As City of Zagreb is medium-sized European city with limited possibilities for further motorized traffic development, especially in the older parts, alternative solution in the form of bicycle transport is necessary. In this chapter current state and possible improvements of bicycle transport in the City of Zagreb will be analyzed and presented.

3.1 CURRENT STATE OF BICYCLE TRANSPORT IN THE CITY OF ZAGREB

The first bicycle line in the City of Zagreb is derived in 1995. for recreational purposes. Until now about 200 km of bicycle lines and paths have been implemented along the 430 installed racks for parking purposes.

Figure 1. shows current the map of City of Zagreb with highlighted existing bicycle lines. From figure 1. one can conclude that most of the existing bicycle lines are not connected and do not form well-designed and meaningful bicycle network.

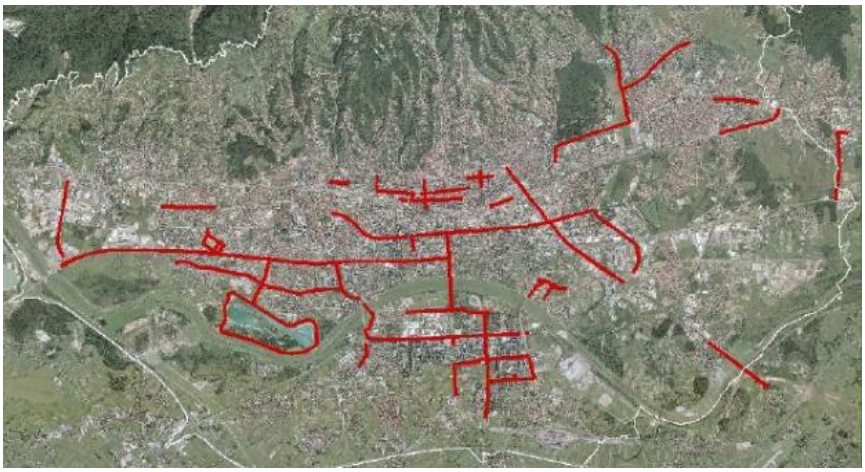

Figure 1 - Current bicycle lines and paths in the City of Zagreb
Source: Ordulj, A.: Uređenje biciklističke staze na savskoj cesti, uređenje biciklističke staze na savskoj cesti, Gradski ured za prostorno uređenje, izgradnju Grada, graditeljstvo, komunalne poslove i promet, Zagreb 2011.

Due to the fact that, in City of Zagreb, attention to the bicycle transport has been given only in the past twenty years, the quality of infrastructure is not at satisfying level. Although in all newly constructed roads bicycle lines are implemented, often they are not physically connected with the existing ones, not properly maintained or executed and do not provide a safe and comfortable ride.

Figure 2 - Examples of improperly maintained (left) and executed (right) bicycle lines in the City of Zagreb
Source: Gamulin, N., Sirovec, J., Širola, D.: Prijedlog razvoja biciklističkog prometa Grada Zagreba, Zavod za prostorno uređenje Grada Zagreba, Zagreb 2011.

During the analysis of the current state of bicycle transport in the City of Zagreb, the following deficiencies were registered:

- non-existence of well-designed bicycle network
- existing bicycle lines are not maintained and/or are poorly executed
- non-existence of parking spaces
- inadequate system of public bicycles
- legislation is not well adapted to the needs and conditions of today.

3.2. MEASURES FOR IMPROVEMENT OF BICYCLE TRANSPORT IN THE CITY OF ZAGREB

The share of bicycle transport in the trip structure in the City of Zagreb is not enough and precise analyzed and depending on the authors (Ordulj, A., Civitas Elan) it is between 1 to 3%. Since one of the goals of Cities' transport development is the development of bicycle transport it can be concluded that the proportion of bicycle transport will grow. The growth of bicycle transport requires improving in the bicycle transport system.

Generally, improvements can be divided into three groups of measures:

1) measures related to infrastructure
2) measures related to legislation
3) measures related to education and promotion

This paper focuses on the infrastructural measures which include implementation of new bicycle lines, linking existing and new lines in a meaningful network, connecting the city with surrounding areas (suburbs), maintenance of existing lines and building parking spaces connected to the bicycle network.

Proposed infrastructural measures for the City of Zagreb are as followed:

a) development of bicycle highway
b) implementation of new and better maintenance of existing bicycle lines
c) development of parking facilities and spaces

a) Development of bicycle highway

The development of bicycle highway would allow, in cycling terms, quality and safe connection of the City of Zagreb and its surroundings (Velika Gorica, Zaprešić, Samobor, Dugo Selo, Rugvica, etc.). As City of Zagreb represents largest economic, cultural and social center of Republic of Croatia, it is logical that a large number of people living in its suburbs travel to the City every day.

The main bicycle highways would link northern and southern and western and eastern parts of the City as well as other areas that make up the suburbs. Also, bicycle highways would form backbone of bicycle network on which existing and new lines would connect enabling the future expanding and development of bicycle culture in Zagreb. Besides traffic, highways function would also be development of cycling tourism and recreation.

Figure 3. shows major bicycle highways on which other bicycle lines are connected.

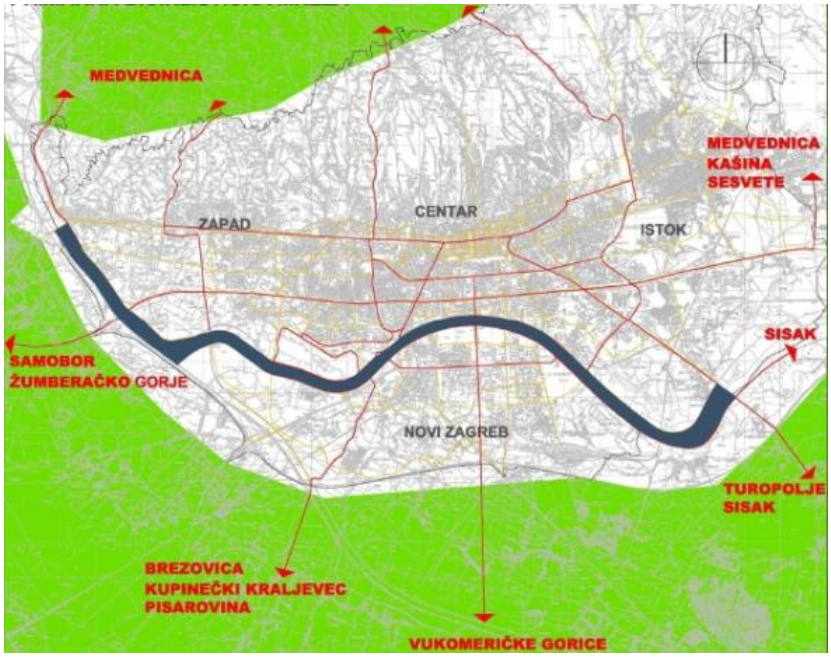

Figure 3 - Proposed bicycle highways in the City of Zagreb
Source: Gamulin, N., Sirovec, J., Širola, D.: Prijedlog razvoja biciklističkog prometa Grada Zagreba, Zavod za prostorno uređenje Grada Zagreba, Zagreb 2011.

b) Implementation of new and better maintenance of existing bicycle lines

Performing new and maintain existing bicycle lines is one of the basic measures for the development of bicycle transport. Currently, in the City of Zagreb, new bicycle lines are implemented at slow rate. However, the possibilities for improvement are significant.

One possible solution is to implement bicycle lines along the creek Vrapčak with the length of 5.5 km that extends through the highly urbanized western part of the City. Bicycle line can be constructed as a separate or within walking paths connecting western part of the city (Špansko, Malešnica, Rudeš, etc.) with a recreational zone along the river Sava creating a paths that would efficiently connect two parts of the city and providing divers recreational opportunities.

Another possible solution is the conversion of traffic surface on streets Đure Deželića which would be an integral part of the bicycle highway Zaprešić - Sesvete.

A possible solution for Đure Deželića street is based on reducing traffic area for motorized traffic and conversion into bicycle. So instead of three motorized traffic lines two would be implemented and the rest of area would be bicycle line with width of 2.4 meters[7].

c) Development of parking facilities and spaces

Bicycle parking's are one of the basic elements of the bicycle transport development. Many European cities with highly developed bicycle transport, like Amsterdam and Copenhagen) have major problems with bicycles parked in public areas and streets.

Parking facilities or spaces for bicycles, in the City of Zagreb, should be implemented at all major city destinations such as hospitals, schools, universities, turnarounds of public transport, sports-recreational areas etc.. Basic requirements for bicycle parking are:

- visibility and availability
- security
- ease of use and
- connection with other needs of cyclists.

These requirements must be taken into consideration during the planning and implementing new bicycle lines as well as new parking spaces for bicycles.

4. CONCLUSION

Looking from the community viewpoint, the problems caused by the increased car use are very serious. Problems are related to the loss of urban space, energy consumption and environment pollution. In addition to the air, water and land pollution, motorized traffis produces noise and the consequences of road accidents and congestion are the real problems of cities today.

Efficient way to reduce those negative effects is by developing bicycle transport which does not pollute the environment and is quiet, economical and accessible to use for different generations.

Generally, it can be said that the main benefits of increasing bicycle transport in urban areas, and therefore the main arguments for its development are:

- economic benefits
- political advantages
- social advances
- ecological impacts

Despite the benefits of bicycle transport in urban areas, its acceptance depends largely on subjective and objective factors. In general, there are three main obstacles in the development of bicycle transport: perception and awareness, space (or lack of it) and policy.

In the City of Zagreb, only in the least twenty years attention has been given to the bicycle transport. In this short period, some progress has been made but the progress and development is to slow (share of bicycle transport in the City of Zagreb is between 1% and 3%) compare to other similar sized European cities. In Amsterdam, bicycle transport has grown by

[7] Bicycle Union: Biciklistička magistralna ruta Zaprešić – Sesvete, Prijedlog idejnog rješenja po etapama, 2012.

more than 40%[8] in the last 20 years and in Copenhagen share of bicycle transport in total transport is 32%[9].

Analyzing the current state of bicycle transport in the City of Zagreb, it can be concluded that main problems are as followed:

- non-existence of well-designed bicycle network
- existing bicycle lines are not maintained and/or are poorly executed
- non-existence of parking spaces
- inadequate system of public bicycles

In order to eliminate insufficiencies of bicycle transport in the City of Zagreb, improvements regarding the infrastructure, legislation and education and promotion must be implemented. This paper analyzed infrastructural measures which include implementation of new bicycle lines, linking existing and new lines in a meaningful network, connecting the city with surrounding areas (suburbs), maintenance of existing lines and building parking spaces connected to the bicycle network.

Proposed infrastructural measures relate to the development of bicycle highway which would allow, in cycling terms, quality and safe connection of the City of Zagreb and its surroundings (Velika Gorica, Zaprešića, Samobor, Dugo Selo, etc.), implementation of new and better maintenance of existing bicycle lines and development of parking facilities and spaces.

For effective implementation of these measures, City of Zagreb must develop progressive bicycle transport strategy which would cover all the elements of bicycle transport.

5. LITERATURE

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[2] [2] European Commision: Cycling: The way ahead for towns and cities, 1999., ISBN 92-828-5724-7

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[7] [7] http://www.europa.eu.int/comm/environment/cycling/cycling_en.htm (03.03.2014.)

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CONTRIBUTION OF SOCIAL NETWORKS TO INCREASED TRAFFIC SAFETY AT LEVEL CROSSINGS

ABSTRACT

Safety is one of the most important subjects for any transport mode where the key objective is the transportation of people and products. There are a number of measures to increase traffic safety, and in recent years social networks have become an important factor in prevention of accidents. Social media, also called social networking or Web 2.0, are defined as a group of web-based applications that encourage users to interact with one another. That include blogs, social and professional networking sites such as Facebook and LinkedIn, micro-blogging site Twitter, media-sharing sites such as YouTube and Flickr, and location-based sites such as Foursquare Facebook, LinkedIn, Twitter, YouTube, Flickr, etc.The paper presents an overview of the most significant social networks, analysis of groups as part of social networks that are primarily oriented to the problems of road and railway traffic safety with special emphasis on the specific groups about traffic safety at level crossings with special emphasis to a group "Vlak je uvijek brži" on Facebook platform.

KEY WORDS

social networks; safety; traffic; level crossings

1. INTRODUCTION

According to statistical data and the carried out analyses of the causes of emergencies in traffic it can be seen that in spite of technical and technological improvements of infrastructural elements as well as the protection system, the number of incidents continues to be substantial which indicates the primary responsibility of traffic participants (road motor vehicle drivers and pedestrians), and only then of the equipment. Thus, for example, in more than 90% of emergencies at level crossings, which represent collision points of road and railway traffic, the main causes are the road vehicle drivers and pedestrians. Moreover, the number of accidents at LCs protected by devices at time of their proper functioning is also significant which is also an indicator of extremely low level of respecting the traffic regulations by the drivers [1]. The measures of improving the existing state with the aim of greater traffic safety are usually grouped in three basic categories:

- Technological and technical aspect – adoption of new technologies and modern technical solutions;
- Human factor – education of traffic participants with the aim of improving the traffic discipline and drivers' culture;
- Legislation – monitoring and participation in harmonising the European legislation and its implementation in national legislation [2].

As a relatively new form of communication, social networks can reach a large number of people, particularly the younger population that are at the same time the most endangered ones in traffic, and thus indirectly act on raising the awareness of their own responsibility and safe behaviour in traffic.

2. OVERVIEW OF MOST FREQUENTLY USED SOCIAL NETWORKS

Social Media is a term that refers to multiple digital communication platforms used for networking and social interaction. Social media refers to online technology that allows people to publish and share content, including text, audio, video, or multimedia and social network is an online community that allows users to create a profile, add friends, communicate with other members, and share content. Examples include Facebook, LinkedIn, MySpace, etc. Social media are still relatively new, as the Facebook was launched in 2004, and others came even later. Therefore, there is still not much research on this topic, so much of the relevant information about social media was obtained from online sources such as websites, conference presentations, blog posts, online journals and publications. Differences and comparison of traditional media and social media are shown in Table 1. As the table shows, traditional media approaches are centralized and focus on delivering one or more messages to customers. Social media methods are collaborative and rely on sharing information and soliciting feedback for their effectiveness. Using traditional media – distributing press releases, granting interviews, etc. – the organization tries to control the message. Using social media, such as YouTube and Twitter, organizations can post information that individuals can share, comment on, and sometimes modify [3]. An overview of social media and grouping in five main groups, based primarily on findings from the literature review is shown in Table 2.

Table 1 – Comparison of traditional media and social media [3]

Traditional Media	Social Media
Customer	Collaborator
Talk to	Talk with
Selling	Sharing
Voice=Company	Voice=Citizen
More expensive	Less expensive
Professional media outlets	User-generated content
Push marketing	Pull marketing
Broader market	Targeted markets
Static content	Evolving content
Short lived	Long life
One-sided	Multiple opinions

Table 2 – Overview of the most important social networks

Social and professional networking sites	Blogging	Micro-blogging sites	Media- and document-sharing sites	Geolocation applications
Facebook LinkedIn MySpace GovLoop	Tumblr	Twitter	YouTube (video) Scribd (documents) Flickr (photos) Instagram (photos)	Foursquare

Facebook is Internet social network founded in 2004 by Mark Zuckerberg, ex Harvard student. In its beginnings Facebook was intended only for the students of the University of

Harvard who used this method of communicating with each other and exchanging information. Later, many other universities, high schools and big companies worldwide joined the network. Today this site has more than 1 billion active users. Facebook is also the most popular place for posting photos, with more than 14 million new added photos daily. The main specific characteristic and advantage of Facebook is free advertising and promoting by means of various applications and the so-called groups on the Facebook.

Twitter is Internet social network for micro-blogging, i.e. intended for sending (and reading) short messages that have been called according to the network name – tweets. The SMS messages on mobile phones are limited to 160 characters, whereas tweets are based on the texts of messages of a maximum of 140 characters. Twitter was developed in March 2006, and the founders were Jack Dorsey, Evan Williams, Biz Stone and Noah Glass. In July 2006 the site was launched, and the service soon became popular worldwide, with 500 million registered users in 2012, which posted about 340 million tweets daily.

Instagram is a popular free application for processing and sharing of photos by means of iOS device on social networks including Facebook, Twitter, Foursquare, Tumblr, Flickr and Posterous. It represents a hybrid of social networking and photo services. It was launched on iOS devices in October 2010, and currently it is used by 15 million users.

Myspace is a multi-lingual social web site, intended for networking of members. The site is funded by advertisements. Myspace was founded in 2003 by Chris Dewolfe and Tom Anderson, and later, in July 2005 it was purchased by News Corporation for 580 million dollars. On this website everyone can easily post their personal profile, photos, video-recordings, blog, add their description, etc. The site has become an Internet phenomenon, every day visited by about 230,000 users, thus being in the top of the social web 2.0 sites. In July 2012, MySpace had 25 million unique visitors in the USA.

Tumblr is a micro-blogging platform and social networking website founded by David Karp in April 2007. The site allows users to post their multimedia. The users have the possibility of following other users' blogs, and to protect their own. Tumblr hosts more than 174.2 million blogs.

LinkedIn is a business-networking site launched in 2003. Usage skews older than Facebook and Twitter; it also skews male. LinkedIn "profiles" are like a living, breathing digital resumes. Users update their information, references and recommendations and "connect" to others forming an extended business network that includes executives of all Fortune 500 companies. LinkedIn also features discussion groups formed around similar interests. This platform has surpassed the 100 million worldwide user milestone.

YouTube is the world's most popular online video community serving up to 2 billion video views daily. Established in 2005 as a destination to watch and share original videos on the Internet, the platform has a broad demographic: 18-54- year-olds watch the equivalent of 150,000 full-length feature films each week. However, more than half of YouTube's users are under the age of 20. As with Twitter, Facebook and LinkedIn, the consumer is in control on YouTube, not the brand.

3. ANALYSIS OF GROUPS ABOUT TRAFFIC SAFETY ON FACEBOOK TWITTER PLATFORMS

Among the most popular modern systems for communication and advertising via Internet are the social networks out of which the most popular are Facebook, Twitter, MySpace, Instagram, Tumblr.

On Facebook one can find a lot of interesting traffic groups that aim at promoting the awareness about traffic safety. The overview of groups which includes the number of "likes", year of launching the project, date of creating the group, description of the group, most frequent age group of users and web location, is presented in Table 3.

In the Republic of Croatia there are also several major groups on traffic safety, and one that can be particularly pointed out is the group "Vlak je uvijek brži" (Train is always faster). This is a preventive-educational action carried out by the Croatian Railways with the aim of raising the awareness about the dangers at level crossings.

Table 3 – Analysis of groups on traffic safety on Facebook platform [4-22]

Ord. No.	Group name	No. of likes"	Year of launching the project	Date of creating group on Facebook	Group description	Most frequent age group [years]	http location
1	Remember Alex Brown Foundation	154.208	2010	11.11. 2010.	Advocating raising of drivers' awareness about importance of following traffic while driving.	18-24	https://www.facebook.com/RememberAlexBrown?fref=pb&hc_location=profile_browser
2	I drive safely	150.602	1998	20.07. 2009.	Improvement of traffic safety through education and training of drivers.	18-24	https://www.facebook.com/idrivesafely?fref=pb&hc_location=profile_browser
3	Don't text and drive	144.581	2009	04.02. 2009.	Raising awareness about risk to which the drivers are exposed by typing on mobile phone while driving.	18-24	https://www.facebook.com/DontTextandDriveParkview
4	MnDPS OTS – Traffic Safety	19.327	1969	21.06. 2009	Improving traffic safety and tendency to zero fatality rate on roads.	18-24	https://www.facebook.com/DPSTrafficSafety
5	Operation Lifesaver Inc	6.866	1972	24.07. 2010.	Not-for-profit organisation with the aim of educating people across country about safety at level crossings.	35-44	https://www.facebook.com/operation.lifesaver?v=wall
6	Traffic safety coalition	5.878	2010	24.02. 2010.	Creation of safer environment for drivers, by synergy of citizens and experts.	18-24 i 35-44	https://www.facebook.com/TrafficSafetyCoalition
7	Safe Routes to School National Partnership	4.057	2005	01.09. 2009.	Promoting values of safe cycling and walking to school across the United States.	35-44	https://www.facebook.com/saferoutespartnership?fref=pb&hc_location=profile_browser
8	Yours - Youth for Road Safety	3.938	2009	14.03. 2011.	Global organisation of youth, with the aim of increasing the safety of young people in road traffic.	18-24	https://www.facebook.com/pages/Yours-Youth-for-Road-Safety/211248158888542?fref=pb&hc_location=profile_browser
9	Krijesnica	3.384	2008	19.06. 2010.	Raise the awareness of pedestrians about the importance of using reflecting vests.	25-34	https://www.facebook.com/krijesnica.info
10	Traffic Safety in Aruba	2.917	2009	20.12. 2009.	Increase of traffic safety.	35-44	https://www.facebook.com/traffic.safety.aruba
11	Road Traffic Injury Research & Prevention Centre	2.509	2006	20.09. 2011.	Analysis of traffic accidents in Karachi.	18-24	https://www.facebook.com/RTIRnPC
12	Global Road Safety Partnership	2.102	2011	19.09. 2011.	Advocating the world free of traffic accidents with fatalities and injuries.	25-34	https://www.facebook.com/pages/Global-Road-Safety-Partnership/275806929114581?fref=pb&hc_location=profile_browser

13	FlightSafety International	1.726	1951	2011.	Increase of air traffic safety through pilot training.	25-34	https://www.facebook.com/pages/FlightSafety International/130298820325094?fref=pb&hc_location=profile_browser
14	Traffic safety corp	1.378	1995	30.11. 2009.	Increase of safety of pedestrian crossings by light signalling devices.	18-24	https://www.facebook.com/TrafficSafetyCorp
15	Vlak je uvijek brži	1.114	2000	25 08. 2013.	Raising the awareness of drivers and pedestrians about the dangers at level crossings.	25-44	https://www.facebook.com/pages/Vlak-je-uvijek-brži/211888768970864
16	Poštujte naše znakove	349	2011	19.08. 2011.	Increase of safety of children in traffic.	25-34	https://www.facebook.com/pages/Po%C5%A1tujte-Na%C5%A1e-Znakove/178886868849352?fref=ts
17	Road Safety Greeting CARDS	86	2013	15.12. 2013.	Advocating greater safety in traffic.	35-44	https://www.facebook.com/roadsafetygreetingcards?fref=pb&hc_location=profile_browser
18	Fondacija za sigurnost i humanost u prometu	66	2005	18.08. 2011.	Education of traffic participants for the prevention of traffic accidents and reduction in the number of fatalities and injured in traffic.	25-34	https://www.facebook.com/pages/Fondacija-za-sigurnost-i-humanost-u-prometu/243639705675914
19	Rail and Road Safety	19	2014	06.03. 2014.	Advocating the increase of safety at level crossings, prevention with the aim of reducing the number of road-railway accidents.		https://www.facebook.com/pages/Rail-and-Road-Safety/513630058754751?ref=ts&fref=ts

The potential utilization of Facebook is promising to dramatically reduce the number of traffic accidents and to spread cultural awareness about traffic safety by providing early warnings, real time notifications, and awareness after violations, which creates a psychological change in the violator's mind which probably helps to reduce/avoid violations of the same type in future. [23]

Since Twitter is intended primarily for the exchange of textual messages one can conclude that the groups on traffic safety are the most represented ones on Facebook platform. But there is on Twitter platform significant number of traffic safety groups as well. Table 4 summarises the analysis of some groups on traffic safety on the Twitter platform. The group Operation Lifesaver which promotes the awareness of traffic safety at level crossings has the largest number of Tweets and a significant number of followers.

Table 4 – Analysis of groups about traffic safety on Twitter platform [24-34]

Ord. No.	Project name	Number of „tweets“	Number of „followers“	http location
1	**Operation Lifesaver**	**5.580**	**2.272**	**https://twitter.com/olinational**
2	**MnDPS OTS – Traffic Safety**	**3.490**	**6.649**	**https://twitter.com/MnDPS_DPS**
3	**I drive safely**	**2.707**	**9.176**	**https://twitter.com/idrivesafely**
4	**Traffic safety coalition**	**2.203**	**1.753**	**https://twitter.com/trafficsafetycn**

5	**UIC - ILCAD**	**2.202**	**277**	**https://twitter.com/ilcad**
6	**Yours- Youth for Road Safety**	**1.407**	**2.090**	**https://twitter.com/yours_yforrs**
7	**Safe Routes to School National Partnership**	**1.398**	**4.159**	**https://twitter.com/SafeRoutesNow**
8	**Traffic safety corp**	**437**	**441**	**https://twitter.com/crosswalklights**
9	**Road Safety Greeting CARDS**	**318**	**10**	**https://twitter.com/avoidaccident**
10	**Rail and Road Safety**	**174**	**46**	**https://twitter.com/radhee_ngo**
11	**Vlak je uvijek brži**	**20**	**39**	**https://twitter.com/raillifesaver**

4. ANALYSIS OF FACEBOOK GROUP "VLAK JE UVIJEK BRŽI" ABOUT TRAFFIC SAFETY AT LEVEL CROSSINGS

The safety of railway traffic is significantly affected also by the road vehicle drivers and the pedestrians who often cross the railway line in an illegal manner and on places where driving i.e. walking on the line is forbidden. Analyses of emergencies show negative consequences of such behaviour that are obvious in the number of fatalities and seriously injured at level crossings [1]. Improvements of such negative condition can be achieved by installing modern signalling and safety devices at level crossings, and particularly significant is performing of various preventive actions and educational programs. Croatian Railways launched in 2000 a preventive-educational action "Vlak je uvijek brži" (Train is always faster) which was intended for children. Its aim was to warn the children about how to behave along the railway line, what threats lie in the games along the line and in crossing the line. However, since the majority of victims in road traffic at level crossings are the drivers, as part of this action a special campaign was intended precisely for road vehicle drivers [35]. In spite of constant investments in the protection devices at level crossings, accidents continue to occur and it is necessary to constantly warn the traffic participants of the dangers when crossing the railway lines. In August 2013 a Facebook site was launched as a new communication channel, and later also on Twitter and Instagram. Figures 2, 3 and 4 show the statistics of success of the Facebook site "Vlak je uvijek brži" during the five months following the launching of the site.

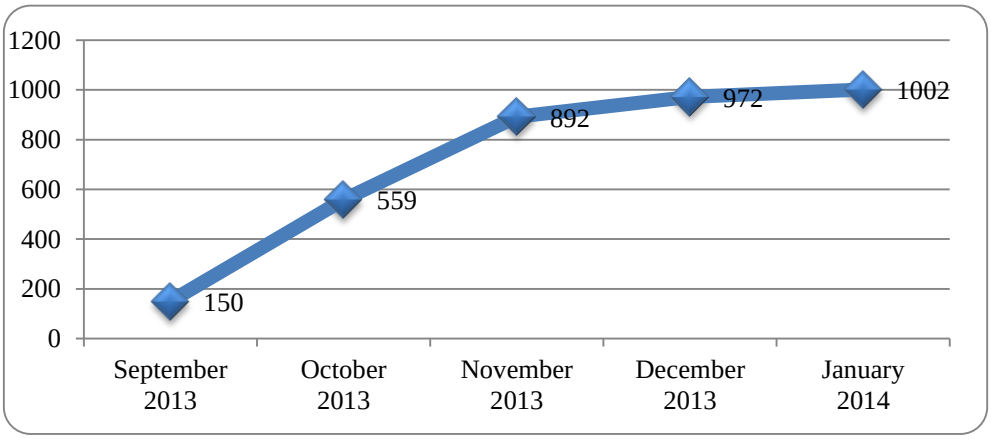

Figure 2 – Number of persons who supported Facebook site "Vlak je uvijek brži"

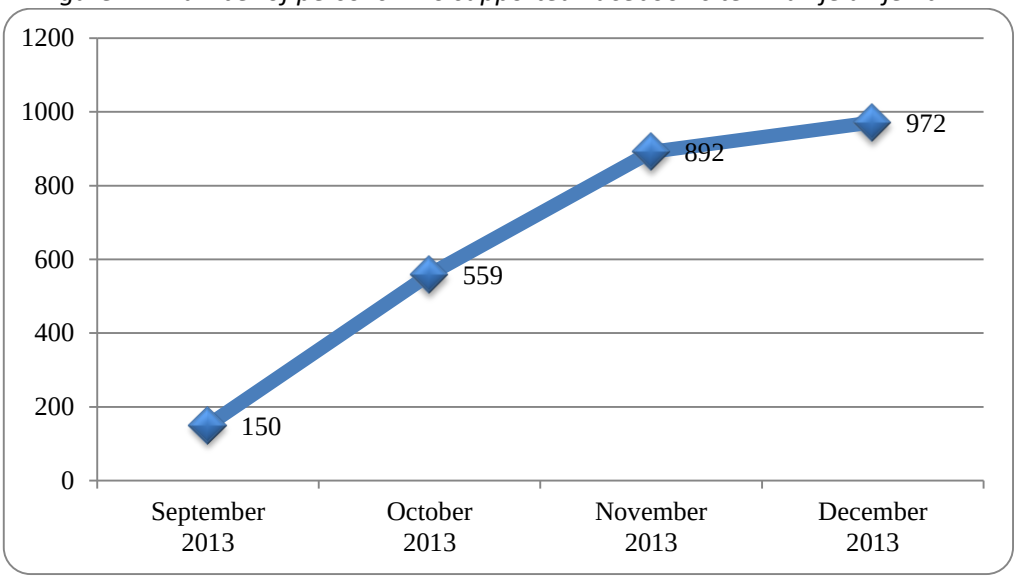

Figure 3 – Number of persons who visited Facebook site "Vlak je uvijek brži" (site access)

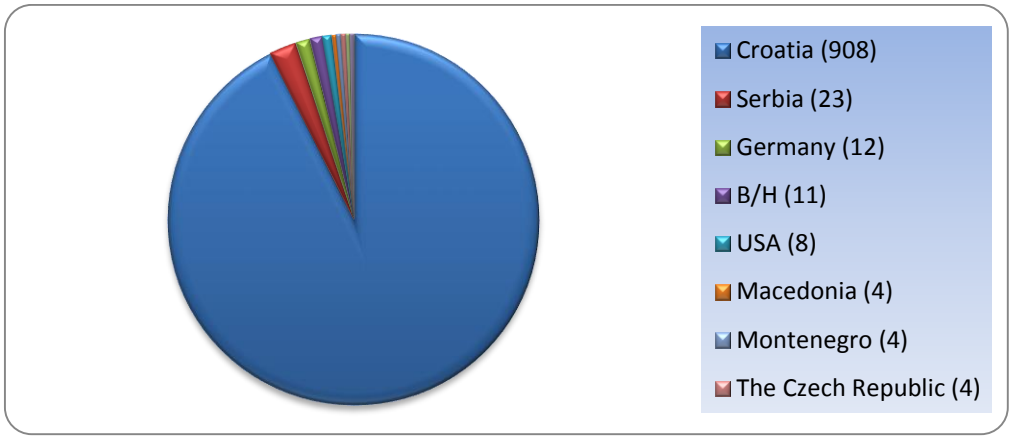

Figure 4 – Presentation of geographical distribution of the members of Facebook site "Vlak je uvijek brži"

5. DISCUSSION

Behaviour of traffic participants is an important factor of traffic safety. Raising of awareness about the behaviour of traffic participants is significant for the reduction of emergencies. The measures of reducing the emergencies and increasing of traffic safety understand technical and technological improvements, changes in legislation and impact on the human factor. For the prevention of emergencies the educational programs and campaigns about traffic safety are of extreme importance. The development of social networks contributes as well to greater safety in traffic. There is no doubt that social networks, as a relatively new way of communication, provide huge possibilities of spreading the message which is of extreme importance. They have great potential for educational and awareness use and are already in use for these purposes. By introducing the new forms of communication (Facebook, Instagram, Twitter) one can reach a large number of people and thus indirectly act on raising the awareness about one's own responsibility and safe behaviour in traffic.

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INTRODUCTION OF PUBLIC TRANSPORT BY SEA ALONG THE COAST OF ISTRIA AS A MEASURE OF SUSTAINABLE MOBILITY

ABSTRACT

Guidelines of the European Union related to the transport sector highlights the new technologies of transport, sustainable transport system and increased mobility. The western coast of the Istrian peninsula has all the prerequisites for the introduction of modern and attractive modes of public transport modeled on the experience of the cities from Europe and around the world. Public transport by sea named SEE BUS represents an idea of organization of public transport using characteristic ships on dedicated area which consists of 12 stations located between cities Umag and Poreč.

One of the most important criteria for a decision on the acceptability or unacceptability of a proposed solution is the development of cost-benefit analyzes. The most significant impacts that defines the social benefit or damage as a result of the realization of the proposed solutions is reduction of pollutant (greenhouse emissions) in atmosphere. Due to this reason it is essential for the future transport solutions, especially in urban centers, to encourage sustainable forms of transport that contributes to a better quality of life for every citizen.

KEY WORDS

sustainable transport system, reducing emissions, new traffic models, public transport by sea

1. INTRODUCTION

Title *Towards a competitive and resource efficient transport system* clearly defines what is expected of the transport system for the period from 2010 until the 2050, and it is primarily the growth of traffic and mobility support by reaching the target of reducing gas emissions by 60% [1]. The ultimate aim of the guidelines of the European Commission presented in the White Paper is to provide the best answers to citizens' desire to travel, and at the same time taking into account the restrictions on resources and environmental protection.

The Adriatic coast attracts a significant number of tourists which are arriving on destination using a personal car, resulting in a significant increase in average daily traffic (i.e. the average summer daily traffic-ASDT) [2, 3]. Increase in the number of vehicles has a number of negative consequences in urban centers on the Adriatic coast: traffic jams, decrease of the level of safety, higher maintenance costs, a variety of negative effects on the environment and the general dissatisfaction with the transport service for both local residents and tourists. Due

to this reason it is necessary to find alternative modes of transport (car/road transport), which would be equally effective for the user, but will eliminate or at least reduce the negative impacts of road transport.

Public transport by sea as an alternative urban public road transport mode is not new in the world. Some examples of Venice, London and Rotterdam in Europe, than Boston, Bangkok, Melbourne, Sydney, and New York in the world proves the attractive and widely accepted mode of transport for residents and tourists that is connecting different parts of the city, regions or islands. In these cities, a system of public transport by sea is loaded with 5-10% of the total daily traffic flow [4].

Transport ships are the main mode of transportation between the Staten Island and Manhattan in New York. The boat ships between two terminals every day, for every 20 to 30 minutes, and less frequent during the night hours. The ride takes about 25 minutes and is free. For public transport of passenger in Venice water buses (called Vaporetto) are used, that operates at 19 lines.

2. THE INTRODUCTION OF PUBLIC TRANSPORT BY SEA ALONG THE COAST OF THE ISTRIAN PENINSULA

Since the area of Savudrija-Crveni vrh, Umag, Novigrad and Poreč in terms of maritime transport constitutes one functional unit, or a traffic zone, the system of public transport by sea has been proposed in area of Savudrija-Crveni vrh to Poreč.

The working title of passenger transport by sea system would be SEE BUS. While the word "bus" is almost universal word in all European languages, the English word “see” will illustrate that this mode of transport can be used by someone who simply wants to see the natural beauties and attractions that are located along the route of SEE BUS. Also, writing and pronunciation of the word "see" is almost identical to the English word "sea" which may suggest that these transport is by sea.

SEE BUS point of interest depends on two factors, supply and demand. Demand is related to the number of users (tourists, but also locals), while the offer is tied to the tourist offer along the coast stretching from Umag and Poreč. Also, the offer may include performers of daily tasks for the local population who, for any reason, have to travel from one place to another - for example, going to the doctor, school, etc.

Points of Interest, which will also be accounted for the SEE BUS stations, are proposed at 21 locations along the western coast of the Istrian peninsula (Figure 1).

In accordance with the proposed location, 21 stations were identified that would be covered by these two lines, A and B. The B line will link Novigrad with Umag and Poreč, while line A will connect Umag with a Crveni Vrh. Line B timetable have to be in line with timetable for line A.

Figure 1 SEE BUS stations (docks/ports) [4, 5]

Table 1 - Distances and travel time between stations of SEE BUS line A

Origin	Destination	Distance by Sea (m)	Distance by Road (m)	Travel Time by Sea (min)
UMAG	Monterol	1,712	2,342	16
Monterol	Katoro	1,352	1,377	15
Katoro	Zambratija	1,385	1,634	15
Zambratija	Bašanija	1,645	1,883	16
Bašanija	Savudrija	1,987	1,589	17
Savudrija	Crveni Vrh	4,524	4,104	23
TOTAL		**12,605**	**12,929**	**102**

Table 2 - Distances and travel time between stations of SEE BUS line B

Origin	Destination	Distance by Sea (m)	Distance by Road (m)	Travel Time by Sea (min)
UMAG	Špina/Sv. Ivan	4,389	6,217	23
Špina/Sv. Ivan	Lovrečica	3,149	2,987	20
Lovrečica	Kamp Park	1,879	4,023	17
Kamp Park	Dajla	1,719	2,845	16
Dajla	Mareda	2,820	6,25	19
Mareda	NOVIGRAD	4,180	3,68	22
NOVIGRAD	Hotel Laguna	2,305	1,7	18
Hotel Laguna	Lanterna	1,737	10,3	16
Lanterna	Solaris	3,432	1,72	21
Solaris	Červar	1,550	9,28	16
Červar	Kamp Ulika	4,256	4,15	23
Kamp Ulika	Hotel Laguna	1,910	4,3	17
Hotel Laguna	POREČ	3,050	5,2	20
TOTAL		**36,376**	**62,652**	**248**

Distance between the end stations of SEE BUS is 36 km (Table 1 and 2) [4, 5]. The first stage envisages the circulation of four SEE BUS ships with two turnarounds per day on line between Umag and Poreč. Multiplication of the number of vessels and the number of turnarounds results in total in 8 trips per day.

If these stations would be covered by standard bus, length of the line will be 63 km, what is for 26 km more than by SEE BUS.

In order to verify the fact of the savings that can be achieved by introducing this form of public transport, or in order to decide the most correct decision to invest in the proposed investment is necessary to conduct an cost benefit analysis.

3. COST BENEFIT ANALYSIS OF THE INTRODUCTION OF PUBLIC TRANSPORT BY SEA

Cost benefit analysis in their approach involves financially quantifiable and non-quantifiable elements of social benefits and harms that implementation of a specific project might produce. On the basis of measurable financial benefits and social damage net present value is calculated, the assessment of financial immeasurable social benefits and harms, and is used for an overall assessment of the acceptability of the project.

Cost benefit analysis is the basis for the definition of the project, project assessment and project selection. Also, such an analysis with other influences, should allow an unambiguous decision whether society is willing to accept or pay the cost (damage) that will specific procedure cause for the society, and the individual in relation to the benefits it will provide. Total benefits and costs related to the possible direct and indirect impacts on [6]:

- ecosystem
- health
- economy
- society.

The process of evaluating the total social benefits and costs (damage) of an intervention is a basic principle of sustainable development, and includes three fundamental types of businesses of large accuracy and clarity [7]:

- estimates of future direct and indirect costs and benefits;
- determination of accounting prices on those effects that do not reflect social costs, and
- discount future effects on the net present value.

The cost of public transport of passengers by sea is defined as the cost of the initial investment and maintenance costs. The cost of the initial investment involves the acquisition of typical ships, building the appropriate ports, obtaining the necessary permits for the operation of such a system of passenger transport, etc.

The benefits of introducing public transport of passengers by sea include reduced emissions, noise reduction and the creation of certain revenue from ticket sales, revenue from advertising, as well as donations from hotels, restaurants and other services near the stations.

3.1. COST BENEFIT ANALYSIS OF PUBLIC TRANSPORT SYSTEM BY SEA – THE CITY OF NOVIGRAD-CITTANOVA CASE STUDY

The above stated cost of the initial investment and maintenance is calculated for Novigrad-Cittanova (Table 3 and 4) [4].

Table 3 - Costs of initial investment of public transport by sea [4]

		Number	Amount (KN)	Amount (EUR)
public transport of passengers by sea	ship	6	9.000.000,00	1.200.000,00
	pier	17	1.440.000,00	192.000,00
	documentation	1	100.000,00	13.333,33
	total		10.540.000,00	1.405.333,33
	cofinanced part City of Novigrad (1/5)		2.108.000,00	281.066,67

Table 4 - Annual maintenance costs of public transport by sea [4]

		number	Amount (kn)	Amount (EUR)
public transport of passengers by sea	Maintenance - ship	6	480.000,00	64.000,00
	Maintenance - pier	17	72.000,00	9.600,00
	Insurance	6	90.000,00	12.000,00
	Captain	12	504.000,00	67.200,00
	Sailor	12	288.000,00	38.400,00
	Annual dock	6	60.000,00	8.000,00
	Charging	90	18.000,00	2.400,00
	Other expences	1	25.000,00	3.333,33
	Total		1.537.000,00	204.933,33
	cofinanced part City of Novigrad (1/5)		307.400,00	40.986,67

The benefits of reduced emissions were calculated using cost of each gas whose emissions is in grams per kilometer (g/km). Due the fact that for most investments starting date is still unknown, in the analysis the increase of price of gas emissions was not taken into account for each year, but only for the current state (2010-2020), and the optimal value was defined as the present value (€ 25/ton). Due to the increasing prices of emissions trend, reductions of CO_2 emission can only achieve greater benefits.

Data on the number of diesel or petrol motor vehicles in the city Novigrad-Cittanova during the tourist season do not exist. In order to calculate the average production of emissions per vehicle, the average emissions per vehicle was taken into account according to Euro 5 standards for gasoline and diesel engines, which is valid from September 2009. Given that the average age of vehicles in the Republic of Croatia is 10 years it can be assumed that benefits from a reduction in emissions will be higher than the analyses has identified.

While determining the percentage of reduction in the number of kilometers, period of the summer season is observed as it is the period with the highest traffic load. Simulation of traffic demand has determined that the locals on average exceed 20 kilometers per day, while tourists are crossing about five km per day during the tourist season (90 days), and this data was used in subsequent calculations of cost-benefit analysis.

The benefit of noise reduction is determined based on the average value of the cost of noise per kilometer [8], taking into account the same criteria reduction in mileage as well as in emissions.

Taking into account all costs and benefits according to obtained data average annual cost of improvements to the public transport of passengers by sea, with no initial investment is about € 40,986.67 while the annual benefit is around € 71,690.70, from which it is calculated that the pure annual benefit from public passenger transport by sea brings to the city Novigrad-Cittanova is around € 30,704.03. According to this calculation, the cost of improvements of public transport by sea would be paid off in the seventh year of its operation.

The overall benefit of the public transport by sea after its exploitation in the period of 25 years under the current state (the first scenario) will amount to approximately € 455,830.13.

According to the key indicators of cost-benefit analysis, net present value amounts to € 39,082.11 while the Internal Rate of Return is 10%. The results of the analysis of the costs and benefits during the period of observation conclude that the investment of public passenger transport by sea is profitable.

3.2. INDIRECT BENEFITS OF INTRODUCING PUBLIC TRANSPORT BY SEA

Indirect benefits that cost-benefit analysis has not included, and which are significant for the society can be classified into the following categories:

- transport infrastructure,
- increase safety,
- health,
- increase the attractiveness.

The car as a mode of transportation required extremely large investments in transport infrastructure, both for construction and for maintenance of the same. Also, the car requires infrastructure facilities not only when moving, but also for parking. We are witnessing the disappearance of green spaces in cities, reduction of pedestrian zones and visual degradation of cities, all in order to ensure sufficient parking area for the growing number of cars.

Due to this reason, the decision to use public transport by sea and to therefore reduce the usage of cars as a mode of transport will contribute to significant savings related to transportation infrastructure.

Public transport by sea will result in a reduction in number of cars moving along the transport infrastructure which will reduce the number of traffic accidents, and increase the safety of all participants in the transport system.

By reducing the amount of exhaust gases the number of diseases related to the respiratory system will be reduced, and reducing noise levels will minimize adverse effects on the human organism (fatigue and irritability) and an improvement in working and living skills.

The introduction of measures for encouraging sustainable forms of traffic would increase the attractiveness of tourist resorts on the Istrian coast, and it will be recognized as a destination for more people who practice a healthy way of life and who want to spend a holiday without the use of a car.

4. CONCLUSION

Project of introduction of public transport by sea is one positive examples of increasing the use of alternative or sustainable forms of transport and the reduction of the usage of personal vehicles in the overall distribution of travels in defined areas and between key cities on the west Istrian coast.

It is assumed that it is not justified to use certain resources if total costs exceed total benefits of their use. Therefore, it is necessary to accurately determine influences that define all the social benefits and costs (direct and/or indirect) resulting from the implementation of an intervention and the likelihood of their creation to the final decision on environmental acceptability that could result in greater safety.

This project, in addition to the County of Istria, is also important for Republic of Croatia because it proposes the introduction of a new model of public transport in the city and inter-city area. If such organization of transport proves as successful, and is well accepted by users, it can become a universal model of the public transport in the whole Adriatic region. Due to this reason, in the realization of these projects, the support of the county and country is necessary.

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METHOD FOR AERODYNAMIC CHARACTERISTICS MONITORING OF TRANSPORT AIRCRAFT IN OPERATION

ABSTRACT

Aircraft in service is exposed to dynamic load that may degrade its aerodynamic and flight characteristics. To ensure timely maintenance and efficient aircraft operations it is necessary to know and keep track of aircraft's actual performance. Existing methods for monitoring aircraft performances rely on monitoring fuel consumption and changes in specific range. Knowledge of aircraft aerodynamic characteristics would allow determination of broader range of flight performance characteristics. The aim of this paper is the establishment of research framework for aerodynamic characteristics monitoring using data collected from regular commercial flights.

KEY WORDS

performance monitoring, aerodynamic gradients estimation, flight data, parameter estimation method, standard flight profile

1. INTRODUCTION

Aircraft flight performance characteristics are defined with features of aerodynamic, propulsive and inertial forces. Aircraft in service is subject to changes of its physical characteristics that determine his maximum range, endurance, optimal climb speed, service ceiling and other flight performances. Degradation of aircraft flight performances can affect its service efficiency. Current state of flight data sensor technology imply using these sensors as regular navigation, control and stabilization support during flight. Recorded flight data are used for post flight analysis, including fuel efficiency estimation, engine operation and health monitoring along basic intention of recorded data for safety incidents investigation [1, 2]. Post flight analysis of recorded data can be used for aircraft performance monitoring. This paper presents research framework for aerodynamic characteristics monitoring from regular flights of transport aircraft in service. This means that aerodynamic characteristics should be determined from data recorded during usual flight profile without tailored maneuvers.

2. LITERATURE REVIEW

Problem of aircraft degradation and performance monitoring methods is explored from available literature [3-15].

2.1. DEGRADATION OF AIRCRAFT IN SERVICE

Aircraft degradation emerges as main topic of numerous research articles through different aspects. The most common problems with aircraft degradation are due to aging of structures. Collection of methods for systematic monitoring of aircraft's structure condition and damage are known under a common name – SHM (Structural Health Monitoring) [4-7].

Methods for monitoring structure aging include measuring material vibration characteristics and their changes caused by strength variation in material and structure.

Purpose of SHM is to get information about true structure condition (possible damage, fractures, etc.) to secure timely maintenance and efficient operations. Aeroelastic effects under high dynamic load can lead to structural changes of flight control surfaces and decrease its efficiency [4].

In the literature, the term aircraft degradation appears also in problems of identification and monitoring of engine health parameters [8-10].

Engine performance monitoring of aircraft in service is known as Engine Health Monitoring (EHM). EHM methods are based on measuring the key "health" indicators individual components such as engine rotation speed N_1 and N_2, fuel consumption, EGT (Exhausted Gas Temperature), etc. The measured "health" parameters can indicate engine thrust deviations compared to nominal thrust of new engine.

Aircraft degradation also includes the term aerodynamic deterioration [11-15]. Major aircraft manufacturers, Airbus and Boeing, developed flight performance monitoring systems that can measure level of aerodynamic deterioration but without capability for separating contribution of individual aerodynamic (physical) characteristics [3, 11]. The total aerodynamic degradation manifests itself purely through an increase in aircraft drag.

Research paper [11] studies correlation between fuel consumption and exterior cleaning of aircraft. Surface roughness caused by accumulation of impurities increases skin friction drag and reduces aerodynamic effectiveness. Aircraft performance monitoring methods use data registered during regular (scheduled) flights [3, 15]. There is no research paper about monitoring the individual aerodynamic coefficients for commercial aircraft in operation. Short overview of flight testing methods that could be used for individual aerodynamic coefficients monitoring is given in this paper.

Also, basic principles of current performance monitoring methods for transport aircraft equipped with automatic flight data recording devices such as Flight Data Recorder (FDR) or Quick Access Recorder (QAR) within Flight Operation Quality Assurance (FOQA) program is explained.

2.2. AIRCRAFT PERFORMANCE DEGRADATION

After manufacturing aircraft its final performances are being established. These final performances are nominal values presented in form of diagrams and tables and included in flight manual or computer program. For regularly maintained aircraft, total drag deviations are not bigger than 0,5% during service time [4]. Aerodynamic influences on aircraft performance can be observed through changes of specific aerodynamic coefficient gradients.

The unwanted changes of aircraft physical characteristics may include: aerodynamic surface misrigging, seals missing or damaged, doors not flush or leaking, rough or deformed surfaces due to bird strike or repair patches, chipped paint, dirty aircraft, etc. [3, 11].

Airlines operation experiences indicate that accumulated dirt on aircraft exterior surface increases the skin surface roughness. Surface roughness, according to Boeing's research, makes 0.4% of the total drag [13]. The authors of that paper found correlation

between fuel consumption and the frequency of exterior cleaning. The results showed that increase of 10% of the aircraft surface roughness is causing additional fuel consumption of 500 \$/m^2 per year.

The authors of [14] are estimating degraded aircraft's performance and pilot handling quality as a part of Icing Contamination Envelope Protection System.

Current trend of digital technology enables using data from many sensors for post flight safety analysis, fuel consumption, aircraft incident investigation and performance monitoring as part of FOQA program.

2.3. AIRCRAFT PERFORMANCE MONITORING METHODS

The current method used by airlines for Aircraft Performance Monitoring (APM) considers monitoring of fuel consumption and calculating specific range using only cruise flight data [3]. This method compares true cruise flight performance with theoretical ones from Flight Manual or flight performance calculation program. APM method uses forty-eight parameters registered during stabilized cruise portion of flight. These data are result of true aircraft performance as a combination of engine and aircraft characteristics since specific range can be written as:

$$SR = \frac{V}{\dot{m}_f} = \frac{a_0 M \frac{C_L}{C_D}}{W \cdot \frac{c_f}{\sqrt{\frac{T}{T_0}}}} \tag{1}$$

where:
V = airspeed [m/s],
$\dot{m}_f$ = fuel flow rate [kg/s],
a_0 = speed of sound at sea level – ISA [m/s],
M = Mach number,
C_L/C_D = aerodynamic lift – drag ratio,
W = aircraft weight [N],
c_f = specific fuel consumption [kg/sN],
T/T_0 = temperature ratio.

APM method gives opportunity to airliners to continually monitor aircraft fuel flow and specific range deviations. These information can be used for structure or engine repair or Performance Index (PI) adjustment inside Flight Management System (FMS). PI are used for theoretical fuel flow correction inside FMS. Major APM method disadvantages are:

- need for at least fifteen minute stable period of cruise flight (not adjusted for short flights)
- cannot determine specific physical factors that degraded
- does not use all available engine parameters when determining engine thrust

3. PROBLEM STATEMENT AND RESEARCH QUESTION

The main research objective is to identify possibilities of monitoring aerodynamic coefficient gradients from flight data during regular commercial flight.

The main research question is:

Is it possible to correctly determine some of aerodynamic coefficient gradients from regular commercial flight for problem of aerodynamic degradation monitoring?

What is the level of minimum degradation that can be identified from these data? How will constant wind or turbulence influence on these gradients?

The main assumptions that will be accepted are:

- aircraft flies in trim flight conditions
- known data for: engine operating state, mass, center of mass, *a priori* aerodynamic gradients
- aerodynamic gradients are time invariant for observed flight regimes
- availability of FDR/ QAR data

After considering research objective and assumptions defined hypothesis that will be tested is:

Based on the registered data from trimmed flight regimes and known engine parameters, it is possible to determine the aerodynamic coefficient gradients and monitor their changes during aircraft service time.

3.1. OVERALL SYSTEM ARCHITECTURE

Overall system architecture for hypothesis testing will be composed of three main parts:

- Aerodynamic characteristics determination (AEROQAR method)
- Data processing
- FDR/QAR data simulation

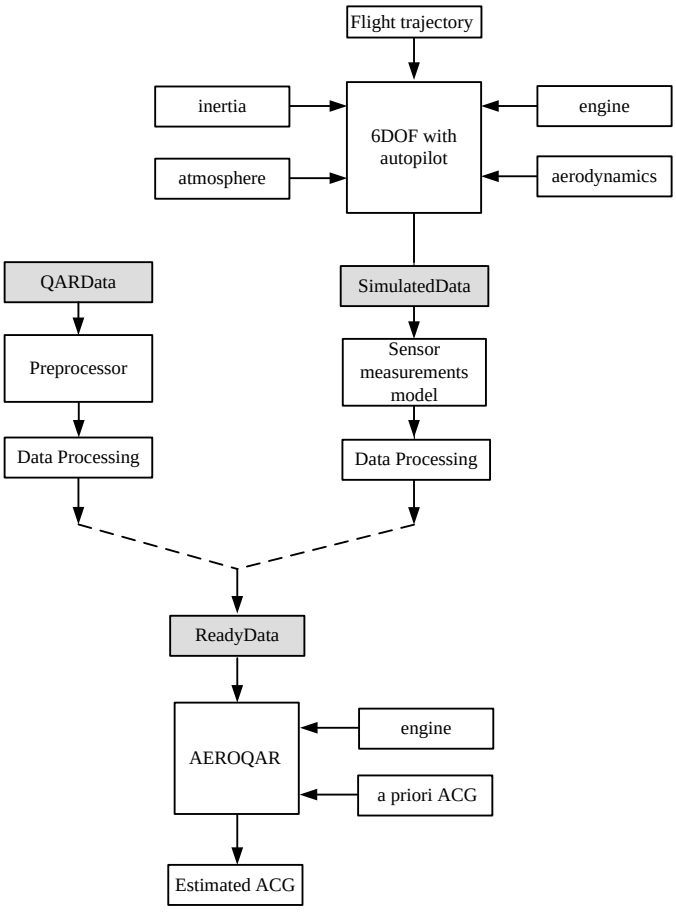

Figure 1 - Overall system architecture for hypothesis testing

First part include 6DOF simulator for aircraft motion with autopilot and aircraft sensor models. Second part include data processor that will enable data selection, filtering, and preparing for third part which is aerodynamic characteristics determination. Result of second part will be set of data ready for AEROQAR method. Result of the third part is vector of determined ACG. Input data for AEROQAR method are:

- ReadyData either from flight or simulator
- engine model that gives calculated thrust and remained fuel based on recorded data
- a priori of ACG

3.2. AIRCRAFT SIMULATION MODEL

Transport aircraft motion will be simulated with nonlinear differential equations (2) of motion for rigid body with six degrees of freedom (6DOF) derived from second Newton law and in proximity of flat-Earth. These equations will be coupled with inertias, propulsion and aerodynamics model. Vector form of these equations in aircraft body-axis reference frame is:

$$\begin{aligned} \mathbf{F}_A + \mathbf{F}_T + \mathbf{F}_G &= m\dot{\mathbf{V}} + \boldsymbol{\omega} \times m\mathbf{V} \\ \mathbf{M}_A + \mathbf{M}_T &= \mathbf{I}\dot{\boldsymbol{\omega}} + \boldsymbol{\omega} \times \mathbf{I}\boldsymbol{\omega} \end{aligned} \tag{2}$$

where:
$\boldsymbol{F_A}$, F_T and $\boldsymbol{F_G}$ are resultant forces due to aerodynamics, thrust and gravity,
$\boldsymbol{M_A}$ and $\boldsymbol{M_T}$ are resultant moments due to aerodynamics and propulsion
m = aircraft mass
$\boldsymbol{V}$ = translational velocity vector
$\boldsymbol{\omega}$ = angular velocity vector
$\boldsymbol{I}$ = inertia tensor

Aerodynamic force and moment coefficient equations coupled in aircraft motion model will have following structure in body-axis frame:

$$\begin{aligned} C_X &= -C_D - C_y\beta + C_L\alpha \\ C_Y &= C_{Y\beta}\beta + C_{Yp}p^* + C_{Yr}r^* + C_{Y\delta_n}\delta_n \\ C_Z &= -C_D\alpha - C_Y\alpha\beta - C_L + C_{L\dot{\alpha}}\dot{\alpha}^* + + C_{L\dot{q}}\dot{q}^* \\ C_\ell &= C_{\ell\beta}\beta + C_{\ell p}p^* + C_{\ell r}r^* + C_{\ell\delta_\ell}\delta_\ell + C_{\ell\delta_n}\delta_n \\ C_m &= C_{m0} + C_{m\alpha}\alpha + C_{m\dot{\alpha}}\dot{\alpha}^* + C_{mq}q^* + C_{m\delta}\delta_m \\ C_n &= C_{n\beta}\beta + C_{np}p^* + C_{nr}r^* + C_{n\delta_\ell}\delta_\ell + C_{n\delta_n}\delta_n \end{aligned} \tag{3}$$

where:

$$\begin{aligned} C_D &= C_{D0} + KC_L^2 \\ C_L &= C_{L0} + C_{L\alpha}\alpha + C_{L\delta}\delta_m \end{aligned} \tag{4}$$

are non-dimensional aerodynamic drag and lift in aerodynamic axis frame. Partial derivatives of aerodynamic coefficients are also called gradients and generally they are function of Mach number, angle of attack (α) and sideslip angle (β).

Aircraft propulsion and inertial model will also be modeled based on propulsion type and aircraft geometry properties.

Transport aircraft on their route fly through different steady-state regimes. These flight conditions or regimes usually consist of steady-state climb, cruise, holding and descent. Each transport aircraft has standard procedures for more or less optimized flight in trimmed states. To simulate flight in these trimmed states autopilot will also be coupled with equations of motion that will continually adjust control surface deflections and throttle needed for chosen trajectory.

Differential equations of motion will be integrated with Runge-Kutta fourth order method and integration step of 0.01 s.

3.3. AEROQAR METHOD

The method that will be used for estimating ACG is based on maximum likelihood principles. Measured aircraft inputs and responses are used to determine gradients of aerodynamic coefficients. Since transport aircraft flies in trimmed flight conditions ($\dot{V} = \dot{\alpha} = \dot{\beta} = \dot{p} = \dot{q} = \dot{r} = 0$) sum of all moments around center of mass are zero. Aerodynamic side force is also assumed to be zero ($C_m = C_n = C_\ell = C_Y = 0$). Equation (2) expanded for *x* and *z* body-axis is (5):

$$\begin{aligned} qS_{ref}C_x + T\cos\alpha_T + mg_x &= m\left(\dot{u} - rv + qw\right) \\ qS_{ref}C_z + T\sin\alpha_T + mg_z &= m\left(\dot{w} - qu + pw\right) \end{aligned} \tag{5}$$

Since accelerometers measure translational acceleration due to applied force excluding gravity, from equation (5) it follows:

$$\begin{aligned} f_x &= \frac{qS_{ref}C_x + T\cos\alpha_T}{m} \\ f_z &= \frac{qS_{ref}C_z + T\sin\alpha_T}{m} \end{aligned} \tag{6}$$

Equations (6) are the basis for defining the AEROQAR method. AEROQAR method can be defined as a maximum likelihood principle for known aerodynamic model structure and time invariant ACG.

For example, we can model aerodynamics as a linear or nonlinear equations considering gradients. For both models, problem of finding gradients will be set as a problem of finding minimum sum of squared differences of calculated and measured accelerations, F_X and F_Z.

$$\begin{aligned} F_X &= \sum_{i=1}^{N}\left[f_x(t_i) - f_{xi\,m} \right]^2 \\ F_Z &= \sum_{i=1}^{N}\left[f_z(t_i) - f_{zi\,m} \right]^2 \end{aligned} \tag{7}$$

where:

N = number of measurements,

$f_{xi\,m}$ and $f_{zi\,m}$ = measured accelerations at time t_i including normally distributed measurement error

$f_x(t_i)$ and $f_z(t_i)$ = calculated equations at time t_i based on (6).

4. METHODOLOGY

To determine gradients of aerodynamic coefficients from commercial flight data, a mathematical method based on inverse engineering principles will be defined. The method will use data registered in FDR or QAR device during regular flight. The name of method will be AEROQAR.

To validate AEROQAR method, mathematical model of transport aircraft will be defined in Matlab and used for generating flight variables of regular flight.

Data given by simulation in Matlab will also contain measurement and noise errors of actual sensors. Thus generated data will be used as input files in the AEROQAR method for determination of Aerodynamic Coefficients Gradients (ACG) instead of actual data from regular commercial flight.

Research for the establishment and application of methods for monitoring the aerodynamic characteristics of the aircraft in service therefore will include:

- Analysis of registered flight variables available from FDR/QAR (frequency and accuracy, flight regimes)
- Mathematical modeling of transport aircraft flight dynamics as a rigid body with six degrees of freedom (6DOF) with system of differential equations coupled with inertial, propulsion and aerodynamic model [16].
- Simulation of regular transport aircraft flight in Matlab. Results of this simulation will be sensor flight variables and all other data needed for determination of ACG such as: control surface deflections, mass, engine and atmosphere data.
- Defining mathematical method for case of linear aerodynamic structure based on maximum likelihood theory.
- Validation of linear ACG determination based on new set of simulated flight variables for known aerodynamic model structure and ACG. These flight variables will not include measurement and noise errors.
- Accuracy estimation for ACG when simulated flight variables included measurement and noise errors.
- Estimation of ACG accuracy when included atmospheric turbulence model
- Definition of mathematical method for case of nonlinear aerodynamic structure based on maximum likelihood theory. Finding algorithm for optimization of multidimensional nonlinear set of equations.
- Validation of nonlinear ACG determination based on new set of simulated flight variables for known aerodynamic model structure and ACG.
- Accuracy estimation for ACG when simulated flight variables include measurement and noise errors and for flight variables collected in turbulent atmosphere. This accuracy analysis will include: filtration method, nonlinear method application for determination of ACG, conclusions.
- Sensitivity analysis of defined AEROQAR method considering accuracy of specific input data such as: mass, center of mass, engine propulsion force and specific fuel consumption.
- Aplicability of AEROQAR method for actual flight data
- Analysis of AEROQAR method application for flight planning of short destination flights
- Comparison of current performance monitoring method and monitoring of aircraft performance through ACG.

5. DISCUSSION AND CONCLUSION

Presented research framework will be used to determine prospects of aerodynamic characteristics monitoring for aircraft in service according to data collected from regular commercial flights. Parameter estimation methods based on maximum likelihood principles will be defined determination of aerodynamic coefficient gradients. Method will be validated using data obtained during flight simulation in controlled conditions. True noise and measurement errors will also be added to simulated sensor data in Matlab. Overview and results of determination of aerodynamic coefficients will be given for the case of flight in constant wind and turbulence.

The expected scientific contributions from this research are:

- Definition of AEROQAR method for aerodynamic characteristics determination from steady-state flight conditions.
- Monitoring changes in the aerodynamic characteristics will allow more efficient aircraft operations, for example, assessing the actual performance of the aircraft that would otherwise degrade during operation.
- Analysis of aerodynamic characteristics accuracy caused by different level of measurement errors.

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APPLICATION OF A QUALITY MANAGEMENT SYSTEM TO IMPLEMENT STRATEGIC TASKS OF THE TRANSPORT COMPANY

ABSTRACT

The new model of the freight transportation market formed as a result of reforming of the Russian Railways Company, demands transition to economic criteria of the transportation process management. The analysis of values and expenses of transportation participants and decisions made on their basis on the realization of interests of rolling stock operators are an important step on the way of expansion of the transport services that leads to the growth of the competitiveness of the Company as a transport operator on the basis of the improvement of the services quality.

The quality management system has to rely not only on professionalism of employees of all levels, but also on responsibility, initiative and leadership of the top management. The quantitative measurability of the results of Quality management system can be provided by the KPI indicators system including four parts: the increasing of the transport business amounts, the increasing in the productive-economic efficiency of business, ensuring quality and safety of the transportations, integration in the Eurasian transport system.

KEY WORDS:

transport business, strategy, competitiveness, the quality management system.

1. INTRODUCTION

The strengthening of the market competition in the sphere of railway transport service, as well as the need to increase the efficiency of business created preconditions for development and introduction of a quality management system in JSC “Russian Railways”.

The system’s integration into all production and administrative processes of the company will be consistently carried out and includes several stages any of which, once completed, will bring the company to a new quality level.

Establishing an effective quality management system in the company will require maximum involvement of all workers into the process, including the one of maintaining its functioning, and also an increased share of the staff possessing leadership skills. Within their duties, each employee of the transport company has to possess opportunities, levers and incentives for creating high-quality products and services.

2. PRIORITIES OF THE RAILWAY TRANSPORT DEVELOPMENT

The priority directions of the company’s development are:

- Traffic safety increase;
- Improvement of quality of transporting and accompanying services offered;

- Improvement of quality of the production made at the Railway enterprises.

Achievement of the objectives requires introduction of indicators of quality in all management processes: from the organization of each workplace to decision-making by the top management.

As a priority problem of railway transport is providing a high level of safety and reliability, the main criteria are not only final figures of flaws, accidents and crashes, but all cases of violation of technology of the organization of transportation process, including those that haven't caused the actual violations of safety. The target state of the company's functioning in the long term is characterized by technological processes (repair, maintenance, management) having to be high-quality in order to exclude non-productive costs of correction of flaws, elimination of consequences of accidents, doing the same work twice and so on in the future. [1]

Today there is an actual need of effective comprehensive achievement of consistent improvement of the traffic safety and acceleration of the cargo and passenger traffic on the basis of quality control of all technological operations during transportation, exploitation, repair and preparation of the rolling stock in the company branches. The main link of the corporate integrated quality management system is the responsibility of the CEO and the principle of "CEO's Leadership".

On the basis of the strategic reference points set by JSC "Russian Railways" it is possible to formulate strategic objectives of heads and executives of divisions and to define a set of indicators changes of which will identify the extent of objectives achievement:

1. The increase of the size of transport business:
   - The increase in the departure of freights.
   - The gain in freight transportation volumes.
   - The passenger turnover gain.
2. The increase of productive-economic efficiency of the activity:
   - The reduction of transportation costs.
   - The increase in the average weight of the cargo train.
   - The increase of productivity of the locomotive.
   - The increase of local speed of cargo trains.
   - The acceleration of the car turnover.
   - The reduction of depreciation of the key production assets.
3. Ensuring the quality of processes and safety of transportations:
   - The maintenance of the passenger trains schedule.
   - The maintenance of the local train's schedule.
   - The decrease in number of crashes, accidents and the decrease in number of flaws.
4. Integration into the Eurasian transport system:
   - The increase in a transit flow through ports of the southern region.
   - The increase in a transit flow through frontier transitions.

The integrated quality management system of the railroad has to be based on the implementation of the requirements and recommendations of the Company, the international standards of the ISO 9000 series which include "Leadership System", "The balanced System performance", the principles of "Lean production", the requirement of the ISO 14000, OHSAS 18000, SA 8000 standards. Its further development is planned to be build on criteria of self-assessment "Awards for quality" and TQM. [3]

Carrying this program out will allow:

- to improve the mechanism of decision-making on the basis of the formalized business processes with the exception of uncoordinated and contradicting decisions; providing coherence of strategic and operational planning and management;
- to encourage tuning of the system of responsibility delegation and administrative decisions and realized processes efficiency monitoring, to reduce excessive centralization of management, to create mechanisms increasing the interest of each structural division in the quality of the created product or service;
- to unite elements of the quality system management currently existing in structural divisions of the Railway in one system and to direct it to the achievement of corporate strategic objectives;
- to define the criteria of the services quality and efficiency assessment from the point of view of the financial result of each of carried-out processes; to improve the planning, the organization and the motivation of rationalization and invention activity;
- to exclude the use of the out-of-date technical means inadequate to modern requirements and regulations of technical equipment that doesn't promote effective implementation of technological processes and doesn't provide their flexible optimization in terms of quality and efficiency of use of resources;
- to improve existing marketing system, i.e. system of studying of a consumer demand on the basis of segmentation of the market of the Railway services consumers, the clients feedback system and the analysis of compliance of quality of provided services to price criteria, to carry out detailed differentiation of services in types of quality and in segments of the market, to increase the sales volume of the Railway services;
- to encourage creation of external and internal risks management system to provide the process of continuous improvement of the work on the basis of the preliminary assessment of probability and potential damage from unfavorable changes and ensuring the appropriate counteraction and protective measures.
- to increase the efficiency of informational flows management, to optimize collecting and analyzing the administrative information, and also the internal statistical reporting; to create a complex system providing measurement, collecting and analyzing the information on the quality of services and processes in order to timely and most objectively estimate activity of the Railway and effectively operate resources and processes.
- to improve and make transparent the existing motivation system; to reach the necessary level of the employees' interest in the quality of the product or service; to improve calculations of the dependence of the employee's remuneration on the quality of his work on the basis of the system of the balanced indicators providing motivation of each employee on high-quality performance of work.

As a result of the actions directed, both on continuous improvements of business and technological processes, and on the implementation of breakthrough decisions, it is planned to bring railway branch to new perspective indicators of performance and with that to provide a worthy contribution to the achievement of strategic objectives for the period till 2030.

3. THE STRATEGY OF TRANSPORTATION PROCESS MANAGEMENT

The central component of implementation of the general strategic program is the strategy of transportation process management. On the one hand, it defines the development of the administrative segment as the main segment of the holding management, on the other hand, it connects productive-resort and market segments of holding management. [4]

Providing transportation process with resources (fig. 1) is a fundamental link at definition of possibility of an economic assessment of the technology of transportation process and the interrelation between contributions to the process made by all participants.

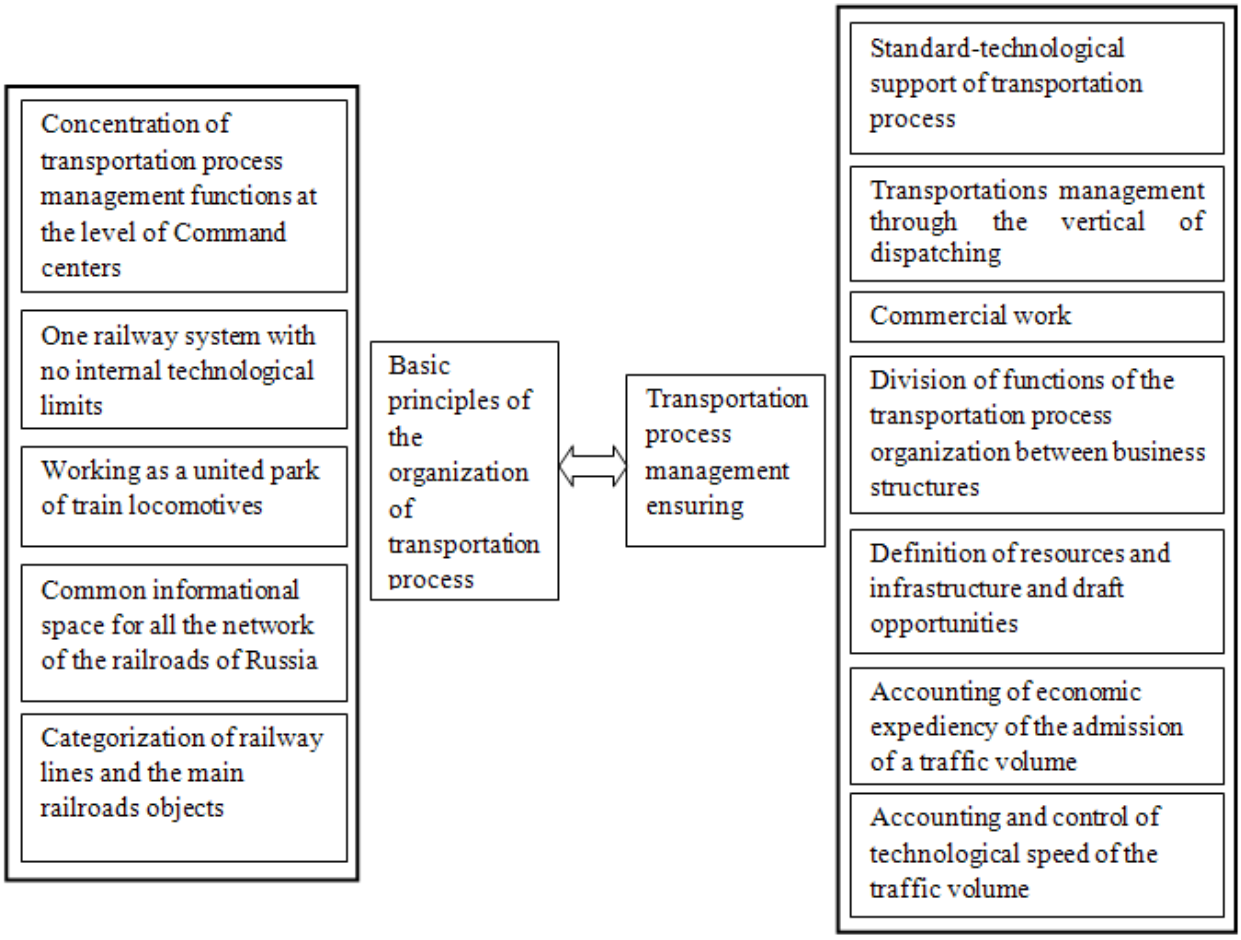

Figure 1 - Interrelation of transportation process organization principles and ensuring the process of transportations

Existence of an appropriate resource represents potential opportunity for realization of transportation process, the upper bound for achievement of target figures of volume indicators. The optimum combination of the possessed resources creates an opportunity to minimize the expenses "attached" to this kind of resources.

4. COMPLEX INDICATORS OF QUALITY MANAGEMENT

For a complex, integrated assessment of activity of business units which are responsible for the organization of transportation process management, it is necessary to allocate the main indicator describing quality of carried-out business process.

The realization of the "Functional strategy of quality management" is directed to the cost-cutting at the expense of the optimization of the business and technological processes on the basis of their improvement, identification of reserves and the reduce of non-productive or inefficient costs of resources.

As the result of the production in the sphere of the rail transportation is service, it determines the specifics of the process of the quality management, increasing the degree of the client-orientation.

In fig. 2 complex indicators of quality management at the realization of the function of the transportation process management are represented.

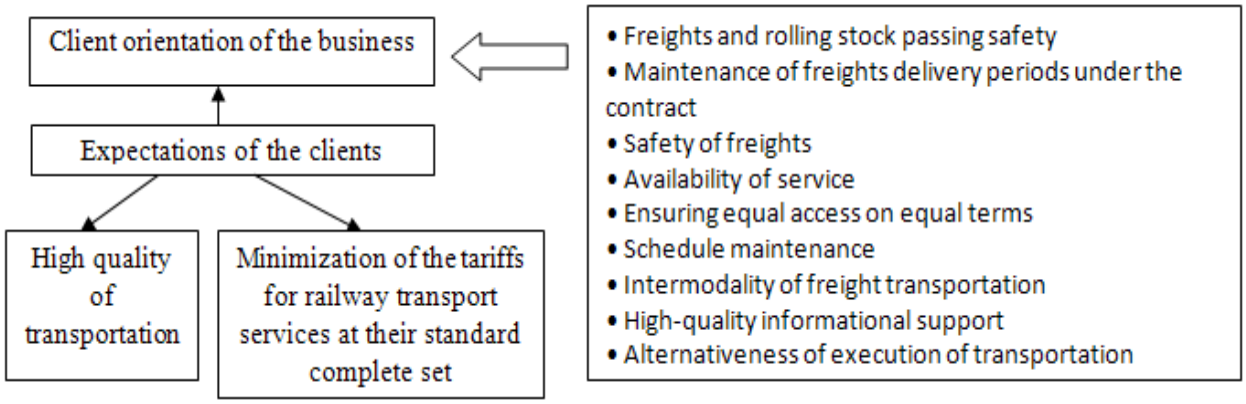

Figure 2 - Complex indicators of quality management at the realization of the function of the transportation process management

The main indicators characterizing the quality of the transportation process management at the given resource restrictions and existing technologies of management are the indicators characterizing the speed and the execution of the periods of freight delivery.

All consignors depend a lot on the quality of the railroad's work. However in the existing reporting there is no operational indicator which the clients would be interested in. Turnover of cars, the train weight, the car demurrage with overtime don't resolve an issue of the satisfaction of the client need in high-quality transportation directly.

The analysis of the clients' expectations who are the consumers of the railway transport services on transportation shows the existence of two vectors of their preferences: the focus of one part of the clients on high transportation quality, and the focus of the other one on minimization of the tariffs for railway transport services at their standard complete set. [2]

The economy of the delivery of mass, rather inexpensive freights most often demands providing a reliable regularity in transport work with the application of route technologies of transportations.

The economy of the delivery of expensive, perishable freights or freights of "production cooperation" makes the demand for maximum possible reduction of the freights' finding period duration in the course of transportation.

The key factors influencing increase in speed of delivery of freights belong to the sphere of operational management of freight transportation. First of all it involves the local speed, the time of cars finding at technical stations and under cargo operations, the transit.

For carrying out the analysis of transportation process management quality it is necessary to consider complex indicators like "The speed of delivery of cargo sending" and "A share of the sending delivered in established periods". The specified indicators have to be considered taking into account the displays of the actually covered distance, the analysis of

performance of delivery period for every operation, the analysis of the deviation of speed of passing of a transit flow on sites of a route and deviations in time of finding of sending at stations. In this format an indicator "The speed of delivery of cargo sending" will provide "transparency" of a production activity of the linear enterprises of the branch - filiations and structural divisions of the company on performance of speed and freights delivery periods, and as such will increase operational controllability of system.

With the assessment of speed and freights delivery periods abidance the following objects become available to the analysis on failing to maintain the traffic speed and sending delivery period: the route; the sending category; the sending movement process; the profitability of sending and the possibilities of reducing the operational costs.

At the complex accounting of costs of car and train traffic running and the assessment of maintaining the quality indicators in management information systems, appears the possibility of coordination of transportations management process on the basis of economic criterion.

5. CONCLUSION

The complete system of transportation process elements management which is urged to solve the problem of optimization of process of transportations from the point of view of the best use of resources by decrease in expenses of implementation of the set qualitative parameters creates possibility of choosing the best alternative of operational and technological development of the Railway transport company.

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THE BROAD GAUGE RAILWAY FROM RUSSIA THROUGH CENTRAL EUROPE

ABSTRACT

«The broad gauge to Vienna» - the ambitious project about which started talking in 2006, but only it was quite recently declared prospects of its realization. In this work the main aspects of the project at all stages of its existence are considered, and also the forecasts of experts proving that extension of a broad gage of 1520 mm 450 km long to Vienna – the favorable and successful decision are provided in questions of increase of carrying ability, reduction of time of idle times of wagons under an overload, economy of expenses of clients and other.

KEY WORDS:

broad gauge, foreign economic relations, effective interaction, carrying capacity, delivery period, increases in efficiency.

1. INTRODUCTION

«Time is money». Probably, there is not a person who has never heard this well-known saying. You can use this expression while talking about the different spheres of life including economy, business and even private life. The sense of this phrase is applicable for railway transport. For example, any person who went abroad by train, wasted a lot of time while expecting the replacement of carts from the Russian track for the European one during the transition, that process usually took about 120-150 minutes. But it is necessary to mention that there is an opportunity to use sliding wheel couples (SWC), the usage of that ease and boost the process mentioned to 30-35 minutes. [1]

The change of the carts can cause great inconvenience during overloading the Goods from Russian vans to the European ones and vise versa, as well as from vans to trucks for the Clients delivery. This process leads to a reduction of profitability.

The Russian gauge 1520mm is unique, that allows to use vans of increased carrying capacity that can compete with the carrying capacity of water transport as an equal.

2. THE PROJECT OF THE BROAD GAGE'S CONSTRUCTION

In April 2008 in Vienna, Austria, the representatives of JSC Russian Railways, Austrian Railways, Slovakian Railways and Ukrainian Railways signed the Protocol of starting of pre-project research work on the lengthening of the broad gage (1520mm) to the Central Europe. In the protocol the common targets of the Sides on the increase of the railway transportation's competitiveness as compared with the sea and road transport were mentioned.

The project of the broad gauge's construction was presented in January 2013 in Bratislava. The approximate term of the construction's completing is 2014-2015. From 2016 the gauge can be used for the commercial transportation. As it was estimated by the President of JSC Russian Railways, the project can be as the accelerator of the rapprochement process and effective interaction of railway systems with different broad gages, as well as foreign economic relations between the countries of the European Union, Russia and Asian countries.

As for Russia, the implementation of the project will lead to expanding the territory of containers' deliveries on the Trans-Siberian Railway.

Moreover, many European countries will be involved in the construction of the new railway line and terminal, among them: Slovakia, Austria, the Czech Republic, Hungary, Germany, Switzerland, Italy, Slovenia, Serbia, and Croatia. The comfortable and beneficial geographic and economic location of railway territory with the gauge 1520mm is a great opportunity for the development of transportation between the Western European and Eastern European countries (fig. 1).

Figure 1 - Scheme of the new railway line[1]

3. PROFITABILITY AND OPPORTUNITIES OF THE PROJECT

The construction of the gauge of 1520mm to Vienna is the project of the major priority for JSC Russian Railways among all the international projects.

[1] http://uz.gov.ua/press_center/ukrainian_railways_in_mass_media/361027/

Turning the project into reality will provide a large supply of goods delivery and reduce time of delivery approximately in 2 times compared with prevailing sea delivery.

The Experts of the well-known international consulting company Roland Berger Strategy Consultants, which have to evaluate the investments in the project, suppose that lengthening of the broad gage from Ukrainian Uzhgorod and Slovak Koshitsa to Vienna by 450 km will give the opportunity to cut the delivery time of cargo from China to Europe to 13-15 days. Today the cargo can be delivered from Shanghai through the Suez Canal by the sea for 30 days.[2]

It is necessary to notice that the project of the broad gage will promote job places' creation in the amount of 21.000, besides the full electrification of the railway site won't harm ecology. As well as the Logistic and provider Center is to be built in Vienna. The project's implementation would increase a number of the container transportations transits and promoted to approach Russia and Europe from the point of view of railway infrastructure. [3]

According to the analysis data of the Strategic Development Fund Center, with a speed of the cargos' transportation of 1500 kilometers per a day from port Nahodka to boundary Brest by 2015 the containers will arrive for 7 days, it will be the step for the incredible increasing of traffics' numbers to 2050 (fig. 2).

Besides, it will give the extra profitability for Russia, the cost of a container's transportation will reduce by the sum of from 100 to 1000 usd. [4]

Investments into construction of a 450-kilometer site of the broad gauge to Vienna are estimated to reach to 6,25 billion euro. For the development of the terminal network it is necessary to invest 370 million euro more.

Fig - 2 Scheme of perspective transport corridor

4. THE PROJECT OF RAILWAY «RAIL BALTICA»

«The broad gauge to Vienna» has a competitor –«Rail Baltica», the project of railway where it planned to use the standard European gage (1435mm), and it have to connect Tallinn, Riga, Kaunas, Warsaw and Berlin in order to improve the connection between the Central and Eastern Europe. Some experts have not expressed their opinions concerning to the efficiency of the project yet. However, we can say with confidence, that after the project's implementation the Baltic countries will be a railway junction with the combined gauge that is to connect freight traffic from the different parts of Europe and Asia to Europe.[5]

But there are some controversial issues. Many people are sure that it will connect the Baltic countries capitals with the European countries ones. But it is possible to do it in the different ways. For instance we can purchase the Talgo trains that can be used on the both gages – 1520 and 1435mm. The construction of the line will lead to creation of 2 different systems: if Estonia refuses the gage of 1520mm, it will stop all the deliveries from Russia. In order to service both systems, it is necessary to use 2 systems of Standards, 2 systems of depot, that it can lead to doubling of all the costs. [6]

5. CONCLUSION

Let's sum up the results. The project of the broad gage is of a great interest for both – for Russia and for European countries. Despite the project has lots of opponents, it will be profitable because on the new road more than 16 million tones of cargos per a year will be able to be transported to and from Russia; it will give an opportunity to not overload the Goods, that leads to the costs and delivery's time reduction.

The transportation on the road will provide the developing markets of Russia, Ukraine, Kazakhstan and other countries that use the gage of 1520mm with more efficient delivered Goods.

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ANALYSIS OF THE IATA E-FREIGHT PROGRAM IMPLEMENTATION

ABSTRACT

Paper based processes are not cost efficient, nor do they comply with the basic demands of air cargo transportation, to be safe and fast. In order to eliminate paper documents from the process of shipping air cargo and replace it with electronic data and messages IATA started e-freight project. The paper analyzes the benefits of electronic cargo operations, and implementation status worldwide as well as in Croatia.

KEY WORDS

E-freight program, paperless transportation process, air cargo industry

1. INTRODUCTION

The transport of goods by air is the baseline of 21st-century global trade, because of its specific advantages over the other modes of transportation, but the air cargo industry still relies heavily on slow and inefficient paper-based shipping processes. The vision of e-freight program is to eliminate paper documents in the air cargo industry and create conditions for their replacement by means of electronic messages for exchange of information between participants in the transportation process. The documents that are required in the transportation process of the goods are the documents that support the cargo or goods release/clearance by customs authorities. These include customs forms; transportation documents, like airway bills and flight manifests, as well as commercial documents such as invoices, packing lists and certificates of origin.

2. E-FREIGHT PROGRAM

Simplifying the Business (StB) initiative combines several programs whose aim is to provide a better customer service while reducing operating costs. As a part of StB initiative e-freight program aims to build and to implement a paperless transportation process for the air cargo industry where paper documents are replaced with the exchange of electronic data.

In 2005, the International Air Transport Association (IATA) launched an industry-wide project whose aim is to take paper out of the air supply chain, and create the conditions to replace the existing processes with new ones where the industry and governments rely on the electronic exchange of information between the parties to facilitate the movement of freight [1].

The long-term vision for the industry is to eliminate the need to produce and transport all paper for all stakeholders – paperless e-freight. To this date, government regulations, barriers in information and communications technology, and the lack of success to achieve a critical mass of users to achieve network effect benefits have prevented the e-freight initiative from being universally adopted.

The principles that support the vision of the e-freight program are:

- Single data capture
- To encircle customs, security and transportation related documents
- To enclose legal, business and technology elements
- Rely on e-Document standards aligned with international standard setting bodies (WCO, ICAO, etc.)
- Allow paper to be printed by exception
- Use existing industry EDI (Electronic Dana Interchange) infrastructure where sufficient and upgrade where relevant [2].

2.1 BENEFITS OF THE E-FREIGHT PROGRAM

As forms and documents pass through the hands of up to seven different stakeholders, including shippers, freight forwarders, ground-handling agents, airlines, customs brokers, customs agents and other government authorities, with each step in the process, the volume and complexity of paper expands, along with its cost and susceptibility to human error. The paper burden does not end upon delivery of the goods. The physical documents must be stored for future reference or audits, making them heavy to access. Paperwork-related delays carry additional costs to shippers in terms of higher freight rates to expedite time-sensitive shipments by air, or insurance charges to cover loss of perishable products and lost sales. Much of that inconvenience can be prevented by switching to e-freight. Using digital technology to pre-clear shipments before they arrive at the airport could prevent approximately 70% of paperwork-related delivery delays at destination. Besides, electronic documents can't get lost and thus cause further delays, but they can allow easier tracking of shipments through the Internet.

If all the participants in the transportation process would use common standards for the exchange of messages, data and documents, which is the goal of e-freight program, transportation process would be globally uniform and easier to implement. By implementing electronic documentation transportation process would become more environmentally friendly, since e-Freight would eliminate more than 7,800 tons of paper documents a year [2].

There are four key financial savings:

- Document processing - by transferring to a paperless process there would be cost savings associated with less manpower to physically handle the document process as well as less data re-entry.
- Delivery time shortening - the ability to send shipment documentation before the cargo itself can reduce the cycle by an average of 24 hours.

- Customs Penalties Reductions - as the industry transfers to electronic documentation the data errors are reduced and thus there's an approximately 53% reduction in customs penalties due to incorrect data submission.
- Increased Market Share - e-freight will make the air cargo industry more competitive [1].

According to IATA case study realized with Cathay Pacific, which has implemented e-freight and was the first airline to achieve 100% electronic Air Waybill (e-AWB) benefits of e-freight for airlines are: increase in productivity, cost reduction from less paper and printer use, customer service improvement, increased level of security and quality of information, and faster respond to regulatory demands [3].

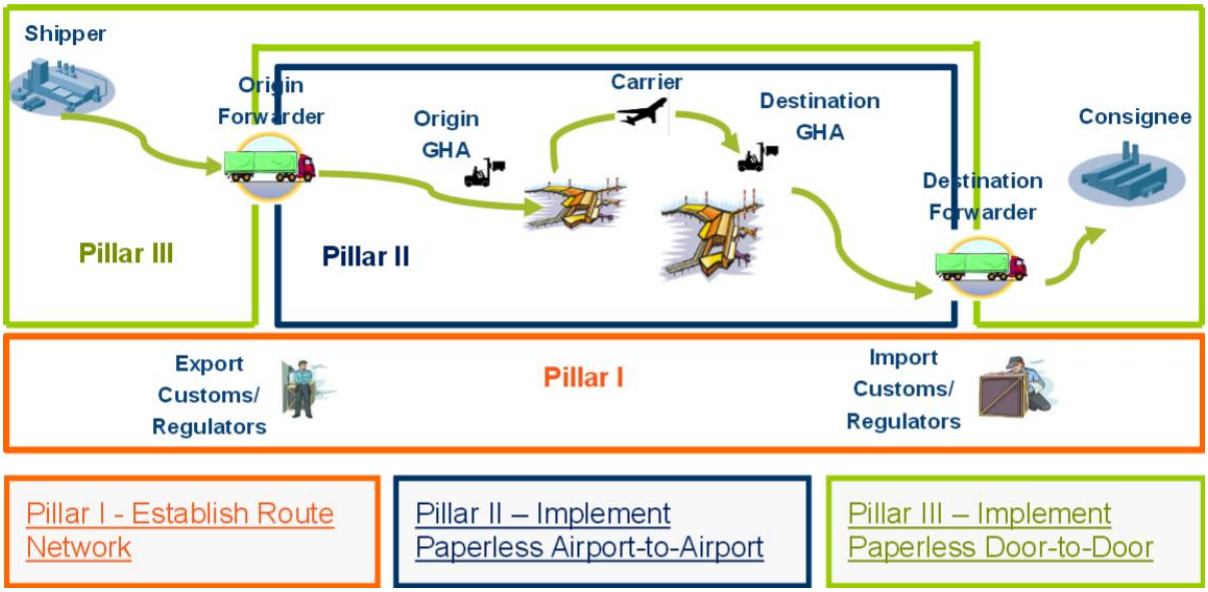

Figure 1- Three pillar guide toward e-freight supply chain
Source: http://www.iata.org/whatwedo/cargo/e/efreight/Documents/efreight-brochure.pdf

To achieve these benefits, the right conditions must be met, and the most important ones are:

- an investments in information system,
- support of government (customs) [4].

2.2 E-FREIGHT INFORMATION FLOW

To achieve the flow of information every one of 12 core document should be replaced with one or more standard electronic messages that stakeholders would mutually exchange as needed. To replace paper documentation with electronic messages it is necessary to provide an acceptable level of safety and quality of information interchange.

Information technology is a key element of a reliable and safe e-freight process. E-freight program applies the logic of onetime data entry at the source. The first stakeholder in the transport process, the shipper, enters the requested information in the system, which is electronically transmitted to another stakeholder. In this way multiple manual entries are eliminated, and potential errors are avoided. The process of obtaining customs approval is accelerated, and thus the entire transportation process is accelerated because the shipper has more time to prepare the documents for customs clearance [1].

Broadly speaking, a shipment is considered an e-freight shipment when no documents accompany the shipment. Specifically, as of January 2013, the following rules apply to consider a shipment to be an e-freight shipment:

- Electronic contract of carriage (e-AWB)
- Electronic customs declarations (i.e. on e-freight trade lane)
- No accompanying documentation to be transported with the freight to destination [3].

In 2012 the Global Air Cargo Advisory Group (GACAG), as IATA partner, developed a Roadmap to 100% e-freight which defines the approach, structure and targets of the e-freight program. First pillar represents engaging regulators and governments worldwide to create fully electronic customs procedures and where regulations support paperless shipments. Second pillar represents collaborative work with the whole cargo supply chain to digitize the core industry transport documents, starting with the air waybill, while third pillar represents the digitalization of commercial cargo documents such as invoice, packing list, etc. These three pillars, as well as the flow of goods are shown in the Figure 1.

3. E-FREIHGT PROGRAM GLOBAL STATUS

The e-AWB initiative is more and more considered as the first step to realize the e-freight vision. The e-AWB project replaces the paper AWB contract with an electronic contract of carriage between the Shipper (Freight Forwarder) and the Carrier.

By the end of 2011 the number of countries that have fully implemented the IATA e-freight technology has grown to 42 [3].

Table 1 and Figure 2 show the actual number of e-freight (EF) consignments reported to IATA by participating airlines and compares them to the total number of AWBs and the potential market for EF known to IATA. An EF consignment is identified by IATA when both the EAW[1] and ECC[2] special handling codes are provided by the airline for that consignment. The potential market for EF is the total number of consignment between airports that are live for EF and between countries that have signed the same MP4[3] or MC99[4] treaties.

The air cargo industry's slow migration toward electronic documentation has led the IATA to revise its internal deadlines. According to Guillaume Drucy, head of cargo e-business management at IATA, the penetration of e-Airway Bills was 10.2 percent as of October 2013, just half IATA's previous target. IATA is now aiming for 80 percent by 2016 [5]. He concluded that the adoption of the multilateral e-AWB agreement in March 2013, allowing airlines to connect with multiple forwarder customers on standardized terms, had removed a major obstacle and would accelerate take-up. By October, 53 airlines and 411 forwarders had signed up, covering 79 percent of the potential AWB market from the carrier perspective and 41 percent in respect of airfreight forwarding (see Table 3 for top airlines and forwarders in terms of e-freight consignments in November 2013, and Table 4 for IATA overall monthly international e-freight consignments numbers between 2007 and 2013.

[1] EAW: is the special handling code for an e-Freight shipment with no accompanying documents
[2] ECC (**E**lectronic **C**argo **C**ontract) handling code is used to identify shipments using an e-AWB.
[3] The Montreal Protocol 4 (entered into force in 1998)
[4] The Montreal Convention 99 (entered into force in 2003)

Table 1 - Monthly international consignments number (Master Air Waybills)

	July 2012	November 2012	March 2013	July 2013	November 2013
Total AWBs volume	1,912,376	1,938,708	2,043,000	1942,231	1,818,988
Potential e-freight volume	681,163	700,992	734,373	711,460	711,627
Potential e-freight vs. total AWBs	35.6%	36.2%	35.9%	36.6%	39.1%
e-freight volume	4,037	7,510	16,950	21,954	24,292
Actual e-freight vs. potential e-freight	0.6%	1.1%	2.3%	3.1%	3.4%

Source: IATA e-freight international monthly report July 2013, IATA e-freight international monthly report November 2013.

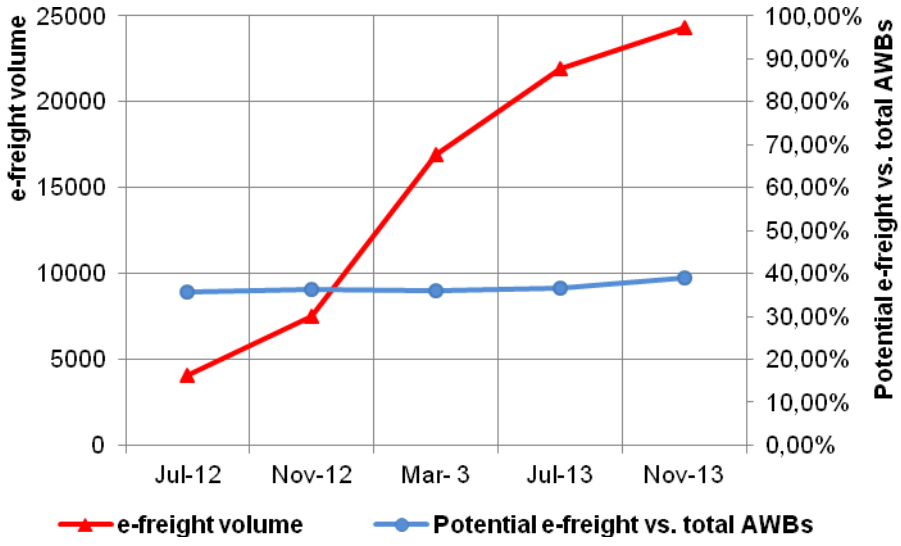

Figure 2 – International monthly e-freight volume (based on the IATA e-freight international monthly report July 2013, IATA e-freight international monthly report November 2013)

China Customs showed great degree of resistance to electronic declarations, while Customs officials in emerging markets such as India still prefer physical invoices, packing lists, manifests and AWBs. In many airlines, cargo departments are dedicated to cut the costs and enhance freight volumes rather than to introduce e-AWBs.

Table 2 - Monthly international consignments number (Master Air Waybills)

Year	Total AWBs volume	Potential e-freight volume	Potential e-freight vs. total AWBs	e-freight volume	Actual e-freight vs. potential e-freight
2007	14,294,128	0	0,0%	0	-
2008	115,340,819	347,350	2,3%	0	0,0
2009	19,314,334	2,701,103	14,0%	0	0,0
2010	21,808,912	5,248,074	24,1%	0	0,0
2011	22,277,813	7,234,342	32,5%	18,544	0,3
2012	24,411,658	8,028,005	35,8 %	60,867	0,8
2013	20,608,685	7,629,746	37,0%	204,813	2,7

Source: IATA e-freight international monthly report November 2013.

Table 3 - Top-10 airlines and Top-10 freight forwarders (Nov-2013)

Rank	Airline	e-freight volume	Rank	Freight forwarder	e-freight volume
1	Cathay Pacific	8544	**1**	DHL Global Forwarding	1445
2	Korean Air	3992	**2**	Kuehme + Nagel	1389
3	SIA Cargo	1814	**3**	TNT Group	1019
4	Asiana	1624	**4**	DHL International	897
5	SIA Cargo	1142	**5**	Samsung Electronics Logitech	594
6	IAG-Iberia	1052	**6**	Panalpina	563
7	China Airlines	1042	**7**	UPS	528
8	Lufthansa Cargo	824	**8**	Transall	488
9	Delta Air Lines	831	**9**	Brink's Group	446
10	KLM	817	**10**	Schenker	445

Source: IATA e-freight international monthly report November 2013.

Table 4 - Monthly international consignments number (Master Air Waybills)

Year	Total AWBs volume	Potential e-freight volume	Potential e-freight vs. total AWBs	e-freight volume	Actual e-freight vs. potential e-freight
2007	14,294,128	0	0,0%	0	
2008	115,340,819	347,350	2,3%	0	0,0
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Source: IATA e-freight international monthly report November 2013.

4. E-FREIGHT PROGRAM CROATIA STATUS

Total Croatian air cargo traffic, is approximately 0.02% of global air cargo traffic. Even though it is a small amount of share in global air cargo traffic, for its geopolitical position Croatia has the potential to become a regional leader in intermodal traffic, including air traffic.

Realized traffic volume in Zagreb International Airport on average per year (in the period 2001 - 2010) is 10 056 tones, which is 85% of the total air cargo traffic in Croatia [6], and although Zagreb airport is not a regional hub, because of the large share of the total Croatian air traffic Zagreb International Airport has primary responsibility for the development of air cargo traffic.

Croatia has, in the formal legal sense, fulfilled a series of conditions for the implementation of e-freight program. Since 2007 Croatia has signed Montréal Convention (MC99), and Montréal Protocol (MP4). Croatia also ratified World Customs Organization Letter of Intent. Based on this Croatia has successfully passed the High Level Assessment and Detailed Level Assessment taken by Croatia IATA office in the country [1].

However, due to the slower than expected digitalization of customs processes, Croatia has not yet reached the status IMP (Ready for Implementation).

Perennial expectations of the implementation of e-freight program, which was supposed to be in 2012, then moved to 2014, due to the sluggishness of bureaucratic system and passiveness of the regulatory bodies, is not expected to be anytime soon. Although customs is introducing G2B service for facilitating communication between customs and the

business community, it is still in the testing phase, and does not fully comply with the requirements of e-freight program, though with the necessary modifications could be used.

According to IATAs Matchmaker only two airports in Croatia (Zagreb International Airport and Split Airport) have the potential to meet the target status of implementation of e-freight program [7].

Even though a new member state, in relation to the countries of the European Union, Croatia is late with the implementation of e-freight program. Just for example, Hungary, which began with the implementation in 2004, today it is on the 25th place in the world using paperless processes [8]. Excluding Slovenia, which has already implemented IATA e-freight program, Croatia is still the most advanced in terms of the current state of adoption of this program, compared with countries in the region. Bosnia and Herzegovina, Serbia, Montenegro and Macedonia are on the way of adopting the program, however, haven't passed yet the High Level Assessment [9].

5. CONCLUSION

By optimizing and rationalizing air cargo process applying e-freight technology it is possible to achieve number of benefits which include different areas, such as productivity, safety, quality and environmental awareness.

Significant increase in number of e-freight consignments is far away from IATA's targets and migration toward electronic documentation in air cargo industry was slower than expected.

Although airlines have to engage with forwarders and create more benefits for them to implement E-freight globally, making paperless border crossing a reality depends critically on the willingness of governments to lift regulatory blockade to electronic customs processing. With meeting the requirements relating to the modernization of customs operations, it is expected that Croatia will get the status of IMP - Ready for Implementation. In comparison to other countries in the region, Croatia is still in a more favorable position, and should try to take advantage of this and become a regional leader in cargo operations, with Zagreb International Airport as a regional hub.

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VALUE OF ITS PROJECTS, HR - EU COOPERATION RELATED TO THE IMPLEMENTATION PROCESS IN ROAD TRAFFIC AND DEVELOPING TRAFFIC SYSTEM IN CROATIA

ABSTRACT

This work presents the project with the working title HRWATT 1, 2, 3, 4 , 5 whose aggregate financial expectation is ~ 83 million euros. Projects are conteptually developed proposals of transport solutions, out of which HRWATT1 is prepared for the highest level of evaluation and implementation (UN ECE). At this stage, it requires minimum of above mentioned resources, but it also intrigues ITS traffic road system the most.According to efforts and goals of ZIRP 2014, another four projects will be actualized and modified, including two previously reviewed expert works, with aim of implementation into the traffic system.Potential partners and their interests to participate on projects generally,have high and clear expectations. Some projects require less intervention like bay-pass, where are upon execution improves technical-technological and safety condition of the roads.The integrity of this work is contained in the extended versions of all 5 projects . (in addition)

KEY WORDS
idea, project, evaluation, intelligent transport systems, quality, implementation processes, integrated transport systems, technical and technological improvements, safety.

1. INTRODUCTION

Execution - Implementation

From traffic technologist-experts are asked, almost requires a certain project in order to be elaborated by and applied in a certain area. What do the same if a part or a whole does not execute? Unambiguous answer would do not give up. In the future, it would mean that the a previously neglected value or quality need to improve, renovate and re-reconstructed to give judgment.

Each value in terms of quality, typically have longer life, and greater likelihood of execution.

1.1 STATUS OF PROJECTS

It is clear that energy or work loaded in the a larger or smaller project are always anywhere reflects, results in. [1]

Traffic projects here will catch sight of new light are denoted by the same working name HRWATT, but also other numbered. [2] Each of the projects will be processed in the manner as required by the questionnaire with additional pictures, short explanations or through insight into the expert work. [3]

1.1.1 The activities and other details connected with the project HRWATT 1

The idea of the project described below is from 2003, professional work was published in the conference KOREMA 2006, Automation in traffic. [4] Further expert elaboration resulted in even more extensive papers, a series of contacts with of relevant institutions individuals Croatian Government, Competent Ministry MMPI,Relevant Ministry MUP,Government institute DZM,DZIV,Tehnically Faculties from Croatia FESB, FPZ, Tehnically Institutions from Croatia CVH,EU Relevant Institutions EU-UN ECE.
The initiative was paused in the year 2013. Five experts Prof. Dr. levels were asked to get involved in the evaluation of the work, additionally to professionally processing materials, and project pass on the decision making to the UN ECE level. [5] Of course, have encountered problems of funds to monitor and work on project. Project is currently at a standstill.
The following matrix application materials MMPI CRO(Competent Ministry).
National program for the development and implementation of ITS in road transport

ANKETA - Planning the ITS projects 2014-2020
Name of state administration, companies, organizationsand similar:
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Name and brief description of the project
HRWATT - 1
A vehicle with front stop light - active element of vehicle safety

In the techniques and technology of road traffic, the intention is to apply technical innovation, a vehicle with a front stop light ,the intention is the low and unstable level of communication improve, of all active participants in traffic. [6] is expected to increase interaction, and the relatively, more safety. [7]

2. Geographical area
The project is expected to be realized in CRO-HR, EU, RUSSIA.
Specijal.Institut of University, Traffic poligon (open-an indoor), laboratories and other open locations.

3. Activities prior to project (preliminary activities)
Conceptual design, and project specifications are presented and published in 2006.
Further activities are wider evaluation of the project and the legislative implementation of ITS. Thus, the expected to wider professional debate about the value of the project, with minimal intervention-changing the legal framework as a condition for project implementation.

4. Technical and technological innovation
A vehicle with a front stop light as technical and technological novelty requests:

- new product - console brake lights and turn signal - application increases interaction by changing silhouettes of vehicles on both sides especially on the front side
- bringing new and better safety parameters for analysis - brings a new way of regulating traffic

5. Prospective the partners and their interests
CRO Government, UN ECE, ITS CRO, FPZ CRO, EU traffic research centers, CRO and EU Colleges, and the various interest group beneficiaries of the project.

6. Expected results and benefits
Application of the car with the front stop stop light affects the improved interaction, and the possible reduction of the number of road accidents-incidents, and thus does influence the overall social impact. Direct and indirect benefits would be numerous.
Multiplicative factor of this project is huge, and instead of cost-benefit analysis only I mention that the project has a high safety factor of success.

7. Costs and forms of financing
Financing method can be implemented through PPP and EU funds.
200,000 EUR is the amount of cost estimates, with a variety of possible oscillations.

8. Time frames for the implementation
The timeframe project duration is 1-2 years, all for the purpose of dynamics and ways of adopting the UN ECE organization and GRE groupings. The start is at the time of disposal options over resources.
The requested change the legal provisions is the end part of the legal implementation and start the actual technical implementation of the project.

1.1.2 The activities and other details connected with the project HRWATT 2

The following documentation published in the Conference ZIRP (Science and development of traffic) in 2008.Responsibly department in the Ministry, the City Split and institutions are familiar with this solutions.
Optimization of traffic flow bypass of the city of Split is work that can be in phases and very elegantly made. [8]
The essential feature of this road corridor is insufficient traffic above road level, with indirect influence on delays and the tails of in the intersections of the lower levels. Technically and technologically it is possible to redirect, regulate and optimize traffic on two levels, this capital facility as in Figure 2. [9]

The following matrix application materials MMPI CRO (Competent Ministry)

1. Name and brief description of the project.
HRWATT - 2
Optimization of traffic flow ring road of the city of Split
Expert observation was determined nonlinearity, utilization of road tangent city of Split L = 1.5 km, and unnecessary interruptions traffic flow with indirect damages.
The project proposes solutions reconstruction plan passes on parts of the crossing, and that the three input-output ramps and new regulation for a smaller part of the traffic toka.Everything is feasible to in phases.

2. Geographical area
Area of construction is part of the city of Split, the so-called detours, contact points of streets Domovinskog rata - Zbor narodne garde - Poljička.
The architectural scope of are three of an access ramps.

3. Activities prior to project (preliminary activities)
Preliminary conceptual design - professional work, published in 2008, and the elaboration of the proposal are tied to Iteligentni transport sustav.

Zona reconstruction is located inside the road corridor, and the reconstruction procedure retains the character of the former space purpose. For construction on the field needed are less, organizational and legislative actions.

4. Technical and technological innovation
Technical interventions in the area,of integrated connect point, and enable better utilization of traffic technology.

5. Prospective the partners and their interests
Competent ministry MMPI CRO, the City Split, County of Split-Dalmatia, and other stakeholders users of this project (citizens, passengers, employees, students, pupils, etc.)

6. Expected results and benefits
The expected result would be completely undisturbed traffic, significantly better exploited direction, a new development momentum of the city and county with the satisfaction of a number of basic factors of network lines and technology city traffic.

7. Costs and forms of financing
Estimated cost of the project is 100,000 to 350,000 Euros.
Source of financing PPP, EU or compensation by utility relocation and sale of the existing traffic light system, for financial needs of the project.

8. Time frames for the implementation
The implementation timeframe is actually time to build one of three ramps (2 – 4 mj.). A key detail; everything can be carried out in phases, without substantial disturbance and interference with existing flows and traffic logic.

1.1.3 The activities and other details connected with the project HRWATT 3

The work was published in KOREMA (Transport Automation) in 2007 . The following are institutions that are partly familiarize, and those that would benefit from the project.
MMPI CRO Competent ministry, City of Split, County of Split-Dalmatia, Split Airport, IT companies, ITS,Promet-urban transport company,planners and stakeholders that will benefit from the project (sports associations, schools, colleges citizens). [10]
The following matrix application materials MMPI CRO (Competent Ministry).

1. Name and brief description of the project
Developmental project proposal with the element of integrated, undisturbed, traffic-spatial solutions or combined application the road traffic on the object L = 2.3 Km
The strategic importance for the city of Split, County and Croatia.

2. Geographical area
The city of Split, on the axis of an underground railway line built in orientation north - south or city port - northern port.

3. Activities prior to project (preliminary activities)
The main activities are included in the professional work in years from 2007 which set forth the main idea, the projected traffic specifics of the project and development possibilities of.
Therefore, the reconstruction and redevelopment of the capital traffic of Physical object from the city of Split is the main activity. The benignity of the project is in the fact that reconstruction retains traffic function, and the necessary modification license.

4. Technical and technological innovation
Technical and technological innovation would contain more new elements, considering that involves integrates network and other forms of transport in the optimum scale.
The effectiveness of technology road traffic is measurable and would result in a series:
- Technical and technological improvements - greater security - important environmental improvements
- The possible merger of specialized companies - joint information center for optimal business
- the acquisition of joint income, depending on the share
- A better level of development of socio-economic affairs

5. Prospective the partners and their interests
MMPI CRO Competent ministry, City of Split, County of Split-Dalmatia, Split Airport, IT companies, ITS,Promet-urban transport company,planners and stakeholders that will benefit from the project (sports associations, schools, colleges citizens).

6. Expected results and benefits
In the item 4. indicated some of the effects on the realization of the project, the current value of the constructed object 80% built (97% unused, time and space). From these two proportions, it is evident that all direct and indirect benefits can bring repurpose reconstruction of this building.

7. Costs and forms of financing
The approximate cost of the project depends on the standard and purpose,but for redevelopment in road transport with side exits and connectors, amount would be 5-7 million euros. Sources of financing PPP, EU stocks.

8. Time frames for the implementation
Time schedule is favorable, does not affect the reconstruction of the building, and by the resources available quickly can be implemented in the transport system, and depends on the dynamics of the contractor.

1.1.4 The activities and other details connected with the project HRWATT 4

Here are presented the traffic factors which are in the prepositional process not took into consideration as part of a meaningful rješenja. Linearly reduced versions Pelješac bridge is presented as a solution proposal. [11]

The following matrix application materials MMPI CRO (Competent Ministry)*.*

1. Name and brief description of the project
HRWATT – 4 Building a solid (or a combination) of the bridge PELJEŠAC L = 2.4 Km
The development proposal with the element of integrated, undisturbed, traffic-of Physical solutions for the application of road and maritime traffic to and under the bridge - building, and all as a capital importance for the city of Dubrovnik, County and Republic of Croatia.

2. Geographical area
The Republic of Croatia is the area of the project realization.

3. Activities prior to project (preliminary activities)
Preliminary activities and their level of performance is for assume very high, because they are still in the domain of state bodies. ITS (intelligent transport systems) including - smart, expertly and feasible solutions with on meaningful way. Maritime traffic, geomorphology field,

seismicity of and planned capacity, are the elements that bring in their projects (linearly reduced size no prejudice to any quality to expectations)

4. Technical and technological innovation
Technical and technological novelty consists in significantly more flexible approach to solutions, bridging and retention of existing and default values (that can be further explanation).

5. Prospective the partners and their interests
The Croatian Government, the EU, MMPI CRO Competent ministry ,the State company HC, County and City Dubrovnik. Diverse providers and users of services as well as interest groups, the possible implementation participants.

6. Expected results and benefits
Realized project brings undetectable profits, and all projections are hypothetical. Otherwise, the direct and indirect benefits are presented in the study.
What I would bring my proposal-solution, it would decrease the cost of construction.
The linear approach to reductions of unnecessary size makes of start to get 40-70%, according to a version of construction and positional permeability.

7. Costs and forms of financing
EU FUND,PPP, CRO FUND (compensatory route), even shareholders may be funding sources.
Landmark for cost, single tube, 4 km tunnel is 40-60 million euros.
Linear reduced dimensions of the bridge was laid with gaps in the first quintile of the bridge and the ship's passage of 200 m and 200 m is 75 million euros ..m + 200 m je 75 mil. EUR.

8. Time frames for the implementation
According to available sources of funds, the construction can be within 1-2 years.
Especially if you approached a combination of a solid construction and prefabricated construction parts of the object.

1.1.5 The activities and other details connected with the project HRWATT 5

The handout was forwarded to all to relevant institutions. Visually solution reduced the number of conflict point from 23 to 5, and calm traffic at a reasonable level that belongs near hospitals, schools, maternity hospital and residential buildings. [12]

The following matrix application materials MMPI CRO (Competent Ministry).

1. Name and brief description of the project
Planing and denivelation crossing street, Poljička and Iza nove bolnice, reduction methods content with permanent solution.

2. Geographical area
Area of construction is part of the city of Split, contact point of the street Iza nove bolnice and Poljička. Reconstructive of interventions is underpass L = 30 m and input-output ramps.

3. Activities prior to project (preliminary activities)
Previously made preliminary solution - expert work, and making and proposal are related to Iteligentni transport system. Zona reconstruction is within the road corridor, and the a reconstruction procedure retains the character previous use of the space. To perform on the field no major additional of legislative action.

4. Technical and technological innovation
Technical interventions in the area of integrally linking meaningful point, and enabling better technology utilization of, and **significantly greater safety** through traffic calming.

5. Prospective the partners and their interests
MMPI CRO Competent ministry, KBC Clinical Hospital Center City of Split, County of Split-Dalmatia, ITS,Promet-urban transport company, and other stakeholders of the project results users (citizens, passengers, employees, students, pupils, etc.)

6. Expected results and benefits
The expected result would be completely unobstructed traffic, substantially better utilized direction, part of the development momentum of the city and county, with the satisfaction of a series of of basic factors of network lines and technology city traffic.

7. Costs and forms of financing
Estimated cost of the project is 200,000 to 400,000 Euros.
Source of financing PPP, EU or earnings from sale by existing traffic lights systems, for part of of works required.

8. Time frames for the implementation
The implementation timetable is actually the time of construction of underpasses and signal arranging intersections (3-5 months). Crucial detail, everything can be carried out in phases, but with little interference with existing flows, but not the logic of traffic.

2. POSSIBILITY OF ADOPTION OF IMPLEMENTATION OF PROJECTS

There is so much material presented, it is difficult, virtually impossible, that the problems and solutions want to avoid. Multiplicative factor of usefulness by most measures,and component of projects is extremely large and efficient.

- Project 1 requires an intellectual effort of experts, a new implementation method, and a new deatail in the ITS the domain with have already the prepared materials.

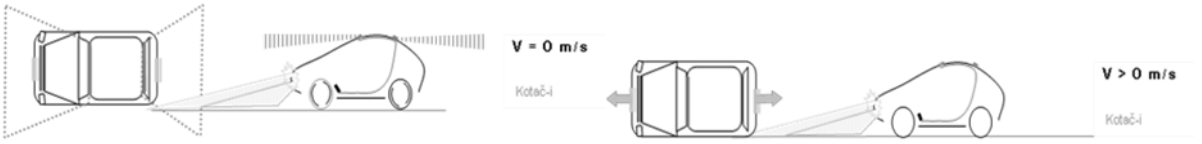

Figure 1 - Condition of vehicles in traffic

- Project 2 requires little technical spatial intervention, phase way, and within the existing of transport system, possibly,a smaller number of permits.

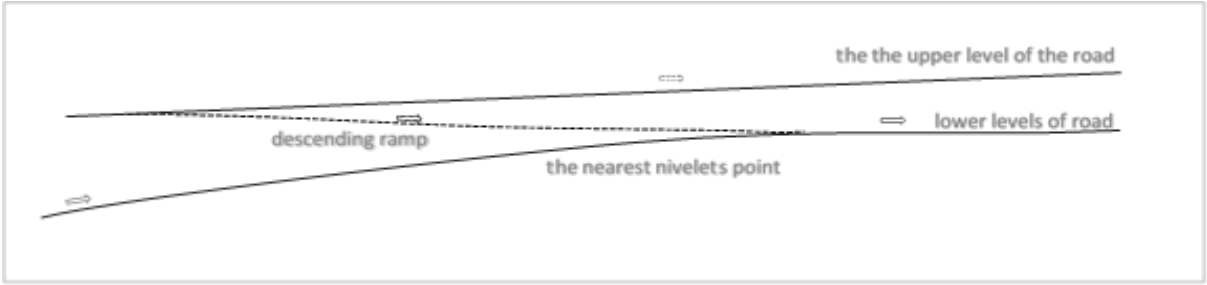

Figure 2 - Sketch west ramp the entrance to the city of Split

- Project 3 requires technical reconstruction and redevelopment within the existing transport facility, with a reduced number permits, phased approach.

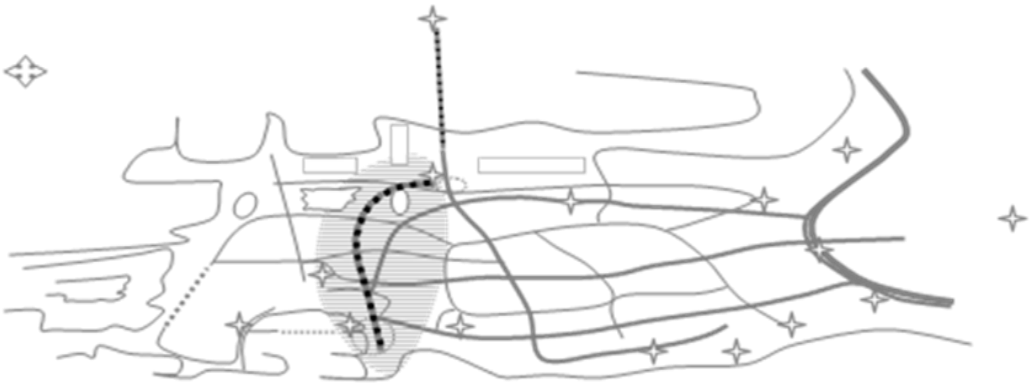

Figure 3. Sketch transverse that missing road corridor of Split with contacts

- Project 4 requires new construction, but with clearly defined elements in the transport and construction meaning where the social cost effectiveness is unquestionable.

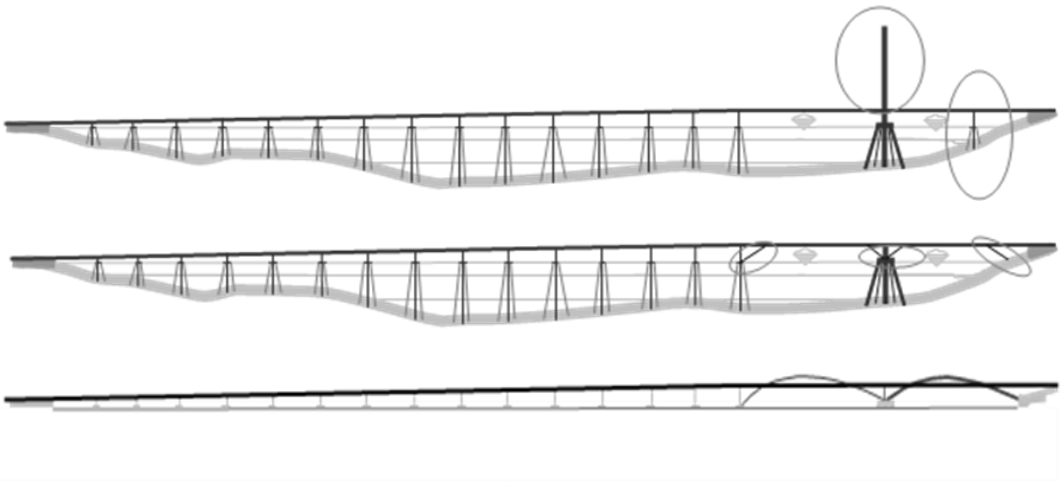

Figure 4. Showing parts the linear reduction of bridge structure with optimum claims

- Project 5 requires little technical intervention spatial construction, phase type, and within the existing transport system, with a reduced number permits.

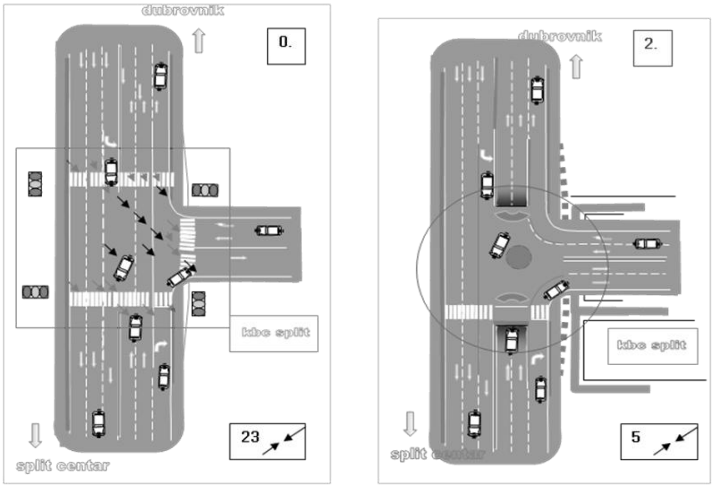

Figure 5. Planing and denivelation crossing street,Poljička and Iza nove bolnice, before (o) and after (2).

3. EXPECTEDNESS PER CONTENTS HEREOF

Fully is ungrateful to describe the expectations of the author,considering the number participants for each proposed project. It is certain that that logic, meaningfulness and willingness of aid providers, can help to understand of certain phases of the project or of projects, reflecting upon on the whole or part.

The specificity of the Project 1 indicates that equaly could be expected and the most and least, considering,that is even with initial advanced phase.

4. INSTEAD OF A CONCLUSION

The conclusion of one expert work, valid for listed projects 2-4, citation as follows;

"To ignore realities presented idea projects, which are clear and is objective, it would be harmful and completely an unreasonable. Reasonably is to elaborate project proposals, to accept realities and open possibilities, and the same apply to the presented method.

Integrate network and other forms of transport in the optimum scale the challenge is to each traffic specialist,and project profitability is unquestionable. Some projects repurpose and adaptation are imposes as a natural solution. "

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ACTIVITY OF DE-MANUFACTURING IN CROATIAN REVERSE LOGISTICS SYSTEMS

ABSTRACT

As opposite to the distribution logistics, reverse logistics is intended to favor the return of the product, involved in evaluating and redistribution of single item and its current condition, which results in higher levels of management complexity in reverse chain. In order to research the Croatian market, existing activities of reverse logistics were explored that are used in reverse logistics systems. Noted activities actually represent the basic activities of reverse logistics, which are usually integrated in all logistics systems, and are often conditioned even by laws. This paper presents an overview of reverse logistics activities, research results and proposal for implementation of additional activities in reverse logistics systems.

KEY WORDS

de-manufacturing, reverse logistics, reverse logistics activities, activities implementation

1. INTRODUCTION

Because of the specificity of reverse logistics systems for processing small quantities, in relation to the amount of the distribution or individual items, the aim is to harmonize the process which is more complex when deciding on the status of the product is done on levels where distribution and feedback processes are mixed because of secondary importance of the return product, motivation and education levels of responsible staff. In the reverse logistics systems which are characteristic for Croatia, on the entry points of the supply chain there are large quantities of products that for various reasons should not enter the system, such as the return of large quantities of seasonal inventories of the supply chain, untimely routing in reverse logistics channels, non implemented reverse logistics activities, return of goods in wrong system, return of the goods whose refund is prohibited by contracts, return of non defective - defective product[1], return of the products with incomplete documentation, return just before expiry date etc.

Due to the unorganized flows and channels of reverse logistics and inadequately trained staff, insufficient number of implemented reverse logistics activities, return of products increases the number of transport and handling processes, company costs, reduces

[1] Products wrongly considered defective

the possibility of re-use of the product or its parts, and affects the quality of the product due to the prolonged disposition cycling time. [1-5]

2. GREENING THE SUPPLY CHAIN

The concept of green logistics through the last decade has been researched very rapidly, evidenced by numerous scientific articles, introductions of company's environmentally friendly businesses and the concern of users for the process conduction within the supply chains.

2.1 GREEN SUPPLY CHAINS

The development of green logistics concept continuously evolves primarly because of the supply chains complexity. In the last 40 years logistics has developed as an academic discipline, expanding its primary focus from the basic functions of the transport for the finished products distribution, to whole transport, storage and manipulation systems within the company, and the overall of supply chains management. With time, field of green logistics has spread to all processes and operations within the companies. Also the development of the scope was affected by the latest trends in environmental awareness, new legislation and the development of national and international standards, etc. [2]

Green logistics, from the the term related to the impact of transport on the environment, through 50 years of research, today combines several areas:

- reducing the impact of transport on the environment,
- city logistics,
- reverse logistics,
- logistics in corporate environmental issues,
- green supply chain management

Green logistics is defined as:

The concept that includes strategies to reduce the impact of environmental pollution of the supply chain, and to reduce the energy trace of freight transportation. Green logistics includes areas related to material handling, waste management, packaging and transportation [1].

2.2 REVERSE LOGISTICS

Different authors primarly state the uncertainty and variability as the basic characteristics of the reverse logistics systems. These characteristics cause the impossibility of planning quantity and time period in which the return of the product will be performed. Although the distribution logistics is complex due to the amount of products that are in the shortest possible time distributed on global market to end users, in the return system complexity is reflected in the processing the individual product, returned for various reasons. However two different flows are linked, as evidenced by the fact that during certain periods and certain seasonal promotions, trade shows, ie. at the increased sales,greater amounts of product also manifest in the reverse logistics systems, which proves that for the improvement of the system it is necessary to informationaly connect these two flows.

The next characteristics of return flows refers to product packaging in the return that is usually damaged or isn't there. Damaged packaging results in a more complex transportation, storage and manipulation processing. At the gatekeeping point, damaged

packaging may be the cause of the lack of data and necessary information related to the product.

Determining the prices of the products in return requires knowledge of the potential market and any potential products that can enter the return chain, also in determining the new prices, each product must be approached individually.

In addition, return systems are characterized by a non-uniformity, the lack of legal regulations, and lack of transparency. Non-uniformed processing usually results in product obsolescence and increased transport costs [2][6].

3. REVERSE LOGISTIC ACTIVITIES

According to authors Rogers and Tibben Lembke Typical reverse logistics activities would be the processes a company uses to collect used, damaged, unwanted (stock balancing returns), or outdated products, as well as packaging and shipping materials from the end-user or the reseller.

Selection of basic activities in reverse logistics systems is different for packaging and for products in return. While the products consist of different components and have a tendency to rapidly lose value and include more complex production, etc., organizing reverse logistivs processing for packaging in return, requires less complexity because of the uniformity which is related to the materials of which it consists and the uniformed look. The number of conducted activities directly affects the amounts directed to landfills that are overloaded. In the EU countries that have developed waste management systems, the implementation of certain activities reduces waste directed to landfills to 40 % , while landfills in Croatia contain 87 % undifferentiated mixed waste from the total amount of waste [7].

Proper selection of activities to be implemented depends on the type of products that company disposes and a strategy that is set as the primary objective of the company. Companies that are strategically focused on customer satisfaction, profit or monitoring the legal regulations will adapt the activities for products in return and the organization of return system itself to its strategic goal. Any combination of reverse logistics activities should result in one or, within the company at the highest level of the reverse logistics organization, with all three set business targets. Below are listed and described the activities of reverse logistics.

Collection - first and mandatory activity of reverse logistics is a process associated with the collection of used, damaged or unwanted products or packaging. In addition beside collection this activity includes packaging and transport of goods from the end user or the supply chain level that initiates a return. Way of collecting usually depends on the type of product and the material from which it is made. It also depends on each entity in the supply chain and existing business contracts.

Gatekeeping is an activity which is carried out during the return of the product, and by which is made a decision on the possibility of product's entering to the system. During return, at the entry point, in addition to the authorization of the product, the relevant information about a particular return are collected. Companies that only introduces reverse logistics systems, usually require general information about the reasons of the return, place of purchase and method of payment when product is entering the system, while business entities who want statistical data, in order to improve the return in the point of entry into the system, require more detailed information on the reasons for return, product usage, type of product, detailed information about the user, service satisfaction, the possibility of introduction of the call center, etc.

Selection/Sortation - upon delivery of return on each level of the supply chain, there is a process that takes place at a predetermined location. After checking the documentation, status of approved return, based on the established quality and condition of the product selection and sorting of the product or packaging is performed. Products sortation represents one of the most complex activities in logistics systems.

Recondition is a process in which worn or disfunctional components of the product or packaging are replaced with new ones in order to re-use. This activity does not include the manufacturing process.

Refurbish is a process in which the products or packaging are sent back to its original state by conducting activities such as cleaning, polishing, painting, etc. In this process structural components remain unchanged.

Re-process is a manufacturing process repeated solely because of failure of the original process.

Remanufacture is a manufacturing process created for the purpose of creating products composed of new and used components.

Reuse is an activity that assumes the use of the returned entity (packaging of finished products) with little or no modifications .

Recovery by the European Agency for the Environment is defined as the operation of waste management which by certain activities of reverse logistics reduces the amount of waste directed to landfills with the aim of obtaining raw materials and energy, and for the purpose of economic and/or environmental benefits.[2] It is important to emphasize that the recovery and recycling are not the same terms, and that a recovery is a broader concept of recycling. Recycling is a process that involves the processing of waste materials in order to obtain raw materials for reuse in the production process with the aim of reducing the amount of waste directed to landfills.[3]

Disposal is the last activity of reverse logistics, which is tried to be avoid as much as possible. Waste disposal is an organized activity of permanent disposal of waste in landfills [2][3].

4. RESEARCHING THE CROATIAN MARKET

Performed studies of the Croatian market included 19 different companies of the Croatian logistics market, i.e. retail chains of a major share on the market, suppliers, producers and distributers.

Activities recorded whithin market, actually represent the basic activities of reverse logistics, which are usually integrated in all logistics systems, and are often conditioned even by laws. At all levels of the supply chain the activity of collecting is recorded, except in one retail chain in which it is completely forbidden to return products of certain commodity categories, and end users must contact the suppliers themselves. Selection and sorting have been recorded in most subjects of the supply chain, and represent an activity, which because of inconsistencies, significantly prolongs the time of disposition. The mentioned activity of sortation is because of disorganization repeated up to five times for the same goods in the return while returning through the levels of the supply chain. When returning, any entity within the chain verifies products identity, documentation, reason(s) for the return, the

[2] http://scp.eionet.europa.eu/definitions/recovery (06.07.2013.)

[3] Sander, K., Jepsen, D., Schilling, S., Tebert, C.: Definition of waste recovery and disposal operations, Institute for Environmental Strategies, 2004., pp. 37.

potential channels for routing, temporarily storages it, and awards a substantial work , which continuously increases the cost of return. Also, due to the above, the return of goods with prolonged time of disposition, directly affects products which lose value.

Repair activity was also recorded as an activity designed for products in return, and refers to services where different levels of the supply chain enable routing of return. All retailers, suppliers and distributors in some way collaborate with service centers, where after a preliminary examination, by inadequately trained staff direct return for repair. Also research studies found that some retailers do not cooperate with service centers, and the main characteristic is that when the end user tries to perform a refund, they will channel them to iniciate return at the location of the service.

Reprocessing activitie was not recorded, while the re-production was recorded in the production of technical goods. If a mistake in the work unit was noticed, production with replaced certain parts will be repeated. It is important to note that the stated was recorded inside the facility, but not after performed return in any form. Repair activity is intended for stated goods.

Activitiy of re-use was recorded very rarely, only in the form of promotions in the retail centers, as well as within suppliers and distributors. Within retail centers certain promotions are organized on an annual basis eg. when to buy a new bike it is possible to return the old one and to get a discount for new one. Old bicycles are donated or disposed, depending on their condition. While it would be possible for such products to allocate them and channel to the secondary market, the certain activities should be assured, what is not recorded in these cases. Also, suppliers and distributors, after a return of certain damaged goods, in accordance with the manufacturer agreement, sell the goods within the company, to their employees at a symbolic price, for the purpose of not generating additional costs upon return.

Activities of recovery and disposal are the most often recorded activities of reverse logistics and are used at all levels of the supply chain. Although there are channels where the goods in the return can be directed, if it is damaged or its date has expired, it will usually be properly disposed by sending the products destruction. Although the proper disposal activity is environmentally friendly, it can cause significant costs within the company. Also in several cases was observed that larger quantities of goods directly before expiration date are stored, where stored wait for the expiration date to be sent on destruction. The research results with individual shares of used activities are shown in Table 1.

Table 1 - Noted activities of reverse logistics on the Croatian market

Reverse logistics activity	Implemented activities [%]
Collection	96%
Selection/Sortation	85%
Recondition	61%
Refurbish	2%
Re-process	0%
Remanufacture	2%
Reuse	12%
Recovery	95%
Disposal	100%

5. CONCLUSION

Exploring the issues of reverse logistics in developed logistics systems is carried out for about twenty years, and is still considered an area that is essential to research, to optimize the entire supply chain. Characteristics of return systems of different logistics market, in its basic structure are not significantly different, while the problems and ways in which the return flows are substantially different, should be observed at the individual level.

As in most logistics systems, return flow is considered as flow of secondary importance. In addition to the recommendation of to implement reverse logistics activities strategically and in accodance to the needs in all the systems, there is a recomendation to implementation of activities that are not recorded on the market, such as de – manufacturing. De – manufacturing is activity related to the concept where returned product, especially if it belongs to the group of electrical and electronic devices, and high quality make, is disassembled into components. Complete components are sold in particular markets, and thus the product can reach a maximum value, greater than providing logical activity of repair that would result in focusing on direction of repaired products on the secondary market (the process in which worn or disfunctional components of the product or packaging are replaced with new ones for the benefit of re-using).

The lack of activity of de-manufacturing is the fact that for the disassembed components, knowledge of their current value on the market is necessary and detailed knowledge of market possibilities where components can be sold. Continuous knowledge of the potentional markets and the values of the components can develop and provide external service providers, especially in form of return centers.

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REDEFINING THE ROLE OF FREIGHT FORWARDERS IN FOREIGN TRADE UPON CROATIAN ACCESSION TO THE EUROPEAN UNION

ABSTRACT

The most of the freight forwarders in Croatia have based their business activities on customs brokerage, which was a succesfull business model up to the accession to the EU. Removal of the customs borders against the EU countries and simplification of the customs procedures had cut down a major part of their incomes. However, integration into the single European market yields some new business opportunities which could compensate the loss of incomes out of customs brokerage. Freight forwarders in Croatia could take advantage of those opportunities by upgrading their competences and expertise towards 4PL segment. It could be successfully facilitated by a closer cooperation with educational institutions in the field of traffic and transport engineering.

KEY WORDS

freight forwarders, redefining, 4PL, accession to the EU.

1. INTRODUCTION

Although the main role of freight forwarding refers to transport management, the most of the freight forwarders in Croatia (foreign companies as well) have based their business activities on customs brokerage. There have been several reasons for that, such as:

- No special infrastructure, nor expensive equipment needed (standard offices only), while the service fees have been high enough to enable high level of profitability;
- Suitable labour force have been highly available at low cost (target profile: secondary school degree in transport or economics, preferably with knowledge of a foreign language);
- Specific skills and competences required can be adopted through internal training, specialized courses and work experience.

It has been a succesfull business model for decades prior to the accession to the European Union. Since Croatia has become the member country, significant changes have been introduced for Croatian logistics industry. Changes in customs procedures related to NCTS (New Computerised Transit System), Intrastat, AIS (Automated Import System), ECS (Export Control System), with different transport procedures have changed the position of freight forwarders. In order to stay on the market, the need reorganize and define new

business strategies. Users of logistics services expect faster, safer and less expensive transport due to elimination of customs procedures at border crossings between EU countries.

Business expansion on the single European market, with respective increase in the volume of trade flows, provides new opportunities for planning, development and implementation of intermodal transport, which is a standard in developed economies [1], as well as setting up modern customs terminals and cross docking centers at suitable points of transport routes.

In addition to expertise in transport management, freight forwarders should further develop a specific logistic know-how to be put on the market as their final product, in orther to compensate the loss of incomes out of customs brokerage. In other words, they should shift back to their main role of transport managers, complementary with logistic consulting, which corresponds to the definition of a 4PL (Fourth Party Logistics provider).

A common theory about the arrival of "foreign players" to the market of Croatian logistics services have no right signification, since global freight forwarder have been present in Croatia for many years and have acquired positions in the market. The a.m. development of modern customs terminals and cross docking centers would enable freight forwarders to participate in optimizing of international transport, in order to meet the constant demand for reducing transport costs.

2. IMPACT OF EUROPEAN INTEGRATIONS TO THE MARKET POSITION OF THE FREIGHT FORWARDERS IN CROATIA

According to the data provided by the Croatian Chamber of Commerce, there were 492 companies registered for freight forwarding in Croatia, with total of 3,58 billion kn turnover in 2012. Most of them are small companies (481) whose business activities are based on customs brokerage. It is still too early for a comprehensive analysis of the effects to the Croatian freight forwarding industry, since Croatia has joined the EU less than a year ago. Therefore, as there hasn't been sufficient statistical data available jet, some preliminary assessments could be based on the available data from the period up to the end of the year 2013. and relevant experience from the neighboring countries, Slovenia at the first place.

In this respect, the most important aspects of European integrations affecting the freight forwarding industry in Croatia could be identified as follows:

- Customs borders with neighboring EU countries have been eliminated, while Croatian border against Serbia, BiH and Monte Negro has become a part of the customs border of the EU;
- Port of Rijeka has become an EU port, i.e. an entry point to the European market;
- Croatia has become a convenient transshipment station for European distribution networks in supplying markets of former Yugoslavian countries.
- Geographical position of Croatia has major importance not only for transit corridors towards the Central European Countries, but also to Baltic (Route 65) and to the rest of former Yugoslavian countries.

In order to analyse the new situation on the market and outline possible solutions, the authors have carried out a short term inquiry among relevant freight forwarders and at the two major cargo (customs) terminals in Croatia. The information gathered refers to the traffic in the period from the beginning of July up to the end of the year 2013. Based on the a.m. analysis, the main impacts to the Croatian freight forwarding industry could be summarized as outlined in the following paragraphs.

2.1 CUSTOMS BROKERAGE

Freight forwarders closed their offices at border crossings on Slovenian and Hungaryan border as they were neede no more. Total number of customs declarations related to import and export hasn't been significantly decreased in July due to the transport & customs procedures started before 1st of July which therefore needed to be closed according to the old regulations.

It caused traffic jam at the borders against third countries and at the customs terminals, as most of the freight forwarders had already cut down the staff or closed some of their offices. Also the new customs software needed some time to adopt. The situation was normalized by the end of July. Significant decrease of the number of customs declarations has been registered at the end of July and continued to drop down in August. It is expected at least 60% less customs declaration than in the same period of 2012. which corresponds with the fact that more than 60% of Croatian foreign trade refers to the EU countries [2].

2.2 WAREHOUSING & LOCAL DELIVERY/COLLECTION

For similar reasons as with the customs operations, customs warehouses have remained busy in the first part of July, but with negative trend started in August. Operations in non bonded warehouses and local delivery/collection operations have remained at the same level. Exception is increase of logistic operations related to e-commerce (online shopping) and courier service.

Although these logistic operations are not primary performed by the freight forwarders, they generate a demand for such services on behalf of their clients, so it s a significant segment of business activities in the freight forwarding industry.

2.3 TRANSPORT MANAGEMENT

Although the major share of the freight forwarders incomes were generated out of customs brokerage, transport management have remained an important segment of bussines activities at companies which have had a long term structured strategy.

There hasn't been any significant impact to the volumes of international cargo transport within the aforementioned period. However, freight rates in road transport, which is the dominant mode of transport in Croatia (Cf. Figure 1.) have been decreased. There has been some increase in the number of shipments in courier and parcel express service.

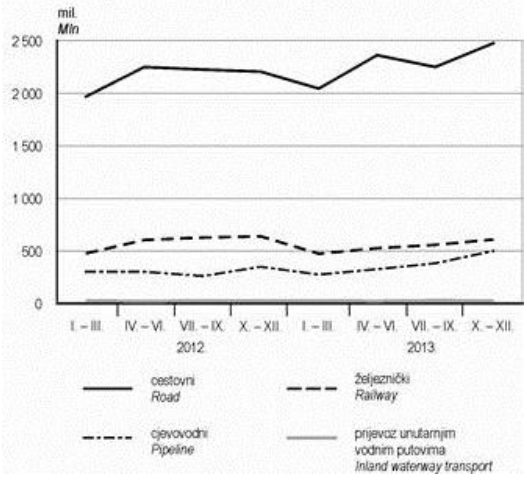

Figure 1 - Tkm performed in inland transport 2012. and 2013.
Source: Croatian Bureau of Statistics, First release, No. 5.1.1/4

3. MARKET PERSPECTIVES FOR FREIGHT FORWARDERS IN CROATIA

The most visible negative impact of accession to the EU refers to decrease of incomes based on customs brokerage. It is expected more than 2.000 employees at freight forwarding companies to lose their jobs for that reason [3]. Next thing is decrease of the road freight rates which has been welcomed by the clients, but puts additional burden to the carriers and freight forwarders.

However, accession to the EU yields new development perspectives for Croatian freight forwarders, as explained in the following paragraphs.

3.1 INTRASTAT REPORTING

Intrastat reporting was expected to partly compensate the loss of incomes generated out of customs brokerage, but such expectations appeared to be groundless. Many companies haven't been included in the Intrastat system due to relatively high threshold value (1,7 million kn total value of trade with EU countries per year), while the service fees for Intrastat reporting were much lower than fees for customs brokerage. The Intrastat threshold value was determined based on the simulation data shown in the Table 1.

Table 1. Simulation of the Intrastat coverage based on data from 2012.

	Total	Export	Import
Companies involved in foreign trade with EU	22.788	6.945	20.991
Companies included in Intrastat system	4.289	1.240	3.779
Percentage share in total number of companies	18,8%	17,9%	18,0%
Percentage share in total value of the trade		97,0%	95,0%

Source: Prepared by the autors against the data provided by Croatian Bureau of Statistics

The threshold value has been decreased to 1,2 million kn for the period of 2014. which will include more companies, but it is still insignificant comparing to the loss of incomes out of customs brokerage.

3.2 TRANSIT TRAFFIC & CUSTOMS BROKERAGE

By integration into the single EU market, the Port of Rijeka becomes an EU port and the logistics infrastructure in Croatia is gaining importance. Also the market positions previously acquired by global freight forwarders will be strengthened up, which will result in further attracting of transit cargo flows. Hence, the need for further development of the Corridor Vb occurs, as well as setting up a modern logistics center & customs terminal in continental Croatia, who could also act as a background terminal of the Port of Rijeka.

Department of Transport Logistics at the Faculty of Transport and Traffic Sciences, University of Zagreb, carrie out a research focused on feasibility of setting up a modern logistics and distribution center (LDC) in continental Croatia (within so called the Zagreb ring) which could also be the background terminal of the port of Rijeka. Trade flows of such LDC are related to the Paneuropean Corridor V, and its branch Vb (Botovo-Rijeka). Prospectively, the commodity flows within the gravity zone of that LDC would be bound also for the Route 65. Development of Routes 65 aims to establish a green transport corridor from the Swedish region of Skane across Poland, Czech, Slovakia, and Hungary to the port of Rijeka, as the shortest route between Baltic and Adriatic. Forecasts of the European Commission indicate that container traffic via the port of Rijeka is expected to increase significantly in the period of the next ten years. It should enable development of new logistics solutions for improving

distribution of goods to end users and to generate additional revenues for Croatian freight forwarders.

Since Croatia holds the part of EU border on its territory, customs operations in transit (NCTS) over Croatia are to be done at Croatian part of EU border. Also the import/export customs clearance for EU countries can be done in Croatia. Major routes of international road transport across Croatia are outlined on the Figure 2.

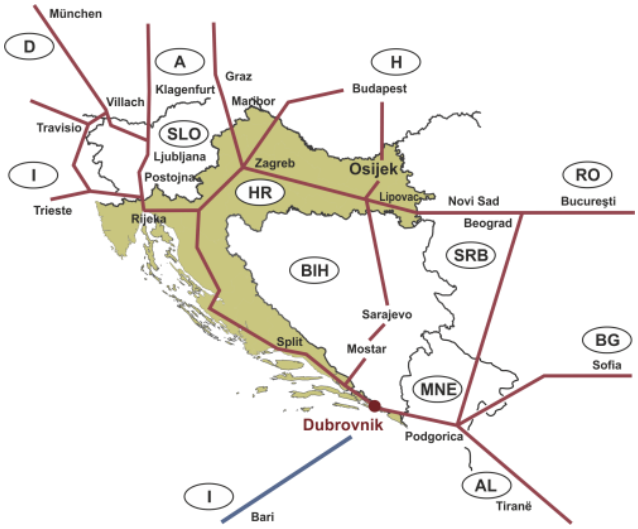

Figure 2 - Major routes of international road transport
Source: Adopted by the authors

It is up to the freight forwarders in Croatia to acquire that traffic, however the opportunities greatly depend on the effectivity of the Croatian customs, which is expected to speed up the procedures and on the quality of available infrastructure.

3.3 PROVIDING 4PL SERVICES

Fourth-party logistics provider, abbreviated 4PL, lead logistics provider, or 4th Party Logistics provider, are consulting firms offering logistics consulting, transportation and supply chain management services. A 4PL is an independent, singularly accountable, non asset based integrator who assembles the resources, capabilities and technology of its own organisation and other organisations, incuding 3PLs and 2PLs, to design, build and run comprehensive supply chain solutions for clients.They are different from the lower three levels: 3PL, 2 PL that are actual operators/carriers, and 1PL that are final users (clients) [4].

A 4PL is neutral and will manage the logistics process, regardless of which subcontractors are involved, including those already used by the client. They can structure the relationship and the process in a way that best meets the requirements of the client, rather than the client having to accept what the outsourcing provider has to offer. It is than an outcome-based result, not just a pure cost reduction issue. Managing this vital part of the supply chain can be frustrating and time consuming. Vendors shipping dates, expediting and changing orders, giving direction to consolidators or 3PLs as to delivery requirement are just some of the challenges dealt with. It is an excellent opportunity for 4PLs to meet.

By upgrading their transport management, customs brokerage and Intastat expertise with 4PL competences, freight forwarders could gain a new market segment that is emerging in Croatia upon accession to the EU. It would require further investing in professional education and training of staff, which could be succesfuly facilitated by a closer cooperation with educational institutions in the field of traffic and transport engineering.

4. CONCLUSION

Although the main role of freight forwarding refers to transport management, the most of the freight forwarders in Croatia have based their business activities on customs brokerage, which was a succesfull business model up to the accession to the EU. Removal of the customs borders against the EU countries and simplification of the customs procedures had cut down a major part of freight forwarders' incomes.

However, integration into the single European market yields some new business opportunities which could compensate the loss of incomes out of customs brokerage. These opportunities mainly refer to the providing 4PL services, an emerging segment of the integrated European market. Beside that, there is a possibility of handling customs operations with the goods arriving from third countries to the European market.

It is up to the freight forwarders in Croatia to acquire that traffic and to take advantage of the new business opportunities. Upgrading their competences and expertise towards 4PL segment would require freight forwarders to make aditiona efforts in professional education and training of staff. A closer cooperation with educational institutions in the field of traffic and transport engineering could succesfuly facilitate such efforts, in order to improve their market position.

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SAFETY ANALYSIS AT LEVEL CROSSINGS

ABSTRACT

From the aspect of safety the level railway-road crossings represent one of the most critical points on the railway network. This is confirmed by the fact that they are often places where traffic incidents and accidents frequently occur, with consequences in human victims and great material damages. These facts represent an actual problem of traffic safety in every country and in the Republic of Croatia as well. According to statistics, the drivers of road vehicles are most often the cause for such emergencies, indicating their extremely low level of complying with the traffic regulations. This is also confirmed by the data on a large number of accidents or avoided accidents at crossings with the highest level of protection. The paper analyses the problems of railway-road crossings, safety condition and all the relevant statistical data about the causes and consequences of emergencies, both at the level of the Republic of Croatia, and at the level of the entire Europe.

KEY WORDS

safety, level crossings, emergencies

1. INTRODUCTION

Level crossings are places where roads cross railway lines or industrial tracks, i.e. from the aspect of construction, a place of crossing of the carriageway and the running surface of the rail [1]. Consequently, level crossing represents a place of direct conflict of the railway and road traffic and from the aspect of safety represents a potential point of high risk. The statistical data indicate frequent emergencies occurring at level crossings resulting in material damage and human victims. Although the prevailing perception is that every accident that occurs at a level crossing is as a rule a problem of the railway traffic sector, the analyses and statistics of emergencies suggest the contrary. Emergencies at level crossings that result in fatalities account on the average for 30% of all accidents in railway traffic and only about 1% of fatalities in road transport [2]. However, the analyses of the causes of emergencies indicate the fact that more than 90% of accidents have been caused by unconscientious road participants who did not comply with the traffic rules. Also, in spite of new technologies and technical improvements of the method of securing the level crossings, there is a significant number of emergencies at the level crossings with the highest degree of security [2]. Therefore, the measures of preventing emergencies have been oriented to a number of systemic activities that include the technical and technological improvements of the protection systems at level

crossings, national safety programs, and educational programs of all the participants in traffic with the aim of raising the level of their traffic discipline and culture [3].

Since level crossings are places of higher emergency risk, they have to be properly protected so as to provide safe traffic flow. On the railway network in the Republic of Croatia all the level crossings are protected so as to provide safety stipulated by legal regulations to all the traffic participants, which depends on the category of the line and category of the road intersecting with the railway line.

The basic classification of protecting the level crossings understands passive and active protection.

Level crossings with passive protection are all those crossings that are equipped with any sign of warning, devices or any other protection equipment that is constant and that does not change depending on any traffic situation [4]. In case of passive protection the road vehicle motorist is alone responsible for observing the railway line and the possible approach of the train. In the Republic of Croatia passive protection is considered to be the use of road traffic signs and triangle of visibility. The most frequently used traffic sign to mark a level crossing for the road vehicle motorists is the St. Andrew's cross together with the sign "Stop".

Active protection of the level crossings is considered to be any type of protection which responds by changing its state (light-signal or protection) in case of train arrival. Active methods of level crossing protection are classified into systems that have manual change of state and those systems that have automatic control of state change (remote from the central signal box of systems that are enabled / disabled by the train passage) [1].

The safest method of solving the problem of emergencies at level crossings is full separation of the railway line from the road traffic by constructing over- or underpasses. However, high financial costs, and often also the lack of technological justifiability of such projects lead to the conclusion that it is of extreme importance to develop simultaneously new and improved systems of level crossing protection together with the continuation of systemic education of all traffic participants.

2. EMERGENCIES IN RAILWAY TRAFFIC

Emergency in railway traffic is an undesired, unintentional or unexpected event or sequence of such events, which result in any kind of damage, regardless of the extent of damage [5]. Emergencies are classified into four basic categories presented in Figure 1.

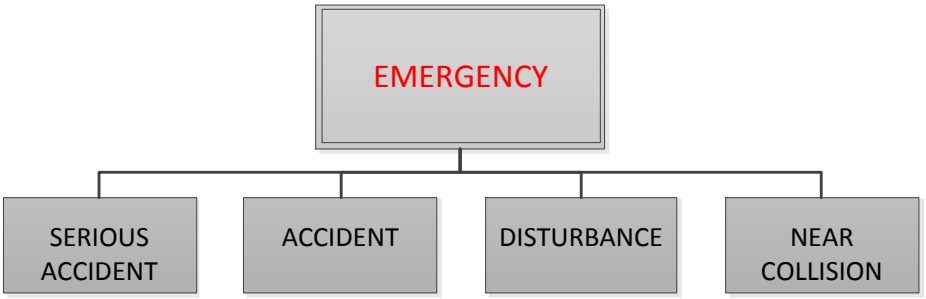


Figure 1 – Classification of emergencies [5]

Serious accident is an emergency which results in death of at least one person, and/or serious body injuries to five or more persons, and/or greater damage that may be immediately estimated at more than 5,000,000 kuna.

Accident is an emergency with harmful consequences such as serious body injury of up to four persons, and/or damage which can be immediately estimated at up to 5,000,000 kuna.

Disturbance is any event related to railway traffic which affects safe traffic flow, apart from serious accidents and accidents.

Near collision is an emergency which could have resulted in serious body injury of at least one person and/or damage.

The causes of emergencies may be personal failures of workers and employees, infrastructure managers, carriers, and road vehicle motorists (in case of emergencies at level crossings). Also, the causes may be breakdowns on the railway line, infrastructure plants, railway vehicles, natural disasters, and reckless or malicious action of the transport users and/or the third parties.

3. ANALYSIS OF SECURITY STATE AT LEVEL CROSSINGS IN THE REPUBLIC OF CROATIA

The total length of the lines on the railway network of the Republic of Croatia is 2,772 km, out of which 2,468 km are single track railway lines, and 254 km are double track railway lines. Electrified are 980 km of railway line network, out of which 977 km by system 25 kV/50 Hz A.C. and 3 km by system 3 kV D.C. (Šapjane – SB) [6].

On the railway network in Croatia there are no unprotected level crossings and out of the total of 1,454 crossings (Table 1) 63.5% are equipped with passive, and 36.5% with active protection [7].

Table 1 – Number and type of level crossing protection in the Republic of Croatia in 2012

LCs protected by traffic signs and triangle of visibility	Pedestrian crossings protected by pedestrian gates and triangle of visibility	LCs protected by automatic or mechanical devices			TOTAL
		Mechanical barriers with manual mechanism	Light-sound signals and half-barriers	Light-sound signals	
923	**60**	**65**	**318**	**148**	**1.514**

Source: [7]

In 2012 there was a total of 45 emergencies at level crossings, including eight serious accidents and thirty-seven accidents (Figure 2). There was a total of eight killed persons, which is still by 45.7% fewer killed than in the previous year (Tables 2 and 3). A cause to worry is that as many as seven emergencies occurred at level crossings protected by automatic devices with light-acoustic signalization and half-barriers, which resulted in two fatalities.

At level crossings protected by light and acoustic signalization there were 13 accidents with one killed person, whereas in 25 accidents that occurred at level crossings marked by road traffic signs “Stop” and “St. Andrew’s Cross” there was a total of five fatalities [7].

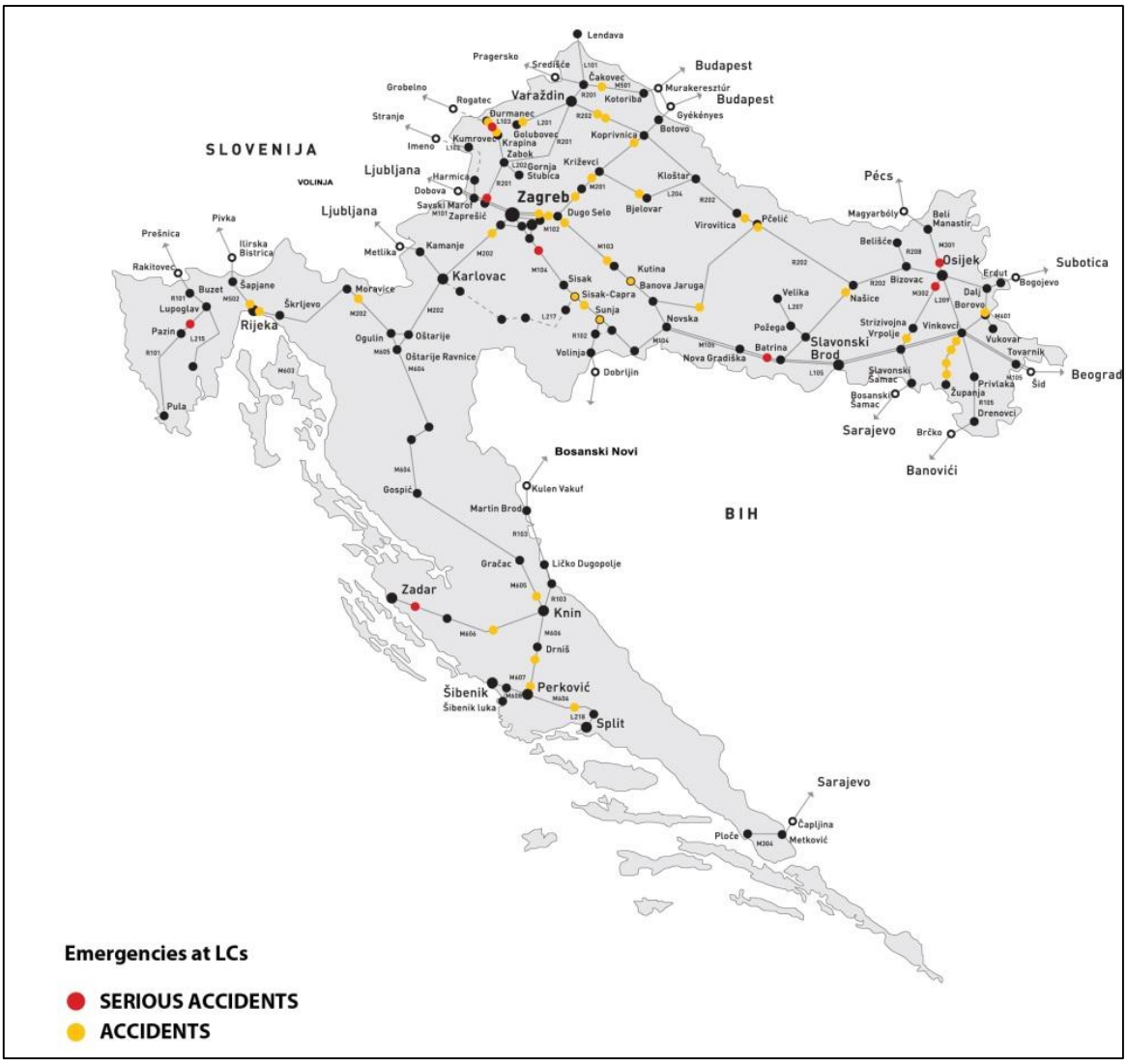


Figure 2 – Locations of emergencies at level crossings in the Republic of Croatia [7]

Table 2 – Type and number of emergencies at level crossings in the Republic of Croatia

SERIOUS ACCIDENTS	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Active protection	4	2	8	1	8	3
Passive protection	5	4	5	4	4	5
Pedestrian crossings	0	1	0	0	1	0
TOTAL SERIOUS ACCIDENTS	**9**	**7**	**13**	**5**	**13**	**8**
ACCIDENTS	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Active protection	15	13	17	11	14	18
Passive protection	48	19	40	25	20	19
Pedestrian crossings	0	0	0	0	0	0
TOTAL SERIOUS ACCIDENTS	**63**	**32**	**57**	**36**	**34**	**37**

Source: [7]

Table 3 – Consequences of emergencies at level crossings in the Republic of Croatia

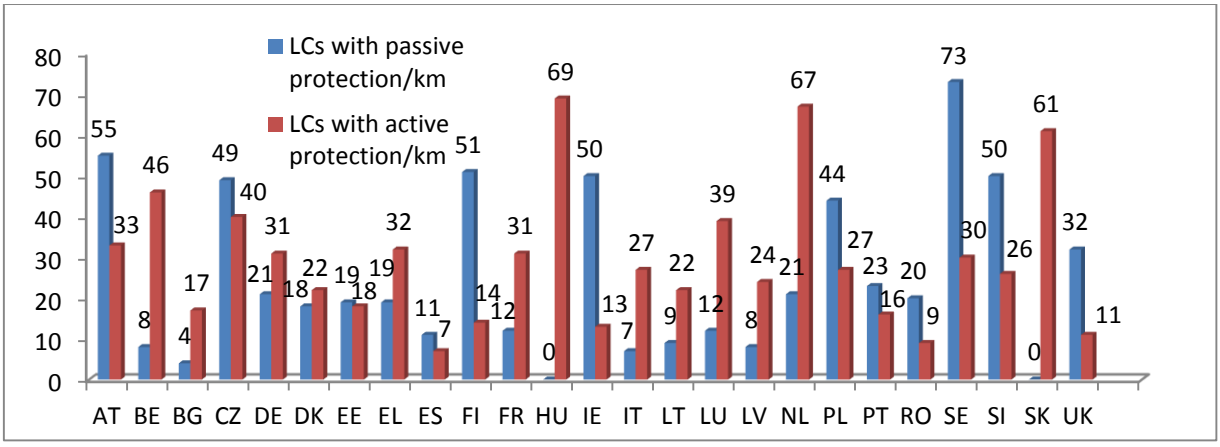
KILLED	2007	2008	2009	2010	2011	2012
Active protection	7	2	9	1	10	3
Passive protection	5	6	6	6	4	5
Pedestrian crossings	0	1	0	0	1	0
TOTAL SERIOUS ACCIDENTS	**12**	**9**	**15**	**7**	**15**	**8**
SERIOUSLY INJURED	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Active protection	1	4	6	5	4	9
Passive protection	11	11	11	5	4	6
Pedestrian crossings	0	0	0	0	0	0
TOTAL SERIOUS ACCIDENTS	**12**	**15**	**17**	**10**	**8**	**15**

Source: [7]

On the average one third of all fatalities related to railway traffic occurs at level crossings, and since the road traffic participants are usually victims of emergencies, the number of fatalities at level crossings is very small from the aspect of the total number of fatalities in road traffic. Thus, in the Republic of Croatia in 2012 there were about 37,000 traffic accidents with 390 fatalities. Only a small number of these accidents, 0.12% represent accidents at level crossings in which 2% were killed out of all the fatalities on the roads [7].

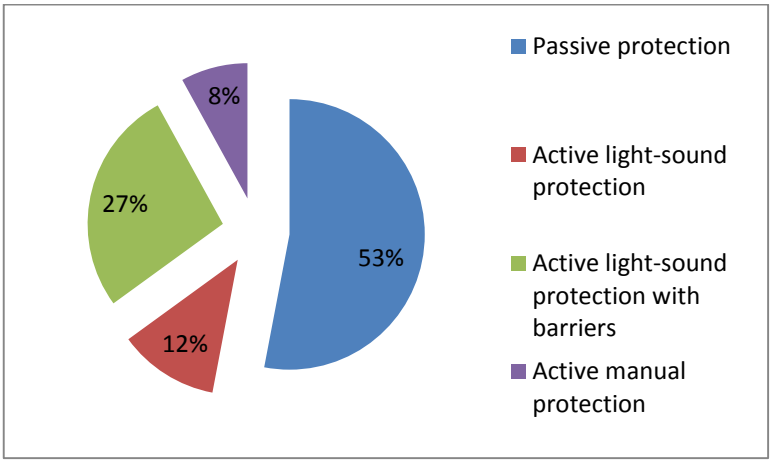
4. ANALYSIS OF SAFETY SITUATION AT LEVEL CROSSINGS IN EUROPE

Currently, there are 114,120 level crossings in the European Union area covering a total of 218,104 kilometres of railway lines [8]. On the average this means five crossings per every 10 kilometres of railway lines in the European Union, where Sweden, Austria, the Czech Republic and the Netherlands have the highest density of crossings compared to the length of the railway lines. The Netherlands has the highest relation of automatically protected crossings to all the other crossings, whereas Spain has the lowest average ratio and amounts to one crossing per every five kilometres of railway line (Graph 1).



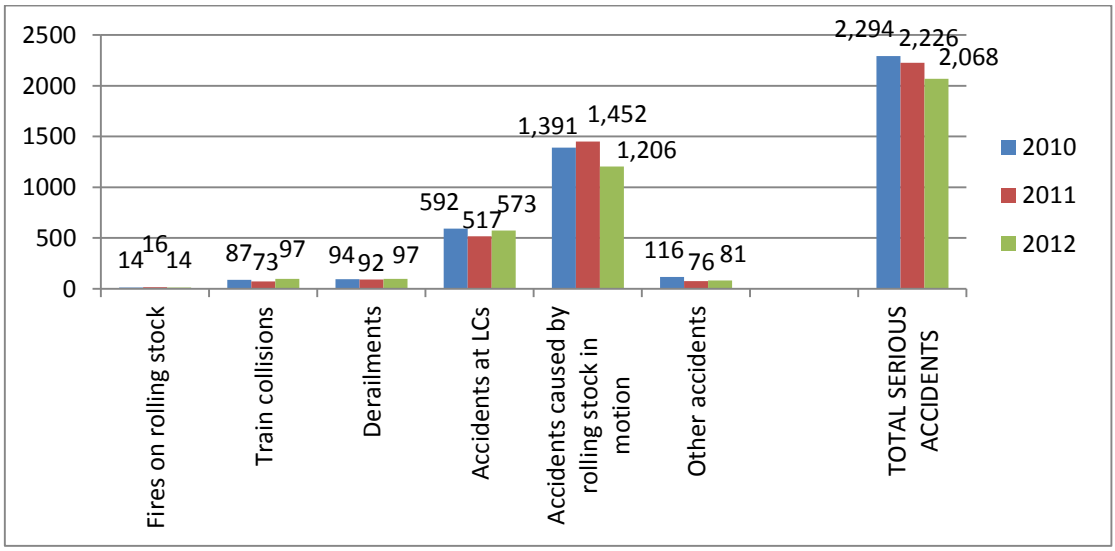
Graph 1 – Density of level crossings in the European Union
Source: [9]

At a little more than a half of all the crossings in the European Union passive protection is used (53%), usually only with St. Andrew's cross, whereas the remaining 47% of level crossings are equipped with active protection. Out of the total of all actively protected level crossings (Graph 2), 25.5% are protected by light-sound signalisation, 57.5% with light-sound signalisation with the use of barriers or half-barriers and 17% with manual mechanism [9].



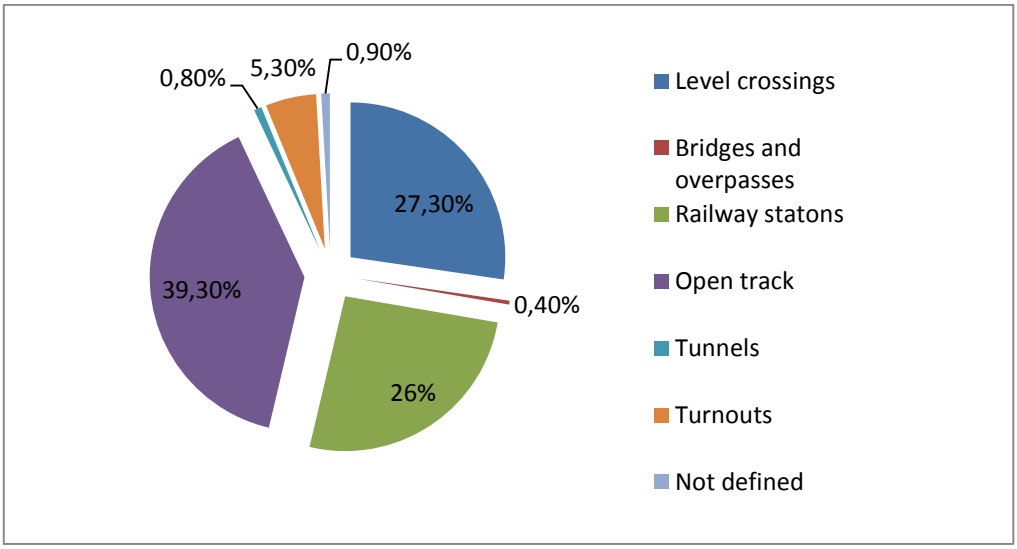
Graph 2 – Distribution of type of level crossing protection in EU (excluding Denmark and France)
Source: [9]

There were a total of 2,068 serious accidents (Graph 3) in 2012 at the level of EU28, which is by 7% less than in the previous year, although the number of accidents in the category of collisions, derailments and level crossings increased [8].



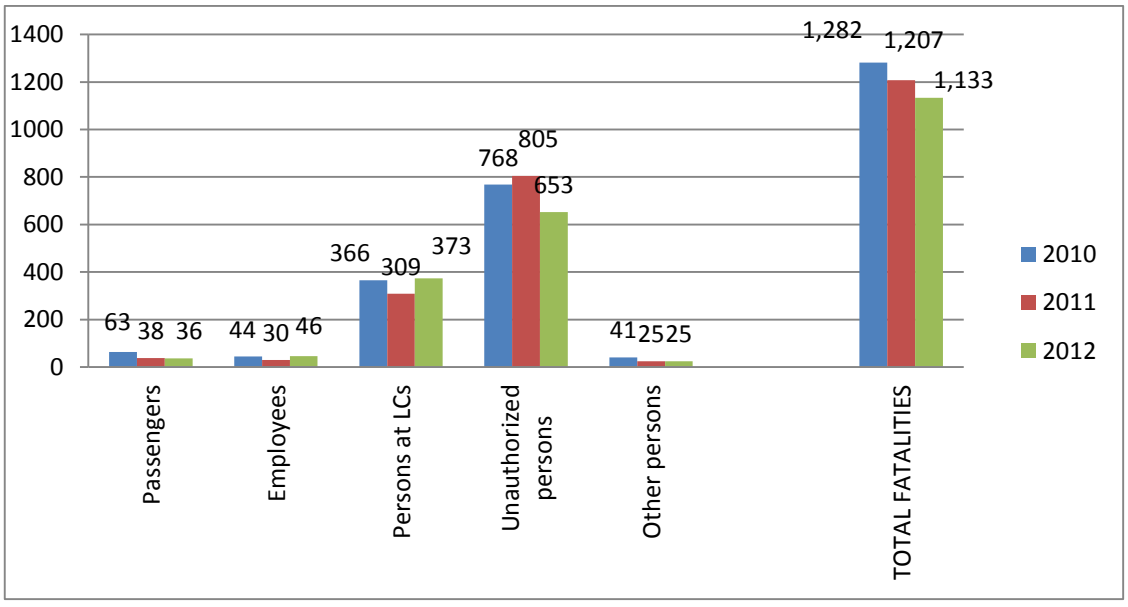
Graph 3 – Distribution of types of serious accidents (EU28)
Source: [8]

When analysing the locations of accidents (Graph 4), it may be concluded that the accidents at level crossings account for about 1/3 of all accidents which is a fact that gives reason for worry.



Graph 4 – Distribution of locations of serious accidents in 2012
Source: [10]

The number of fatalities in railway accidents in 2012 amounted to 1,133 persons (excluding suicides), which is the lowest number recorded on the railways of the European Union since 2006 (Graph 5), since when the data at the EU level started to be collected systematically [8].



Graph 5 – Distribution of the killed in railway accidents in 2012 (EU 28)
Source: [8]

Accidents at level crossings have been growing on the average annually by 11% and they account for a high share in the total number of accidents in railway traffic, and for 2012 they amounted to 27.7%. Also, the number of fatalities at level crossings accounts for 32.9% of all fatalities in railway accidents in the region of EU in 2012 [8], and this number of fatalities is only 1% of all the killed persons in road traffic.

As a rule, accidents at level crossings are not considered as problems of road traffic, but exclusively as problems of railway traffic, although it is a fact that about 95% of all

accidents were caused by careless action of road vehicle motorists who intentionally or unintentionally fail to respect the traffic rules related to passing a level crossing [10].

5. CONCLUDING CONSIDERATIONS

Railway traffic is one of the safest transportation modes, and therefore the fact for concern is that on the average 30% of all emergencies with fatalities in railway traffic occur at level crossings, whereas there are only 1-2% of fatalities in road traffic. This leads to the conclusion that it is exclusively railway traffic which is responsible for implementing the measures of prevention and protection at level crossings, although for more than 90% of emergencies the blame is precisely on the road motor vehicle drivers, cyclists and pedestrians who, consciously or unconsciously failed to comply with the traffic regulations while passing the level crossing. Since breakdown of the equipment or fault in infrastructure account for only a minor share in the causes of accidents, one arrives to the conclusion that human factor is the key cause of emergencies at level crossings, and that for the efficient solution of this problem joint cooperation of both traffic systems is of extreme importance. This problem is not only significant for the Republic of Croatia, but rather for the traffic systems of other countries as well.

To conclude, there is no unique measure of preventing emergencies at level crossings. Regardless of the future advancements of technical and technological measures of emergency prevention, it may be expected that the human factor will continue to be the main cause of accidents, so that the highest efficiency in reducing the number of emergencies at level crossings will belong to those technical and technological solutions that will, on the one hand, increase the awareness of the drivers and pedestrians about the risks of passing the level crossings, and on the other hand, simultaneously provide solutions that will minimize or completely eliminate the influence of human unconscientious (intentional or unintentional) behaviour.

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GUIDELINES FOR EXPANSION OF BROADBAND INTERNET ACCESS IN RURAL CROATIA

ABSTRACT

Broadband Internet access involves transfer of large data at high speeds, and at the same time the proliferation of new services. Rural areas, for a number of particularities such as the population size, geographical dispersion and lack of commercial attractiveness are often areas of limited availability of broadband access. This paper presents the objectives that must be met in order to minimize the evident differences when compared to urban areas. By achieving the above-mentioned objectives, the country could potentially realise direct (GDP increase) and indirect benefits. In addition to the already existing Strategy for Broadband Development in the Republic of Croatia within the period from 2012 to 2015, it is necessary to continuously harmonize with the determinants of Digital Agenda for Europe. Through strategically planned investments for the implementation of new information and communication infrastructure, and the improvement and modernization of existing ones, it's imperative to gradually increase the availability of broadband access, regardless of geographic area.

KEY WORDS

Broadband access, Internet, Rural areas, Guidelines

1. INTRODUCTION

Broadband Internet access is seen as one of the development indicators of a country, its economy and society in general. The level of Internet use within a certain country (especially broadband Internet access) is proportional in relation to its economic strength and overall quality of life. Some statistics show that the economically stable and advanced countries are fully aware of the modern information society based on online communication. An efficient and high-speed Internet access serves as the basis of Internet communication.

Furthermore, the existing differences in Internet use and in its very approach are noticeable within a country. This statement is particularly obvious in the case of Republic of Croatia. Generally speaking, it is possible to conclude that the development of broadband Internet access within the Republic of Croatia, to a greater or lesser extent, is lagging behind urban areas. It is understandable that countries tend to eliminate the differences between some of their parts, as well as in the segment of Internet access.

The main objective of this strategy is to create all necessary preconditions for accelerated expansion of broadband infrastructure and services requiring high-speed access. This will enable further development of the information and knowledge-based society, and ensure availability of broadband access services under equivalent conditions in the entire territory of the Republic of Croatia. The crucial point is to encourage local authorities to implement various activities, with the purpose of expansion of broadband Internet in areas without any commercial interest (islands, mountainous and rural areas).

By joining the European Union (EU), it is important for Croatia to harmonize its existing regulations and guidelines with those of the EU. The determinants of the Digital Agenda for Europe (one of the European Commission planned documents adopted within the Europe 2020 strategy) are related to: Broadband Internet access and its expansion status in Croatia up to 2011, as well as the expected state-level economic impacts.

The systematic implementation of proposed measures is required, in order to achieve the main objectives, such as to provide basic access to 100 % of the population, to form a single digital market, increase funding for information and communication technology to €11 billion, digital inclusion, etc. The above-mentioned measures should increase the availability of broadband internet in rural areas.

2. BROADBAND INTERNET ACCESS SERVICES

The boundary between narrowband and broadband communications, according to [1], is set to 2 Mbit/s (1.5 Mbit/s in the U.S.), i.e. to the higher speed than the primary ISDN access speed. However, that limit had later been shifted towards lower speeds, i.e. to 144 kbit/s data rate which is the basic ISDN access (U.S. 200 kbit/s).

With the progress of technology and telecommunications market, initially defined minimum broadband speed of 144 kbit/s in the EU is slowly losing its importance when it comes to practice, i.e. on the EU market in mid-2010, more than 87% of broadband connections run at speeds above 2 Mbit/s [2].

It should be emphasized that these terms of basic, fast and ultrafast broadband connections, although, according to [1], defined within the Croatian Strategy, and in numerous European Commission documents, have not been widely accepted and are often used for different ranges of mismatched access speeds (e.g. fast broadband connection is a connection with speed above 10 Mbit/s). In order to reduce ambiguities and for later referencing purposes in the study, according to [3], four types of broadband connections are defined, according to the access speed ranges (Table 1). Listed ranges of access speeds are related to the download speed, while the upload speed can be and usually is lower.

Table 1 - Types of broadband connections

Label	Ranges of data transfer access speed
U1	144 kbit/s – 2 Mbit/s
U2	2 – 30 Mbit/s
U3	30 – 100 Mbit/s
U4	> 100 Mbit/s

Source: [3]

2.1. INTERNET BROADBAND ACCESS TECHNOLOGIES

Existing technologies that offer the possibility of broadband Internet access can be, according to [1], depending on the transmission medium used and appropriate technology, classified into following categories: wireless access (optical signals, satellite feeds links, radio access - WiMAX, 3G, LTE), optical access (FTTx) and wired access (Digital Subscriber Line technologies (xDSL), cable, power cables and network access via leased lines.

Although DSL technologies dominate the market, telecom operators are increasingly oriented to wireless technology. Primary classification of wireless broadband technologies is based on speed and data transfer. Given the range of data transmission, networks can be divided into: WAN (Wideband Area Network), a long-range network; MAN (Metropolitan Area Network), a city-range network; LAN (Local Area Network), a local scope network and PAN (Personal Area Network), a short-range network.

Wireless broadband technologies represent an attractive solution for high speed access to Internet and to data, voice and video services. The major advantage of wireless to wired and optical technologies is a relatively low cost of implementation. However, wireless access network still can't, by its performance, compete with wired and optical networks [1]. The most important wireless broadband access technologies (described in a more detail below) are cellular access technologies (Table 2), wireless optical access and satellite links.

Table 2 - Data transfer speed of wireless (cell) access tehnologies

Wireless access technology	**Data transfer speed**	**Feature**
2.5G – GSM + GPRS/EDGE, CDMA 2000 1x	240 kbit/s	Broadband
3G – UMTS, CDMA2000 1x Ev-DO	384 kbit/s	Broadband
3.5 – HSDPA/HSUPA	14.4 Mbit/s	Broadband
Wi-Fi – IEEE 802.11	+50 Mbit/s	Broadband
WiMax – IEEE 802.16	+50 Mbit/s	Broadband
4G – LTE	+100 Mbit/s	Broadband

The greatest advantage of wireless optical signals (FSO - Free Space Optics) compared to the conventional technology of wireless data transmission, lies in the fact that it can achieve transmission speeds comparable with transmissions via fiber-optic cable, with substantial financial and time savings in implementation because there is no need for laying optical fiber cable. Conceptually, this technology is indistinguishable from the transmission through fiber [4].

According to [5], wherever there is an alternative solution, broadband Internet access via satellite connection is not suitable for connection. The satellite links are useful in areas with the lack of terrestrial infrastructure, where it is necessary to provide a link. However,as a result of great distance that signal must traverse, there was an obvious delay in communication in older satellite technology.

Certain wired access technologies use some of the wire mediums for data transmission, and provide the possibility of broadband Internet access. The development of broadband Internet access and data transfer speed, using one of the wired access technologies, is shown in Table 3. Basic classification of the given wired media is the copper pair, cable network (coaxial cable) and power line network access.

Table 3 - Wired broadband technologies

Wired access technology	Data transfer speed	Feature
Dial up	56 kbit/s	Narowband
ISDN	144 kbit/s	Broadband
ADSL	8 Mbit/s	Broadband
Cable access	+10 Mbit/s	Broadband
ADSL 2+	24 Mbit/s	Broadband
Leased lines	<34 Mbit/s	Broadband
FTTC + VDSL2	100 Mbit/s	Broadband
FTTH	+1 Gbit/s	Broadband

In the case of broadband Internet access using optical fibers, Fiber to the x (FTTx) is used. According to [1], it includes: optical fiber to the apartment - Fiber to the Home (FTTH), optical fiber to the building - Fiber to the Building (FTTB), fiber to the curb - Fiber to the Curb (FTTC) or Fiber to the Kerb (FTTK) and optical fiber to the cabinet - Fiber to the cabinet (FTTCab).

2.2. THE USE OF BROADBAND SERVICES

The basic service, provided through broadband connections, is a high speed internet access, allowing users to adopt a wide range of applications: educational, business, and informative purposes. It should be pointed out that there is a whole range of electronic systems and applications that allow an access and use of Internet public services to citizens (e-education, e-health, e-government, e-business, e-commerce, e-banking, distribution of TV content, etc.). Some of the most important services for the broadband expansion are: information services, communications services, electronic mail, multimedia messaging, audio-visual services, etc.

As shown on Table 4, some of the services require a specific transfer speed for their continuous performance. Data transmission speed lesser than those shown on Table 4 lead to a reduction in the quality of service or to a hampered performance.

Table 4 - Information and communication services and data transfer speed requirements for data transfer, [7]

Service/activity	Minimum required data transfer speed
E-mail, Web search	64 kbit/s (narrowband)
Download (smaller files)	128 kbit/s
Music files download, loading video files	1.5 Mbit/s
Shopping/loading films, IPTV (standard quality)	5 Mbit/s
Blue-ray video	16 Mbit/s

The positive effects of the widespread broadband infrastructure deployment can be grouped within four main categories: education, health and welfare, employment and economic development, as well as energy and transport. By comparing the movement of broadband penetration in Croatia (the national average) and the EU (average of all Member States), in the period from end-2006 to the end-2011, the Croatian average is continuously lagging behind the EU average. This lag is being reduced, too. Also, after the 2009 there has been an expansion slowdown in broadband connections in both, the EU and Croatia. It is partly caused by the economic crisis. [8]

By analysing the status of broadband infrastructure at the village (smalltown) level, as well as basic demographic population unit, it was found that 2.2% of the Croatian population (or about 92,000 people) in mid-2012 was not covered by broadband infrastructure and did not have an access to broadband services. The areas without broadband infrastructure included a total of 1,025 villages, most with less than 200 residents, usually located in mountainous areas, areas affected by the homeland war, islands, and in rural areas.

At the same time, according to [9], some additional information and current broadband status in Croatia can be seen through "The broadband access availability areas" interactive map (Figure 1), depicting the three speed categories (2-30 Mbit/s, 30 - 100 Mbit/s, and over 100 Mbit/s), with the remark that the available speeds are displayed in a way that they can be achieved without any major investments or an extensive work on electronic communications networks.

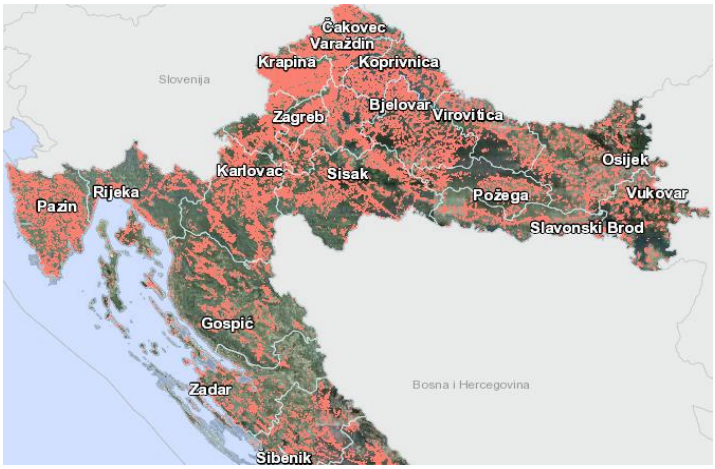

Figure 1: Interactive map „ The broadband access availability areas ", [9]

3. CHARACTERISTICS OF RURAL AREAS IN CROATIA

For administrative purposes, the difference between rural and urban areas in the Republic of Croatia is based on the territorial division, where the smaller administrative units, municipalities, are considered rural, while cities are considered urban areas. On this basis, according to [10], 44.4% (1,971,005) of the total population (4,437,460) is considered rural while 55.6% (2,466,455) is considered to be urban residents.

By applying the OECD criterion (150 inhabitants per km^2 in the local administrative units in the county), for the purpose of defining rural areas in Croatia, according to [10], Table 5 shows the percentage of rural and urban areas.

Table 5 - Rural and urban areas, population and smalltowns according to OECD criteria, [10]

CLASSIFICATION	OECD criterion					
	km^2	%	Number of small towns (villages)	%	Population	%
Rural areas	51,872	91.6	6,001	88.7	2,110,988	47.6
Urban areas	4,731	8.4	763	11.3	2,326,472	52.4
Total	56,603	100	6,751	100	4,437,460	100

Although reduced in the previous period, after government incentives, there still remains a significant uneven density of broadband Internet access via fixed networks in

Croatia, and thus the legitimacy of selective incentives in the development of broadband Internet access (Figure 2).

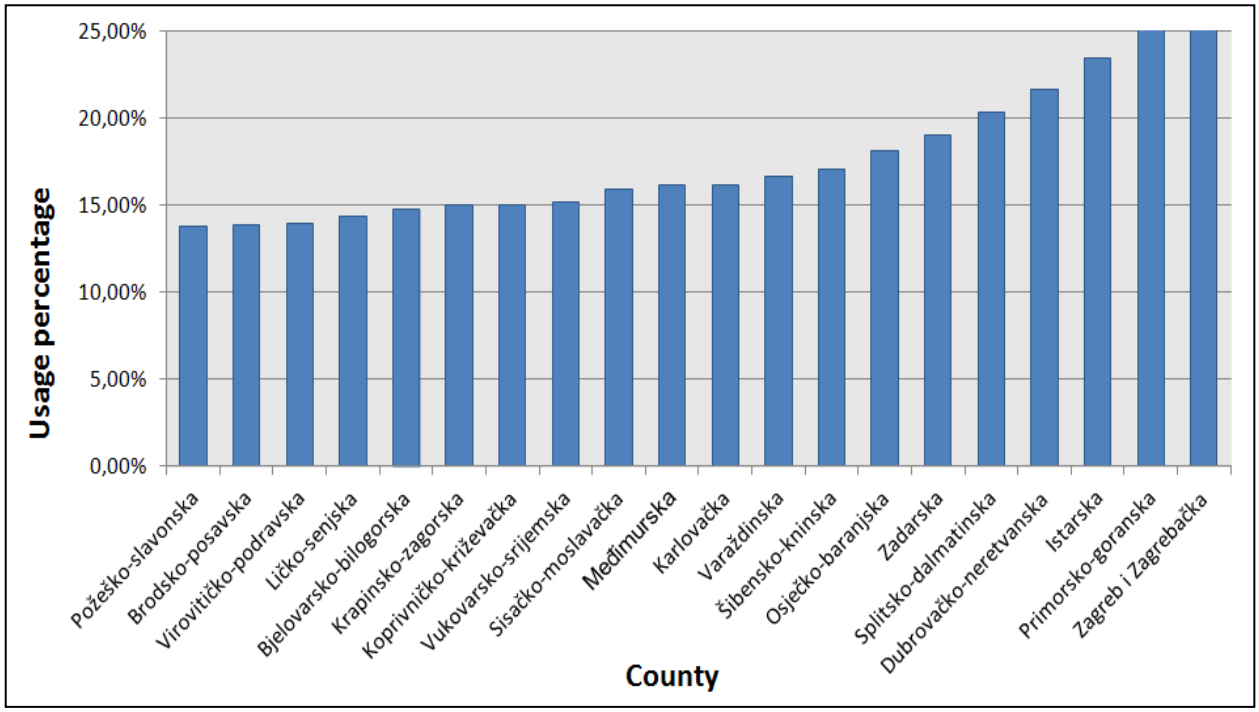

Figure 2 - The density of fixed broadband Internet access per county in Croatia, [11]

According to [12], there are several reasons for a lower broadband penetration rate in less attractive investment areas. The fact that the potential user density is lower and distances, at the same time, larger in rural areas, is resulting in more expensive implementation. The lower density leads to lower demand, i.e. lower revenue per user for operators.

Furthermore, the age structure of the population in rural areas is less favorable. Older people are less likely to use the Internet because they are not familiar with computers and are often afraid of technology or, more precisely, they are afraid of making mistakes. The rural population is often less educated, resulting in lower computer literacy. The problem is a potential barrier when using the Internet. Local communities often don't make enough effort to change the current situation.

4. THE OBJECTIVES AND GUIDELINES OF BROADBAND ACCESS EXPANSION

The determinants of the Digital Agenda for Europe are related to status of broadband expansion in Croatia up to 2011 and also to expected economic effects at the country level. In the area of broadband expansion in the EU, for the first time Digital Agenda for Europe outlines specific actions, objectives and recommended deadlines for achieving these goals. In this way, the greatest benefits for the economy and for the European Union population itself are gained.

The goals of Digital Agenda for Europe, according to [6], are:

1. Single digital market,
2. Digital inclusion – the increase in use of the Internet to 75% of the EU population by 2015,

3. Public services,
4. Broadband access availability (basic, fast and ultrafast access),
5. Research and development – increasing funds for information and communication technology up to €11 billion.

Investments in the broadband access development are certainly promising if approached in a responsible way, which is proven by the results of numerous studies. According to [13], the increase in the number of broadband users influences the growth of gross domestic product (GDP), and the more developed the country, the greater the influence. Forecasts predict a possible GDP growth of 0.47% in countries with less developed broadband internet access, of 0.63% in countries with fast-developing broadband access, of 0.70% in big industrial countries and 0.89% in the most developed countries, which are using all the possibilities offered by the knowledge society to their full extent.

According to [14], it is expected that investment into broadband access by 2015 will create about one million new jobs in European Union Member States and provide incentives for the economy amounting to €850 billion. Reference [15] mentions four indicators directly related to the creation of the broadband benefits: (1) average income, (2) number of computer users, (3) number of smartphone users, (4) network coverage.

On the basis of assessments of direct and indirect benefits from broadband expansion, the analyses show that, in the period between 2010 and 2019, Croatia could enjoy direct benefits amounting to between €2.2 and 3.2 billion. The studies also say that, generally speaking, a 10% increase in the number of broadband users leads to 1.38% GDP increase, which results with the increase in the number of jobs related to network development and maintenance, as well as to the increase of general economic activity resulting from increased usage of electronic services provided by broadband access [15].

According to [6], the main objective of this strategy is to create preconditions for further development of broadband Internet access, to ensure its availability to citizens and the business sector and to point out all the advantages offered by broadband use in different segments of society, such as education, health and public administration. It is crucial to enable services requiring high access speed, as a basis for further development of information society and knowledge-based society, and to ensure availability of broadband access services under equivalent conditions in the entire territory of the Republic of Croatia.

Specific objectives arising from the main objective of the strategy, according to [6], are:

1. Ensuring effective market competition,
2. Ensuring availability of broadband access,
3. Encouraging demand for broadband services and use of broadband access by citizens and business entities.

The objective of effective market competition is to develop open-type infrastructure together with an appropriate offer of broadband services that may be used by all participants on the electronic communications market.

By ensuring the availability of broadband Internet access with the target values shown in Table 6, it wants to achieve higher percentage of population who will have the option of broadband Internet access, regardless of area of residence.

Table 6 - The target values of broadband Internet access availability, [6]

Indicator / Target value	**2013.**	**2015.**
Availability of fixed broadband connections (share of the population to which the service is available)	75% (≥ 2Mbit/s)	35% (≥ 30Mbit/s)
The availability of broadband access (share of the population to which the service is available)	90% (≥ 2Mbit/s)	50% (≥ 30Mbit/s)

By stimulating demand for broadband services is a way to achieve the goal of increasing the number of users of broadband Internet access in the widest range of population, with the target values shown in Table 7.

Table 7 - The target values of broadband Internet users, [6]

Indicator / Target value	2013.	2015.
Total number of fixed connections	1,000,000 (≥ 2Mbit/s)	500,000 (≥ 30Mbit/s)
Total number of mobile connections	500,000 (≥ 2Mbit/s)	700,000 (≥ 2Mbit/s)
Broadband connections share from the total number	50%	75%

The main view of the development of broadband Internet access may be reduced to three dominant segment in this area: Information and communication infrastructure, the population of rural areas of Croatia, and state and local governing bodies.

Based on the stated objectives, basic guidelines and steps needed are visible of upgrade of the existing system. It's apparently that increase of the use of broadband Internet access entails a number of infrastructure changes. The development of broadband Internet access in rural areas is a prerequisite for the realization of the telecommunications network by using some of the existing technologies that enable broadband access to the Internet.

Furthermore, beside the infrastructure, a significant contribution to increase use of broadband Internet access is provided by the users and the population of rural areas of Croatia. The users' awareness of the possibilities and ways of using broadband service, its convenience and ease of use, greatly affect the development of the entire system.

As one of the key factors in the development of broadband Internet access in rural areas of Croatia, local and regional governments and their rural development policy are pointed out. It is desirable that precisely these factors that anticipate the need and application of broadband Internet access. Adequately informing the population, encouraging the use of information and communications equipment and services, business modernization and impact of the reduction in prices of telecommunications services in their area, represent only some of the tasks of local and regional authorities and governments.

5. CONCLUSION

In order to reduce the social, cultural and economic differences in various in Croatia, it is necessary to use all available measures and methods of homogenization for a country to develop. Decentralized management and equal development of all areas is a relevant authorities' field of interest. Although, the lifestyle of urban and rural parts of Croatia varies to a greater or lesser extent, it is necessary to apply the common principles and technologies

that will enable higher quality and standard of living of the population of these areas. One of the indicators of the differences between these areas is the level of broadband Internet access availability.

In mid-2012, 2.2% of the population (aprox. 92,000 people) didn't have broadband infrastructure and therefore were without an access to broadband services. Those areas (total of 1,025 villages/small towns with a population of <200 inhabitants) are generally mountainous areas, the areas devastated by the homeland war and the islands (rural areas).

According to the above-mentioned, it is evident that there is still a discrepancy in the development of particular regions, and therefore in some minor (urban and rural) areas, too. It is important to minimize these differences, thus broadband Internet access expansion seems reasonable, primarily in rural areas.

The purpose of increasing the availability of broadband Internet access in rural areas, primarily relates to the reduction of, so-called, digital divergence between developed (mainly urban) and rural (less developed) areas. As a result of the previously mentioned problems of rural areas (geographic dispersion, commercial unattractiveness, and population level), it's necessary to motivate the local government to invest in such areas. The Republic of Croatia should strive to reduce the centralized development of the country, regardless of the economic, cultural and tourism development. Considering the fact that the expansion of broadband Internet access is indirectly associated with economic development of the country, the coordinated development is of inevitable importance. Available broadband access resources are preconditions of the adequate development of information and communication technologies.

Consequently, it is necessary to align with the directives of the European Union and the Strategy for broadband development in the Republic of Croatia within the period from 2012 to 2015. These guidelines are crucial for the broadband expansion of an integrated, unified and systematic development of the country. This development should be based on modern information and communication society. Numerous factors (e.g. income and GDP increase) are directly affected by increased availability of broadband access, as shown in this paper.

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PARK & RIDE SYSTEM IN THE FUNCTION OF SUSTAINABLE MOBILITY AT TOURIST DESTINATIONS IN CROATIA

ABSTRACT

Park & Ride is the name for a form of intermodal transport, which involves the exchange of passengers between individual and public modes of travel in order to conduct a comprehensive journey through the use of parking facilities with direct access to public transport. Beginning of development of Park & Ride system has started spontaneously by the users of the transport system. Further development of transport demand leads to traffic congestion in urban areas and require a planned approach to the development of Park & Ride system. The problem of implementation of the above system is the cost of the initial investment and condition for constant traffic demand. The inconstant traffic demand is the major problem of introducing Park & Ride system in the tourist centers along the Adriatic coast where demand during the summer season grows for up to 3 times. The purpose of this paper is optimization of existing parking areas and reorganization of existing public urban transport in the case study Novigrad-Cittanova and to present the advantages as well as the justification for the introduction of Park & Ride system in tourist destinations along the Adriatic coast. It will also present the role of Park & Ride system in encouraging the development of sustainable mobility, and increasing tourist attractiveness by improving the quality of life for residents and visitors. As a criterion for making a decision on the acceptability of proposed solution, a cost-benefit analysis was used.

KEY WORDS:

Park & Ride system, sustainable mobility, cost benefit analysis, air pollution, peak tourist season

1. INTRODUCTION

If the spontaneous arising of Park & Ride system is taken into account, then we can say that their history dates from the twenties of the last century. Due to the remarkable effectiveness of Park & Ride system in history, and even today, they were often formed spontaneously by the users of the transport system. Following the further development of cities and the rapid development of the transport system, particularly development of the car industry, traffic planners also perceived advantages of Park & Ride system in operation to solve traffic congestion in urban areas and their introduction is starting to be planned. Proves

of planned introduction are numerous studies, projects and guidelines for implementation of Park & Ride system [1, 2, 3, 4, 5].

Park & Ride systems have become very popular in the U.S., and according to the context the three main types of Park & Ride system are used [1, 6]:

1. Park & Ride systems for long distances (60-130 km) - connects the satellite cities and rural villages with the place of work;
2. Park & Ride systems connected to local public transport - operating at narrower areas;
3. Peripheral Park & Ride systems - located on the edges of urban areas and are used by passengers traveling to the city center.

Popularity and application method of Park & Ride system in Europe is different, so regardless of the level of development of public transport in some European cities and countries, this system is evaluated differently. For example, regardless of the development of public transport, Park & Ride system in the Netherlands is not sufficiently represented while from the standpoint of the number of users, its popularity in Germany is very high. When talking about the Park & Ride system of Great Britain, interesting fact is that it is mainly based on bus transport. [7]

The disadvantages of introducing Park & Ride system are the high costs of initial investment for the construction of new facilities and the application of large spatial area. An additional problem with the introduction of Park & Ride system is the lack of traffic demand which makes the return on investment. The lack of constant traffic demand throughout the year as well as occupation of the spatial area is particularly emphasized in tourist towns along the Adriatic coast. The traffic demand during the tourist season can be from 2.5 to 3 times higher than during the rest of the year [8, 9], which requires large capacity of parking areas that would be utilized only during the tourist season.

2. PARK & RIDE SYSTEM IN TERMS OF SUSTAINABLE TRANSPORT

Park & Ride is the name for a form of intermodal transport, which involves the exchange of passengers between individual and public modes of travel in order to conduct a comprehensive journey through the use of parking facilities with direct access to public transport [1]. The system works in such a way that on the outskirts of the city large-capacity parking areas are organized and they are with some form of public transport linked to the city center. In such system, visitors to the metropolitan area who come into the city by car, leave their car in the parking lot at the edge of town, and their journey continues by public transport. The ticket for parking in such a system is also return ticker, or one-day pass for use of public transport.

The aim of the introduction of Park & Ride system is to reduce the number of cars in the city center, and encouraging the use of public transport. That results include reducing traffic congestion, reducing emissions and noise, as well as reducing the number of traffic accidents.

Main goal of the deployment of Park & Ride system is primarily aimed at reducing the external costs of transport, and social costs caused by traffic system. According to a study [10] the external costs of transport (without congestion costs) for the EU-27, including Norway and Switzerland, and excluding Malta and Cyprus for 2008 amounts to 514 billion, or 4% of total GDP. From that, 44% of the total external costs are traffic accidents, 29% climate change, 10% air pollution while the noise takes 4% of total costs. The total cost of congestion is between 146 and 243 million euros or about 1.1-1.8% of GDP. It is important to note that road transport

accounted for 93% of total external costs of the overall traffic, of which 61% were passenger cars, 13% to 9% of heavy vehicles on vans, 6% for vehicles with two wheels and 4% on buses.

In order to reduce the external costs of transport and to create a sustainable transport system, it is very important to influence on all aspects of the transport system from the standpoint of sustainability [11]. One of the measures for reducing traffic volume in cities is increasing the attractiveness of public transport. The requirement for increased use of public transport is availability, affordable prices and high level of service. According to the results of an international survey conducted by human resources solutions provider Kelly Services in 2007, only 40% of respondents used public transport to go to work, and poor connectivity is one of the main reasons for avoiding public transport on the way to work. In developed European cities major role in increasing the use of public transport has the Park & Ride system itself. Development of Park & Ride system in some European cities is presented in Table 1.

Table 1 - Examples of Park & Ride system in Europe [source: 12]

CITY	Inhabitants	P & R SITES	P & R parking spaces	PUBLIC TRANSPORT FARES (ROUND TRIP 1 Adult) €	PARKING SPACES FREE OF CHARGE	PARKING FEES € (MAX PER DAY)
Berlin	3,422,943	44	4947	4.20-5.60	all	
Hamburg	1,773,218	49	9409	3.30 to 5.20	all	
Cologne	995,397	28	5570	4.60-6.40	all	
Munich	1,314,350	24	7128	4.60	7120	1.50
Helsinki	568,146	27	3163	4:40	2908	2
Paris	2,166,200	28	5849	3:20	1700	12.50
Sheffield	530,300	8.	1754	*	750	4.50
Rom	2,708,395	31	12,880	2	260	3
Luxembourg	86,329	5.	4116	3	all	
Amsterdam	743,104	5.	1 278	**	none	6
Oslo	565,653	5.	3000	5.20 to 10.40	2330	14
Vienna	1,681,469	6.	6226	3.40	none	3
Stockholm	795,163	22	3000	6-12	none	3
Geneva	1,314,350	19	4854	4-7.60	none	29.10
Ljubljana	278,638	1	217	*	none	1
Prague	1,194,407	17	3196	1.50	none	1
Budapest	1,696,128	2	3384	2	2682	1

** Included in the parking fee for the driver*

*** Round trip for up five persons included in the parking fee*

According to Table 1 slightly more than 52% of parking spaces are free of charge, while about 6% percent of the parking spaces that are tolled in the overall price include the price of tickets for public transport for drivers (or up to 5 people). From the above it can be concluded that in most cases the Park & Ride system is not profitable due to the reason that its cost-effectiveness primarily examines the social benefit rather than direct income.

According to a study [12] from 2007, three percent of all passengers of urban public transport in Munich were using the Park & Ride system, and corresponding figure is 25,650 cars less on the streets. If this fact is observed through the external costs of reducing emissions and noise and congestion as they get large social savings, i.e., one kilometer reduction for each vehicle in the center of the city will generate a reduction of CO_2 for about 3.4 t / year.

3. CASE STUDY - CITY OF NOVIGRAD CITTANOVA

The introduction of Park & Ride system, and all other segments of the transport system requires a sufficient number of filled capacity to make the system viable. Given that this is a system that is connected to the system of public transport, which in most cases is co-financed by the city or state, the profitability of the Park & Ride system through direct income is not expected.

When it comes to tourist towns along the Adriatic coast, i.e. in this case the City of Novigrad-Cittanova, additional problem for profitability of introduction of Park & Ride system represents uneven traffic demand. Specifically in the area of Novigrad-Cittanova, during the tourist season (if the calculation duration of the season for three months is used) there is an increase in traffic demand for 2.5 to 3 times. Taking into account that the increase lasts only during the tourist season, it is irrational to construct parking facilities in the city that would meet the new traffic demands. Due to his reason, the proposal repeals off most of the parking area in the center of Novigrad-Cittanova and, if necessary, expansion of existing parking areas at the periphery of the city with high-quality connections with public transport. Existing parking areas that are located around the perimeter of the city are weak or almost never used. In this way, space in the city center will free and could be converted for other functions such as cycling paths, pedestrian walkways, green spaces, etc.

As its name suggests, the main elements of the Park & Ride system are parking facilities and public transport. Existing parking facilities as well as proposals for optimization of existing lines of public transportation in the city of Novigrad-Cittanova are explained in detail in following chapters.

3.1. PARKING AREAS

In the area of Novigrad-Cittanova proposal includes the introduction of Park & Ride system in a way to make use of existing parking areas at the periphery of the city and that they are in line with the increase in demand for parking, and if needed, extended with additional parking areas. As parking locations that would be included in the Park & Ride system the following car parks are proposed:

- sport hall - north;
- sport hall - south;
- Street Carlotta Grisi - public parking in front Plodine;
- Street Carlotta Grisi - public parking in front of the bus station;
- Street St. Anton - public parking lot across from the Hotel Nautica;
- Street St. Anton-parking near the port Mandrač ("white parking");
- Car parks on areas owned by the city north along the Street Carlotta Grisi.

Today, at specified locations exists 14,000 ^{m2} of parking area (about 500 parking spaces), which is for a city of the size of Novigrad enough space for the introduction of Park & Ride system. In the future, if the needs arises, it can be easily upgraded to an additional 11,000

m^2 of parking areas, or from about 400 parking lots for parking which can meet the needs of Novigrad-Cittanova in long-term planning period.

Figure 1 - Existing and proposed parking areas at Novigrad-Cittanova

Figure 1 gives an overview of the existing and proposed parking areas that would be included in the Park & Ride system.

3.2. PUBLIC TRANSPORT

System for connecting the parking area with the city center and major facilities in the city is proposed to be the existing system of public transportation - the tourist train. Existing lines are passing close to the parking lot near the hotel Nautica Street, St.Anton Street and Carlotta Grisi, and for better connection of the parking area at the sports hall an introduction of a new line of tourist train from the center of Novigrad to Sports halls across the Murvi street is needed.

In the proposal of Park & Ride system for the city of Novigrad Cittanova, parking ticket in the Park & Ride system will also double as a ticket for the public transport system by tourist train.

After the introduction of Park & Ride system, parking fee in public car parks in the city center has to be raised in order to discourage the use of these parking lots.

Figure 2 - Existing and proposed lines of the tourist train

Figure 2 gives an overview of the existing and proposed lines of the tourist train that would be included in the Park & Ride system.

3.3. PARK & RIDE SYSTEM - NOVIGRAD-CITTANOVA

In addition to connecting the parking area with the city center by public transport, Park & Ride system would also allow a connection with nearby tourist attraction (camps, hotels). In order to stimulate the local population to use public transport a co-financing measure for their tickets is proposed.

Park & Ride system proposal for Novigrad-Cittanova is given in Figure 3

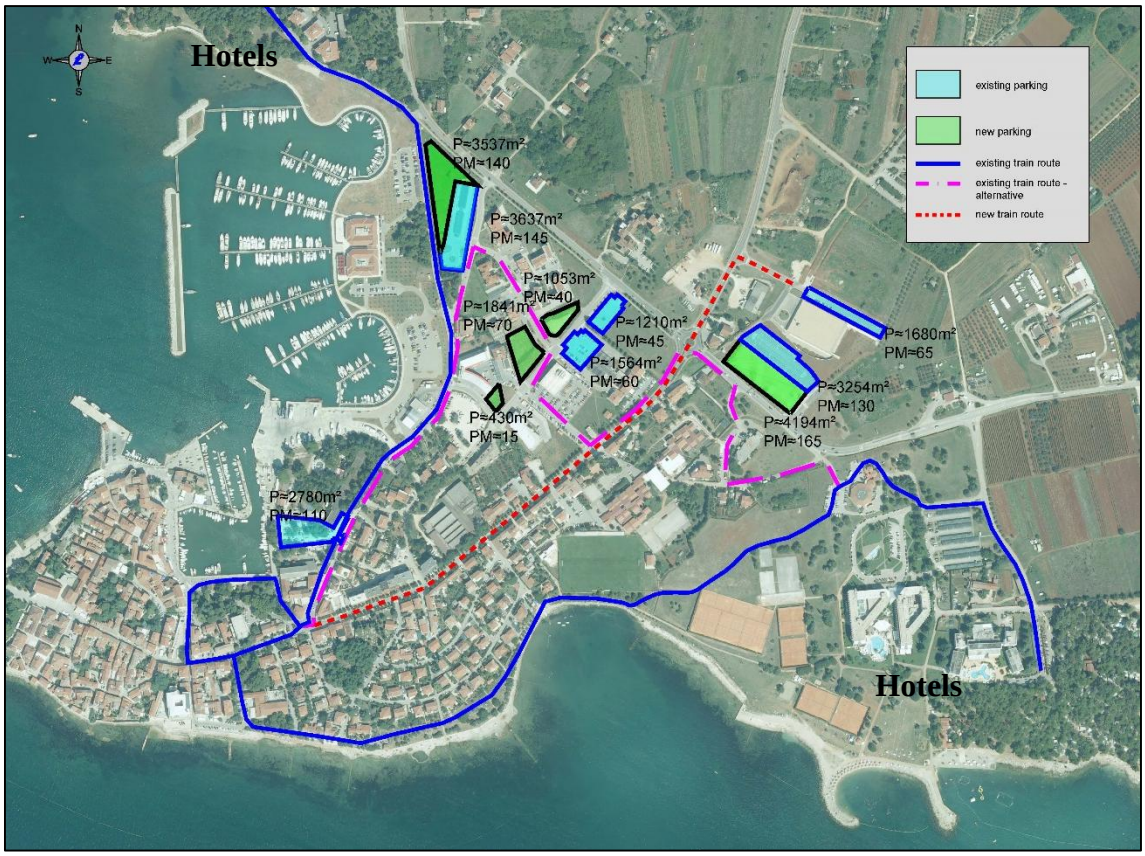

Figure 3 - Proposed Park & Ride system for Novigrad-Cittanova

Following the [8] the introduction of Park & Ride system, a reduction of traffic in the city center for about 9% is expected. In the current situation in the tourist season during a typical day in the center of Novigrad traffic counting has established 8,788 vehicles. In the end, this measure will result about 71,000 less vehicles in the city center during the summer season.

As an essential element of the Park & Ride system it is necessary to introduce traffic guidance system towards parking areas using traffic signs. From all entrances to the city (from the highway, Umag and Porec) traffic should be guided towards parking on outside the town center to reduce the "pressure" of motor vehicles in the city center. This action will eliminate a huge number of "empty runs" which drivers are performing while seeking for a free parking lots. For guiding system, latest ITS technologies systems is proposed, which will together with the directions for parking show the actual number of empty places available at the nearest parking lot, as well as distance from the city center. If the specified parking lot is completely full, system should automatically redirect traffic to the nearest free parking.

The current situation in the city center is that there are no bicycle paths, and they could be introduced following the reduction of number of parking spaces, as well as the introduction of one-way streets. The introduction of one-way streets in the center is possible because a large portion of traffic meets the demand of public transport within the Park & Ride system.

4. EVALUATION USING COST-BENEFIT ANALYSIS

For evaluation of the proposed solutions Park & Ride system cost-benefit analysis was used. Cost-benefit analysis was chosen because, unlike the analytical methods which weighed

individual effectiveness of the project, cost-benefit analysis examines the overall social effects of the project. The discount rate used for calculating the cost-benefit analysis is 8%.

Cost-benefit analysis was performed for the period of 25 years and was done for the pessimistic scenario (current state). Assuming that the number of visitors will grow during the planning period, the analysis was not performed for the low and high scenario of increasing traffic demand for the reason that if the cost-benefit analysis shows the profitability of investments in the scenario of the current situation, its justification in the other two scenarios will only be greater.

The cost of the introduction of Park & Ride includes the cost of the initial investment and maintenance costs. The cost of the initial investment includes one of the tourist train, the construction of new routes for the tourist train and arranging existing parking lots. The total cost of the initial investment is estimated at around 980,000.00 kn or 130,970.00 €. Park & Ride system which is planned to be introduced in the city Novigrad-Cittanova has no excessive maintenance costs because the parking areas does not require extensive maintenance and so the maintenance costs are only the costs of maintaining the tourist train and the payment of salaries to the staff employed. Thus, certain maintenance costs on an annual basis would be around 108,500.00 kn or 14,466.67 €.

The benefits that could be quantified [8] are reduced emissions, reduced noise, and income on the ticket sales. Benefits that due to lack of data could not be evaluated are the increase in safety, positive impact on the health of the population, an increase in tourist attractions and spatial reoccupation of transport infrastructure. The values for the calculation of emissions and noise were taken from the manual for the price of emissions for Slovenia in the 2000, and were reduced to the 2012 year (GDP / capita) [13]. Results from Slovenia were used because of its proximity to Istria as well because the European Union does not have data for Croatia since Croatia became the member recently.

Taking into account all costs and benefits, the average annual cost of improvements to the parking system, with no initial investment, is about 14,466.67 € while the annual benefit is around 62,404.00 € from which it can be calculated that the pure annual benefit for that Park & Ride system brings the city Novigrad-Cittanova around 47,937.33 €. In this way, the costs of improving the parking system would be paid in the fourth year of its operation.

The overall benefit of the Park & Ride system after its exploitation in the period of 25 years under the existing condition will amount to around 1,019,520.77 €.

According to the key indicators of cost-benefit analysis, net present value amounts to 346,060.52 €, while the internal rate of return is as much as 37%. This high-value internal rate of return and net present values are to be expected due to the very small initial investment costs as well as maintenance costs. The results of the analysis of the costs and benefits during the period of observation concludes that the investment for introduction of Park & Ride system in the city Novigrad-Cittanova profitable. [8]

5. CONCLUSION

Road transport is the largest consumer of energy, fossil fuels, and thus generator of pollutants. In the 2004 83% of energy consumed in transport was related to road transport while 93% of greenhouse gas emissions come just from road transport.

The White Paper of the European Union from the 2011th [14] have set 10 main objectives in traffic for 2050 year. The purposes of the goals are to reduce greenhouse gas

emissions by 60% until 2050. To achieve this goal, the strategic development of the transport system in order to promote the policy of sustainable traffic is required.

One way of reducing the external costs of transport is the introduction of Park & Ride system, as for example, the implementation of Park & Ride system in the city Novigrad-Cittanova will obtain a reduction of CO_2 for a more than 300 tons / year. In addition to the social benefits resulting from the reduction in the number of vehicles, Park & Ride systems also encourage the development of sustainable forms of traffic that is enabling the conversion of roads for the development of sustainable transport modes (cycling, walking, public transport). Following the implementation of the Park & Ride system availability and service quality of public transport is also increasing.

At the city of Novigrad-Cittanova case study, it can be concluded that the transport planning, which is in accordance with the guidelines of sustainable mobility from the Green Paper and other EU documents that define the strategy for the development of traffic, can with less investment optimize the existing state of parking areas and public transport connections and significantly affect the transport system of smaller tourist destinations on the Adriatic coast as Novigrad-Cittanova is. Due to this reason, transport planning must be under the ingerention of traffic experts and transport sciences.

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POSSIBILITY OF IMPLEMENTING UNMANNED AERIAL VEHICLES IN FIREFIGHTING OPERATIONS

ABSTRACT

The aim of this paper is to explore the possibilities of using unmanned aerial vehicles for the purposes of the emergency aviation operations with special emphasis on the use in firefighting operations. The expected result of this research is a definition of the basic platform of the system that will be suitable for the implementation in various profiles of unmanned aerial vehicles depending on the operational requirements.

KEY WORDS

unmanned aerial vehicles, firefighting, detection, surveillance

1. INTRODUCTION

Increased number of fires during the summer season leads to the need for development of alternative ways for early fire detection and reporting about the exact location of fire. Information about the movement of fire front is crucial to the team on the field in order to optimally utilize available resources. Previous methods of fire detection are supplemented by video surveillance systems of open spaces. Although the significant progress was evident in the early detection of fire, there still remains a need for further development. The rapid development of unmanned aerial vehicles (UAVs) in the last decade has led to the possibility of using them in the firefighting sector.

The aim of this paper is to describe basic and additional UAV systems that are used for the detection and monitoring of fire. This paper can be the base for further development of UAVs, whether it's for fire protection or for another segment in which UAVs have the ability to apply its potential (e.g. search and rescue, border control, etc.).

2. CLASIFICATION OF UNMANNED AERIAL VEHICLES

Unmanned aerial vehicle is an aircraft that is heavier than air and fly with the help of aerodynamic lift created by fixed or rotary wings. As their name suggests, they do not have a crew, can fly autonomously or be remotely controlled, are made for single or multiple use and can carry a combat or non-combat cargo.

From its beginnings, UAVs have evolved in so many ways so it is possible to find several ways to classify UAVs with respect to weight, endurance and flight range, maximum flight altitude, engine type, type of the mission, etc.

Table 1 shows the classification made by the UVS International (Unmanned Vehicle Systems International - a non-profit association which has a general goal to look after the interests of the remotely piloted systems (air, ground, naval & space) community). Based on such classification, it is possible to create a framework within all the new types of aircraft can be joined. The commercialization of UAVs enabled large penetration of different types of UAVs on the free market and the boundary between individual groups becomes less visible.

Table 1 – Classification of unmanned aerial vehicles [1]

	Category (acronym)	Maximum Take Off Weight (kg)	Maximum Flight Altitude (m)	Endurance (hours)	Data Link Range (Km)	Example	
						Missions	Systems
Micro/Mini UAVs	Micro (MAV)	0.10	250	1	< 10	Scouting, NBC sampling, surveillance inside buildings	Black Widow, MicroStar, Microbat, FanCopter, QuattroCopter, Mosquito, Hornet, Mite
	Mini	< 30	150-300	< 2	< 10	Film and broadcast industries, agriculture, pollution measurements, surveillance inside buildings, communications relay and EW	Mikado, Aladin, Tracker, DragonEye, Raven, Pointer II, Carolo C40/P50, Skorpio, R-Max and R-50, RoboCopter, YH-300SL
Tactical UAVs	Close Range (CR)	150	3.000	2-4	10-30	RSTA, mine detection, search & rescue, EW	Observer I, Phantom, Copter 4, Mikado, RoboCopter 300, Pointer, Camcopter, Aerial and Agricultural RMax
	Short Range (SR)	200	3.000	3-6	30-70	BDA, RSTA, EW, mine detection	Scorpi 6/30, Luna, SilverFox, EyeView, Firebird, R-Max Agri/Photo, Hornet, Raven, phantom, GoldenEye 100, Flyrt, Neptune
	Medium Range (MR)	150-500	3.000-5.000	6-10	70-200	BDA, RSTA, EW, mine detection, NBC sampling	Hunter B, Mücke, Aerostar, Sniper, Falco, Armor X7, Smart UAV, UCAR, Eagle Eye+, Alice, Extender, Shadow 200/400
	Long Range (LR)	-	5.000	6-13	200-500	RSTA, BDA, communications relay	Hunter, Vigilante 502
	Endurance (EN)	500-1.500	5.000-8.000	12-24	> 500	BDA, RSTA, EW, communications relay, NBC sampling	Aerosonde, Vulture II Exp, Shadow 600, Searcher II, Hermes 450S/450T/700
	Medium Altitude, Long Endurance (MALE)	1.000-1.500	5.000-8.000	24-48	> 500	BDA, RSTA, EW weapons delivery, communications relay, NBC sampling	Skyforce, Hermes 1500, Heron TP, MQ-1 Predator, Predator-IT, Eagle-1/2, Darkstar, E-Hunter, Dominator
Strategic UAVs	High Altitude, Long Endurance (HALE)	2.500-12.500	15.000-20.000	24-48	> 2.000	BDA, RSTA, EW, communications relay, boost phase intercept launch vehicle, airport security	Global Hawk, Raptor, Condor, Theseus, Helios, Predator B/C, Libellule, EuroHawk, Mercator, SensorCraft, Global Observer, Pathfinder Plus,
Special Task UAVs	Lethal (LET)	250	3.000-4.000	3-4	300	Anti-radar, anti-ship, anti-aircraft, anti-infrastructure	MALI, Harpy, Lark, Marula
	Decoys (DEC)	250	50-5.000	< 4	0-500	Aerial and naval deception	Flyrt, MALD, Nulka, ITALD, Chukar
	Stratospheric (Strato)	TBD	20.000-30.000	> 48	> 2.000	-	Pegasus
	Exo-stratospheric (EXO)	TBD	> 30.000	TBD	TBD	-	MarsFlyer, MAC-1

Source: Adapted from "UVS-International-"UAV System producers & Models: All UAV Systems Referenced," 2006

TABLE 1. UAV Classification

NBC*: *Nuclear Biological Chemical*
EW**: *Electronic warfare*
RSTA***: *Reconnaissance, Surveillance and Target Acquisition*
BDA****: *Bomb damage assessment*

3. MAIN SYSTEMS OF UNMANNED AERIAL VEHICLES

In order to make UAVs functional, they need some crucial systems that, together with the UAV, form a functional unit. Basic UAV systems are in principle not much different from the same systems used in manned aircraft. However, the characteristics of the UAVs are generally smaller size and weight which leads to certain restrictions in terms of available volume and capacity.

3.1. PROPULSION SYSTEM

Depending on the weight, size and purpose of the UAVs, it is possible to choose between several types of propulsion systems. Propulsion systems can be divided into two groups depending on the type of energy that motors use to generate propulsive force. First group use different types of internal combustion engines which convert chemical energy of fuel into thermal energy, which is then converted into energy of motion, and second group, electric motors group, directly convert electrical energy into energy of motion.

3.2. NAVIGATION SYSTEM

Navigation system (NS) is one of the most important systems in UAVs because the absence of a human factor in UAVs put greater emphasis on NS since it becomes the one and only source for acquiring navigation data.

Standard systems for position determination are Global Positioning System (GPS), Inertial Navigation Systems (INS), altimeter and Pitot tube for measuring the velocity. Every each of these systems has its own advantages and disadvantages so the goal is to combine output signals from those systems and with the use of certain filters, among which the Kalman filter is most well-known, to minimise the error to the lowest possible level. GPS has a global precision determination and INS a local precision determination so the merged signals from these two navigation system provides overall high quality navigation data.

3.3. COMMUNICATION SYSTEM

There are several requirements that communication system must fulfil in order to maintain proper functioning. In some cases, deflection of just one requirement can lead to unplanned and catastrophic hazards like:

- interference with communications of other subjects in the operating area,
- partially or full loss of control over the UAV,
- UAV will not properly perform given tasks.

Basic structure of communication system is divided into three segments: telecommand, telemetry and payload link. [2]

Telecommand link is the use of telecommunication services for the transmission of signals to initiate, modify or terminate functions of equipment at a distance. Telemetry data represents data about mission status, on-board resources such as battery or fuel capacity, etc. Besides the functional sensors used to monitor the vital functions of an UAV, there are also operating sensors used for accomplishing main mission tasks. Data required from these operating sensors, due the importance they provide for the mission, are to be classified in a separated group. In a case of forest fire detection, the main operating sensor is an on-board camera that captures the image of the ground. Huge amount of data created by the camera requires much higher transmission rate than other communication systems.

One of the main obstacles for a more widespread use of UAVs is the communication range limitation. Further development in this segment will provide the possibility of transmitting higher amount of data to longer distances and this will for sure push the overall development and the use of UAVs.

3.4. SYSTEMS FOR MANAGING THE TECHNICAL AND OPERATIONAL TASKS

One of the most important advantages in using an UAV is its ability to fly and conduct tasks autonomously. Degree of the autonomy is correlated with the complexity of the situation; while an autonomous UAV can conduct many basic tasks, high demanding and critical tasks are still under the command of the ground control operator. To make easier for a ground control operator to decide about the proper level of autonomy or to take control of some of the UAVs systems, Task Management Unit (TMU) was introduced. TMU controls and coordinates all other systems and is able to autonomously make a decision. In the absence of the human in the vehicle, it presents some degree of artificial intelligence.

Ground Control Station (GCS) represents the segment that categorizes UAVs into different category than aerial vehicles with human crew on board. It allows operators on the ground to take control of some or all UAV systems.

When an UAV is used for the forest fire detection and monitoring, great potential lies in the possibility of making the GCS mobile so it can be, from its usually permanent position, transferred more closely to the area of interest or it can be even moved constantly, for example in a minivan. *Figure 1* shows a remote operating console that can be used for accessing and taking controls of all UAV on-board systems. It can play a vital role in critical situations when there is a high demand for rapid communication between the UAVs operator and the firefighters.

Figure 1 - Remote Control Station [3]

The level of autonomy based on flight stages can help ground operators to organize their work in advance, presenting critical phases of flight where human intervention is going to be needed. Most UAVs gain the lift by the same means like airplanes with fixed wings with the human crew on-board, so the flight profile is almost the same.

In the context of safety, landing phase represents the most critical phase of flight. Although there would always be a possibility of a human intervention during this phase, with the use of on-board systems as well as those on the ground, it is possible to conduct an autonomous landing that can result in a much more stable and precise landing.

The most basic landing system uses a basic radar altimeter to instruct the TMU during the landing phase. A more sophisticated landing system called Optical Guidance System is shown in *Figure 2*. This system determines the exact position and velocity of an UAV and obtained data sends directly to the UAV upon which the TMU can control further the glide path and velocity of the UAV. Optical guidance system consists of three parts, including optical tracking equipment, ground control station and the remote communication terminal. The optical tracking equipment includes laser radar, optical mirror and the corresponding electronic system. The ground control station is used to process the data received by the UAV, send order to the UAV and to control its landing trajectory. Remote communication terminal uplinks the processed data to the UAV flight control system which can adjust the state of the UAV. The necessary equipment on the UAV consists of a group of optical retro reflectors which are mounted on the nose of the UAV. [4]

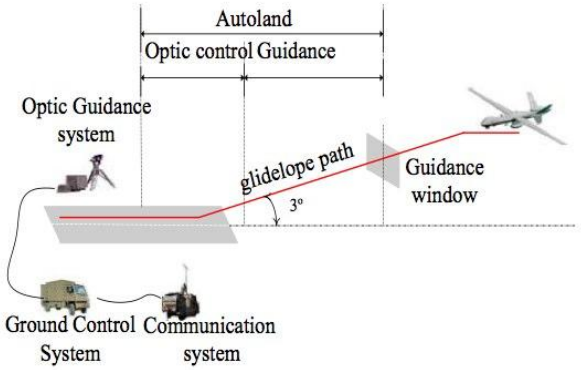

Figure 2 - Landing process of the UAV based on the optical guidance system [4]

4. FIRE DETECTION AND SURVAILANCE

Ability of fire detection depends on two mutually inseparable components: special designed cameras (*Figure 3*) for use on UAVs and algorithms that processes data from those cameras. Due the high processing power of the present-day processors, the main on-board processor can be used to run the fire detection algorithms at the same time while it is conducting other processing tasks for other UAVs systems. The last decade brought us rapid development in both camera and algorithm technology so today exist complementary systems that are low cost, low level complexity and have high level of fire detection possibilities.

Figure 3 - Surveillance cameras for use on aerial vehicles of Wescam company [5]

The main feature of a fire detection algorithm is its ability to detect pixels that correspond to fire pixels or in other words, to compare unknown pixels to pixels that belong to fire. The ability level of an algorithm will determine the percentage of true detected fire pixels against the percentage of false detected fire pixels. Detection can be made with the use of colour pictures as well as black and white pictures. *Figure 4* shows the experimental results for different input images using Vippin's algorithm for forest fire detection.

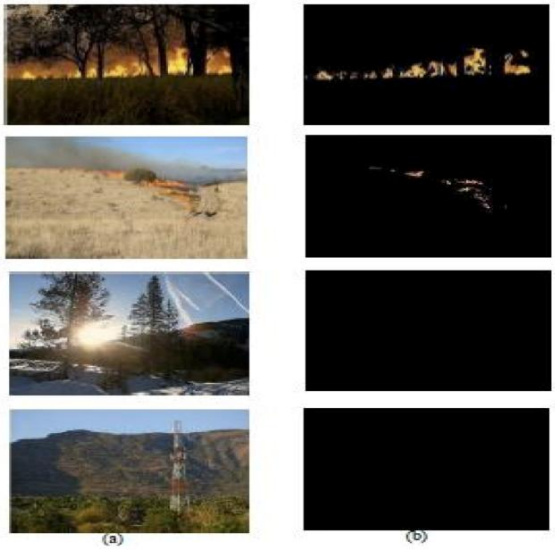

Figure 4 - Experimental Results (a) Input images, (b) corresponding output images [6]

5. COORDINATION WITH GROUND AND AERIAL UNITS

Coordination with other relevant subjects can be classified into two domains: coordination with the Air Traffic Control and other aerial vehicles and coordination with the ground firefighting units. The first is a more complex system because it needs to be incorporated globally but the communication procedures and requests with the ground firefighting units can be set locally. As the main subject of this paper regards firefighting system, the focus will be on the second segment.

Ground fire forces are under command of the firefighting Officer who coordinates a fire fighting mission. Firefighting Officer is a person who gives orders to the rest of the firefighting crew and is responsible for their safety. For this reason, pictures of the area and all other necessary data acquired by an UAV need to be available to the firefighting Officer or to his assistants, depending on the range and complexity of the mission.

Control over the UAV can be achieved only by the GCS, regardless if the GCS is located in one of the Operating centres or somewhere in the vicinity of the burning area. Because of this, coordination is carried out between the GCS and the firefighting units lead by the firefighting Officer. In order to get data from the UAV located above the ground, the firefighting officer must be equipped with a device that is able to receive video signal and other data from the UAV concerning the condition on the ground. One of the possibilities is to use a tablet capable of receiving video data from the UAV (*Figure 5*). Besides the picture of a terrain that has been shoot by the UAV with an on-board camera, the Officer can also view other parts of areas around the scanned area in order to select other points of interest. After selecting the desired points or areas of interest, selected coordinates are sent to the GCU whose operators will fly the UAV in accordance with given instructions.

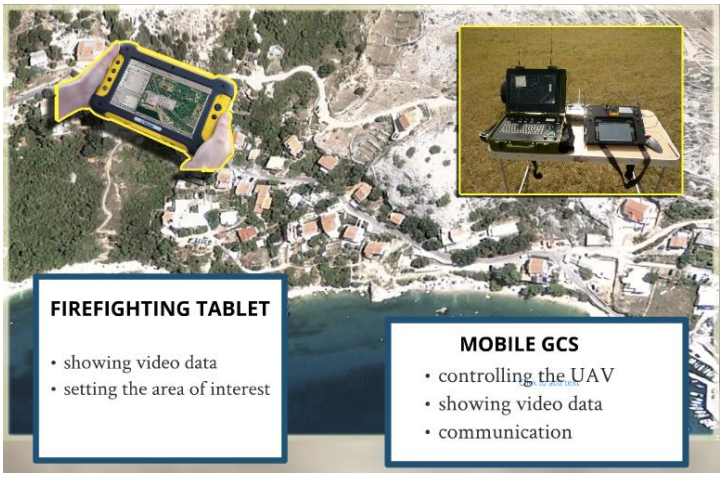

Figure 5 - Mobile systems for communicating and/or receiving on-board sensors data [7]

Optimal strategy for firefighting actions consists of coordinated movements of two separated groups in two levels: ground firefighting crew and air forces with aerial vehicles. The process of firefighting can be set on many bases but the one that is most widely accepted is the one from the Canadian experts that divide the process into three main groups: suppression of fire, second step of fire extinguishing and full extinguishing - total suppression of fire. Aerial fire squadron is mostly active in the first stage of the process known as the knockdown stage. It is vital to start firefighting as soon as possible in order to minimize the potential massive fire spreading. If the fire is developing on the rough, for ground forces inaccessible terrain, the only way to conduct the first stage is to conduct it with the air forces.

Areas labelled as “high risk for fire development”, especially in critical seasonal periods, are under the jurisdiction of government agencies for forest protection, owners or land lessees, factories that have interests in forest preservation or under national protection and rescue directorate. Request for an aerial firefighting action can be triggered by authorized personnel from local authority or even by forestry workers. The request is sent to the flight officer who will discuss the issue with local authority before taking a decision to send a scout, a water bomber or even both. Requests for an air support from other areas or organisations (which have their own aircraft) must be referred to a flight coordinator and to a liaison officer between the Office for the protection of forests and services responsible for the use and maintenance of firefighting aircraft, regardless of whether they are concerned as the military, civilian or some other bodies within other organizations or government administration. Air coordinator oversees the use of firefighting aircraft through protected areas and ensures the optimal use of power, and therefore it is very important that this person is one of top firefighting aircraft pilots. [8] Air coordinator must estimate the situation on the ground, insure high-quality ground cover by aircraft and also coordinate the work with ground fire brigades, as it is shown in *Figure 6*.

Figure 6 - Available options for Fire Stations when using UAVs [7]

During the process of firefighting, aerial vehicles normally operate in the airspace class G. In this segment of the airspace, only general aviation can be found and this is to be informed by the ATC about the on-going firefighting operations.

All the participants in firefighting operations have interacted radio link and it is obvious that UAV segment could be easily integrated into the existing system (*Figure 7*). Danger that UAVs could pose to firefighting aircraft can be avoided by increasing UAVs flight altitude and by that to retain control over the fire site and to allow uninterrupted flight of other aircraft involved in firefighting operations. In the same way as firefighting aircraft pilots communicate with the fire Officer on the ground, it is possible to communicate with the staff in GCS and make further coordination of aircraft actions.

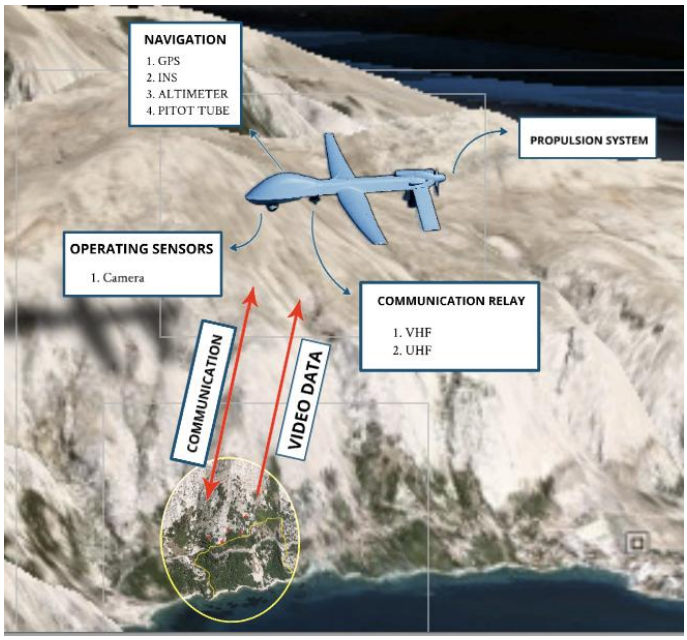

Figure 7 - UAVs systems and the potential usage of UAVs operating systems [7]

The great advantage of the UAVs is that they enable a direct view of the large area affected by fire. Supervision of the current situation on the ground with the exact location of

all fire departments is possible with use of infrared transmitter that fire fighters would carry. These infrared transmitters are devices that are mainly used for missile guidance when the device transmits infrared rays on the target, and a sensor for detecting rays guides a rocket toward the target. In this case a device for marking targets (fire fighter) could be incorporated in fire fighters protective clothing and by that UAV could detect every man on the field and pinpoint its location. The resulting data could be combined with existing maps and by that gain a realistic three-dimensional image of the field with the current positions of all fire departments in this field. In combination with data about the shape, position and movement of the fire front, the resulting field image would represent an incredibly powerful tool with which the fire officers could successfully guide firefighting mission. In the case of an accident, fire fighters on the ground would be able to press a switch connected to an infrared transmitter and thus warn of the danger. UAV in the same moment sends an alert to responsible parties along with a picture of the terrain and the location of closest land units that can first help the injured person. An UAV can be also used as a radio relay in situations where terrain configuration prohibits clear communication between ground firefighting units. As it is flying high in the air, it is able to maintain direct visual contact with ground units so they can use UAVs on-board radio transceiver to maintain stable and clear communication between each other.

The further usage of UAVs could include surveillance of border areas that particularly comes handy when Croatia enters to the Schengen zone, where it will be necessary to monitor stringent land border longer than 1,000 kilometres. Aerial surveillance could also help fishermen in search of shoals of fish and for Search and rescue missions.

6. CONCLUSION

Development of UAVs was marked by their use in military domains and technologies were limited to non-commercial activities for the military sector. By developing new technologies like composite materials, high speed data processing microchips, lithium-polymer and lithium-sulphur batteries, the abolition of wilful misconduct of GPS and finally algorithms that were able to exploit the full potential of microchips, allowed the development of UAVs for civil commercial purposes. Although today available technologies allow the use of UAVs in different domains of public administration, technology complexity of the aviation industry and the complexity of the integration of new into existing systems do not allow a sudden using of UAVs as one might assume.

The issue of implementation UAVs in the fire protection system is more a question of implementation of new technologies than the actual making of the aircraft. UAV represents an excellent example in which new technologies fail to develop their potential because of unsettlement in the whole system: the technology of making and using the UAVs are already known and recognized, but unfortunately these technologies have gone too far with the development which prevents a simple and fast implementation.

As with most products coming from the aviation industry characterized by the high level of technological development, the implementation of certain technological solutions is directly related to the development and financial power of the state and units of local government. Given the above assumptions, it is expected that use of UAVs in firefighting operations in the near future will not come to life in this region, while it is eminently inevitable that in some parts of the world this kind of solutions represent a logical sequence of technological development.

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COMPETITIVE CAPABILITY ANALYSIS OF THE NORTH-ADRIATIC TRANSPORT ROUTE

ABSTRACT

The aim of this paper is to analyse and display the competitiveness of the North Adriatic in relation to alternative transport routes and show the guidelines for the future development of the North Adriatic port system. Northern Adriatic ports, Rijeka, Koper and Trieste are key transport hubs on the North Adriatic transport route. The analysis of micro and macro logistic elements of the northern Adriatic ports indicates that their common points in the business strategy and consequently the further concept of potential progress are emphasized. After the analysis of the economic environment and the potential market of the North Adriatic transport route is performed as well as the distribution display of traffic flows on the route Far East - Europe, an analysis of the competitiveness of the North Adriatic in relation to alternative transport routes is carried out. At the end guidelines proposal for the development, including the need for cooperation and integration of the North Adriatic ports through logistic principles and construction of the land transport infrastructure that will connect starting points of the Pan-European Corridor V and branch V_B is given.

KEY WORDS

North Adriatic transport route, northern Adriatic ports Rijeka, Koper and Trieste, Rijeka-Koper-Trieste railway line, Rijeka-Koper-Trieste roadway

1. INTRODUCTION

The biggest problem that the port of Rijeka has passed several decades ago and which is now reflected on her position is the lack of an entirely state maritime and port policy and the lack of defined development and planning strategy of the port system

In practice, the national maritime policy stimulate the development of one or at most two seaports while undefined process of litoralisation contributed that all Croatian ports in the past wanted to be major and become essential.

Ports of Trieste and Koper were intensively developed in the second half of the eighties and the nineties of the last century.

Within the narrow catchment area the ports of Trieste, Koper and Rijeka act as competitors in respect they occupy equal geographical gravitational field. Taking into account the increase of cargo flows via other routes, especially in the proportion of Hungarian and Austrian cargoes, it is imposed the necessity of joint action of the ports of Rijeka, Koper and Trieste towards the competition.

The goal set in this paper is to analyse the competitiveness of the North Adriatic in relation to alternative transport routes and to show the guidelines for future development of the North Adriatic ports system.

2. ECONOMIC ENVIRONMENT AND POTENTIAL MARKET OF THE NORTH-ADRIATIC TRANSPORT ROUTE

Due to the Adriatic Sea is the deepest point of the European continent, it follows that for Central European countries North Adriatic provides the shortest access to the world sea through the Gulf of Trieste and Rijeka.

At the narrower Central European area there is significant existing and possible potential economic and demographic market that could use the North Adriatic transport route as the optimal route for the flow of goods from the Mediterranean and the rest of the world .

The economic impact of closer European environment on the North Adriatic transport route is as follows:[1]

- the territory of the Republic of Hungary, which covers nearly 10 million people who earn over 196.6 billion US$ gross domestic product (purchasing power parity) and whose total foreign trade amounts to 182.5 billion US$; [7]
- the territory of the Czech Republic, with a population of approximately 10.6 million residents, the gross domestic product of more than 286.5 billion US$, and foreign trade of 264.9 billion US$;
- the territory of the Republic of Slovakia that covers 5.48 million residents who earn 133.4 billion US$ of gross domestic product and which the total amount of imports and exports is at a level of 160.6 billion US$;
- the territory of the Republic of Austria, which covers about 8.2 million people with 361 billion US$ gross domestic product and whose total foreign trade amounts to 333.5 billion US$.

3. DISTRIBUTION OF TRAFFIC FLOWS FAR EAST - EUROPE

According to data of the European Commission, pursuant to a study rating the impact of the concept of the new EU port policy, container traffic has achieved the highest growth in the maritime industry through the past two decades, with an annually average growth of 11.5%. The major propotrion of the container traffic is concentrated in the ports of North West Europe, which has a share in turnover of nearly 60% of the total European container traffic.

Figure 1 –The current scenario of the distribution of traffic flows Far East – Europe
Source: Accompanying document to Comunication on a European Ports Policy: Full Impact Assessment {COM (2007) 616 final} {SEC (2007) 1340}

In Figure 1 the unfavorable situation of the North Adriatic ports and associated transport route is noted: North European ports service areas such as Austria and northern Italy and even Hungary, which according to its natural geographical location gravitate towards the northern Adriatic.

One proposed alternative scenario is shown in Figure 2. It is pointed out that the implementation of alternative scenario depend on investments in port and transport infrastructure.

Figure 2 – Alternative scenario of the distribution of traffic flows Far East - Europe
Source: Accompanying document to Comunication on a European Ports Policy: Full Impact Assessment {COM (2007) 616 final} {SEC (2007) 1340}

Table 1 – Maritime, road and railway distance between the ports of the Far East and destinations in the EU for existing and alternative scenario

Transport	Scenario	Switzerland	Italy	Austria	Spain	France
Maritime (M)	Existing	10,234	10,234	10,234	10,234	10,234
	Alternative	8,645	8,645	8,459	8,940	8,739
	Difference	- 18%	- 18%	- 17%	- 16%	- 16%
Road (km)	Existing	614	950	975	1,650	579
	Alternative	239	142	354	618	505
	Difference	- 61%	- 85%	- 64%	- 63%	- 13%
Railway (km)	Existing	594	925	990	1,545	560
	Alternative	239	140	350	600	500
	Difference	- 60%	- 84%	- 65%	- 61%	- 11%

Source: Accompanying document to Comunication on a European Ports Policy: Full Impact Assessment {COM (2007) 616 final} {SEC (2007) 1340}

Calculating the costs of container transport by different modes of transport between the Far East and various destinations in the European Union comparative analysis of the two scenarios is figured out.

Table 2 – Savings according to alternative scenarios in relation to the existing

	External costs (€)	Transport costs (€)
Maritime transport	- 313,458,783	49,353,774
Road transport	- 260,133,009	- 170,315,229
Railway transport	- 47,099,862	- 106,983,638
Total	- 620,691,654	- 227,945,093
Tons	18,682,864	18,682,864
TEU-s	1,868,286	1,868,286
Average savings per TEU	332	122

Source: Accompanying document to Comunication on a European Ports Policy: Full Impact Assessment {COM (2007) 616 final} {SEC (2007) 1340}

As can be seen from Table 2, the average savings in containers transport is € 122 / TEU and taking into account the external costs it amounts to € 332 / TEU. Total savings in external costs amount to more than € 600 million and observing their structure by traffic branches it reveals they are largest in maritime traffic, followed by savings in road traffic as a result of shorter itineracies.

4. COMPETITIVE CAPABILITY OF THE NORTH ADRIATIC TRANSPORT ROUTE

Central European countries that do not have direct contact with the sea but are distinctly maritime trade oriented have an independent opportunity choice between individual ports taking into account the efficiency of their operations, price and speed of transportation through the entire transport route with the aim of seeking the most favorable routes for the transport of certain goods.

4.1. COMPETITIVENESS OF NORTH ADRIATIC COMPARED TO ALTERNATIVE TRANSPORT ROUTES

The countries of Central Europe can choose from a number of maritime transport routes to the Mediterranean, and to the countries of the Near, Middle and Far East, and on to Australia, as follows:

1. The Atlantic sea route from northern and western ports: Hamburg, Rotterdam, Antwerp, Amsterdam, Bremen.
2. The maritime route from the Black Sea ports: Braila, Izmail, Costanza.
3. The maritime route from the Baltic ports: Gdynia, Gdansk, Szczecin, Rostock.
4. The maritime route from the Mediterranean ports: Marseille, Genoa.
5. Maritime direction from the North Adriatic ports: Ravenna, Venice, Trieste, Koper,
6. Rijeka.
7. River-canal system Rhein - Main - Danube.

Table 3 – Total turnover movement (in 000 tonnes) through North-West European transport route ports and through the ports of Rijeka Trieste and Koper (2008th-2012th years)

Ports	2008	2009	2010	2011	2012	difference (%) 08/12
Hamburg	140,400	110,381	121,186	132,216	130,938	- 6.7
Bremen	74,600	63,036	68,690	80,585	83,979	12.6
Amsterdam	94,800	86,875	90,645	93,018	94,261	0.6
Rotterdam	421,136	386,957	429,926	434,551	441,527	4.8
Antwerpen	189,400	157,807	178,168	187,151	184,136	- 2.8
Total (North-West)	920,336	805,056	888,615	927,521	934,841	1.6
Rijeka, Trieste Koper	76,720	68,774	72,973	74,679	75,550	- 1.5

Source: Made by authors based on statistical data of the ports of Rijeka, Koper and Trieste, and Internet address http://www.rotterdam.com (01:03 2014th).

According to the European and world relations ports of Rijeka, Koper and Trieste are ranked among the small and medium-sized ports.

Looking at the total turnover in the analysed northern and western ports and the ports of Rijeka, Koper and Trieste, it is evident that in the 2012th year it was higher by 12.3 per cent but that the difference in the observed period grew steadily (Table 3.).

Due to the global economic crisis, the turnover of all the observed ports in 2009 year fell compared to the previous year.

By analyzing the movement of traffic since 2009 to 2012th year it shows that the total turnover through ports of Rijeka, Koper and Trieste grew at a significantly lower relative terms than in the northwestern ports of the European transport route.

Table 4 – Container turnover movement (000 TEU) through North-West European transport route ports and through the ports of Rijeka Trieste and Koper (2008th-2012th years)

Ports	2008	2009	2010	2011	2012	difference (%) 08/12
Hamburg	9,737	7,008	7,896	9,014	8,864	- 8.9
Bremen	5,529	4,565	4,888	5,916	6,115	10.5
Rotterdam	10,783	9,743	11,145	11,877	11,866	10
Antwerpen	8,663	7,310	8,468	8,664	8,635	- 0.3
Total (northwest)	34,712	28,626	32,397	35,471	35,480	2.2
Rijeka, Trieste, Koper	858.5	744.8	887.4	1,127	1,093	27.3

Source: Made by authors based on statistical data of the ports of Rijeka, Koper and Trieste, and Internet address http://www.rotterdam.com (01:03 2014th).

The northwestern European ports realised during five-year period the container turnover growth of 2.2 per cent while the container traffic of three Adriatic ports grew by 27.3 per cent (Table 4).

4.2. INTEGRATION OF THE NORTH ADRIATIC PORTS BY LOGISTICS PRINCIPLES

Within the narrow catchment area the ports of Trieste, Koper and Rijeka act as competitors. All three ports have the same natural gravitational fields, but there are certain differences in operating on the market.

In order to improve their position on the market the Association of Northern Adriatic ports NAPA was set up, which includes the ports of Ravenna, Venice, Trieste, Koper and Rijeka, and soon is expected the joining of the ports of Monfalcone and Chioggia.

The main task of the NAPA association is to direct the ports to operate in the international market as a single port system. Harbour members of the association have agreed among others to work on strengthening the links between transport infrastructure of the North Adriatic transport route and the Pan-European transport corridors, and that will support the inclusion of the Central European Transport Corridor in the TEN - T network. [10]

In order to achieve complete connection between ports of Rijeka and Trieste highway section through the Republic of Slovenia, Jelšane – Postojna needs to be constructed. Interest in the completion of this road corridor, in addition to strengthening the position of the port of Rijeka but also the entire system of North Adriatic ports, lies certainly in the ability of routing freight traffic to Croatia or to increase it.

The new railway line that will link the ports of Rijeka, Koper and Trieste, with respect to comparable technical specifications, conjugates on a new high-efficiency lowland railway Rijeka - Zagreb.

The North Adriatic transport route and the corresponding ports connected by highway and by high speed and lower elevation railway become an integral part of the transport network of the Pan-European Corridor V, and the construction of a new high efficiency railway line Rijeka - Zagreb tracing the Corridor V_B and the Danube - Sava Canal reinforces the importance of the Danube Corridor VII and the Pan-European Corridor X.

5. CONCLUSION

The North Adriatic ports of Rijeka, Koper and Trieste on the one part act as competitive ports fighting for the same goods that gravitates to same area in their hinterland. On the other hand, to the ports of the northern Adriatic operates significant competition of larger and stronger Mediterranean, Black Sea and western and northern European ports. This suggests the need for cooperation between the North Adriatic ports by strengthening their comparative advantages and reducing the impact of mutual competing interests. Today new business and development strategies of ports that will allow their strengthening on the market. Are required.

The need for cooperation between the ports of Rijeka, Koper and Trieste lies in the fact that their geographical and traffic position today is not sufficiently exploited, and that their role in the transport of goods to the Central European Market is in secondary position in relation to the northern ports. The ultimate goal of cooperation between the ports of Rijeka, Koper and Trieste should be the creation of a single area of North Adriatic port system.

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IMPACT OF HEAVY VEHICLE VISIBILITY ON TRAFFIC SAFETY

ABSTRACT

One of the essential elements of safety is a good marking and thus the visibility of vehicles in traffic. In order to better visibility of long, heavy vehicles and their trailers, etc., these vehicles have to be marked with edge marking. This marking (contour marking) has to be from highly reflective materials which can guarantee better visibility during night and poor weather conditions. This paper focuses on heavy vehicle safety and aims to demonstrate how innovative reflective technologies can prevent truck crashes and fatalities by increasing their visibility. Over the last 10 years the road toll has shown a declining trend in all vehicle categories, including heavy vehicles despite the facts that the number of vehicles and the kilometers travelled on the roads have significantly increased. It is important that the downward trend remains and simple, low cost conspicuity measures support and accelerate the declining tendency.

KEY WORDS

heavy vehicle safety, innovative reflective technologies, contour marking

1. INTRODUCTION

On the roads of EU, some 50.000 people are killed, and more than 1, 6 million are injured per year[1]. These numbers of killed and injured people constitute an enormous social and economic loss for the European Union. For this reason, the European Commission aims to reduce road casualties during the last 10 years and several large scale experiments were made on behalf of introducing a contour marking for trucks for better conspicuity. The results comparing the accident rates of marked and unmarked trucks always showed a reduction of the number of accidents. This was the reason for preparing a new ECE-Draft Regulation: Uniform provisions concerning the approval to retro-reflective marking of heavy and long vehicles and their trailers as an annex to the agreement: Concerning the adoption of uniform

[1] Conspicuity of Heavy Goods Vehicles; Contract Number: SER-B27020B-E3-2003-Conspicuity-S07.28185 FINAL REPORT, 22 December 2004.

conditions of approval and reciprocal recognition of approval for motor vehicle equipment and parts. Within this Draft Regulation[2] several requirements were made on behalf of:

- Geometrical dimensions
- Coefficients of retro-reflection
- Chromatic co-ordinates and others.

Large scale experiments were restricted to Germany and it was allowed by only special permission to equip trucks and trailers with logos, graphics, letters, and characters of different material types and colors. The geometrical data and the coefficients of retro-reflection of the marking of trucks and trailers were measured during the procedure of giving the special permission for installation of the markings. This paper is focused on regulations related to the vehicle marking and innovative reflective technologies that can prevent heavy vehicle crashes and fatalities by increasing visibility.

2. GENERALLY ABOUT MARKING VEHICLES

The Department for Transport (DfT) has committed to implementing European legislation on the fitment of conspicuity markings to large goods vehicles. These markings effectively illuminate the outline of a vehicle at night by reflection from the headlights of vehicles following behind. These requirements were intended to be transposed into the Road Vehicles Lighting Regulations and enter into force on 10 October 2009. However, in September 2009, the Secretary of State for Transport announced that the requirement for heavy goods vehicles to be fitted with conspicuity markings had been postponed and was introduced from 10 July 2011.

Currently, the Road Vehicles Lighting Regulations 1989 (RVLR) require certain motor vehicles with a gross vehicle weight exceeding 7.5 tones to be fitted with retro-reflective rear marker plates approved to the European Regulation, UNECE Regulation 70.00. (The latest version of this regulation is known as Regulation 70.01; however the UK still permits the use of Regulation 70.00 marker plates.) These plates are fitted in addition to rear lights and reflectors and are intended to make the vehicle more conspicuous to other drivers so they are aware of the presence of a large, potentially slow moving vehicle.

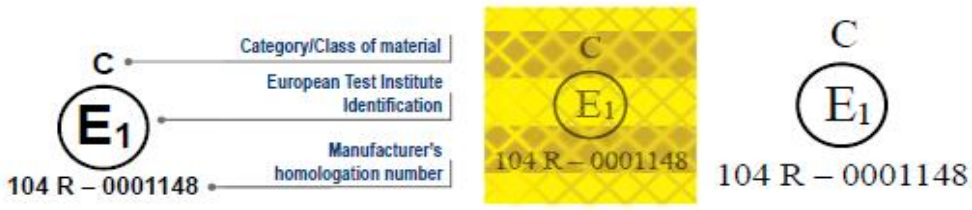
Some vehicle operators also fit conspicuity markings to their vehicles. These are vertical and horizontal lines of retro-reflective material which emphasize the length and shape of the vehicle and also warn other drivers of their presence. UNECE Regulation 104 (R104) provides a technical specification for these conspicuity markings and their use on vehicles in the UK is optional at present under the Road Vehicles Lighting Regulations. UNECE Regulation 48 (R48) is a European regulation that sets out harmonized installation requirements for vehicle lights and reflectors. It is broadly equivalent to the RVLR and the UK cannot refuse registration of vehicles approved to this regulation on the grounds of their lighting. Recently R48 was amended to mandate R104 specification conspicuity markings on certain new heavy vehicles and trailers.

[2] ECE TR-NslWP.29R.773 - Proposal for a Draft Regulation: Uniform provisions concerning the approval of retro-reflective markings for heavy and long vehicles and their trailers, 12- 1996.

3. RETROREFLECTIVE MATERIALS FOR VEHICLE MARKING

Conspicuity marking legislation requires a full contour marking on the vehicle's rear, i.e. horizontal and vertical markings to outline the shape of the vehicle, and partial contour markings on the side. Partial contour markings consist of a horizontal line showing the length of the vehicle and 'tick' marks showing the upper corners of the vehicle. However, where the shape, structure, design or operational requirements make it impossible to install the mandatory contour marking, a line marking is acceptable.

UNECE Regulation 48 requires that the location designated for installing the markings shall allow for marking material at least 60mm in width. The actual width of the marking materials specified in UNECE Regulation 104, which states the width should be 50mm (+10 - 0). So provided the vehicle will accept markings of 60mm it is acceptable to fit any marking material approved to Regulation 104. The certification approval process for conspicuity products is done to ensure that they meet requirements for color, reflectivity and durability set out in Regulation ECE104. The E marking, as shown in Figure 1, is a proof that the product has been tested, certified and meets all the requirements of ECE 104. Without the E-mark, the product is not compliant with the regulation.



Rear marking	red or yellow
Side marking	yellow or white

Figure 1 - Show obligatory requirements for contour marking material (class of material, European test institute identification and homologation number)
Source: FTA compliance guide: Conspicuity marking requirements on goods vehicles

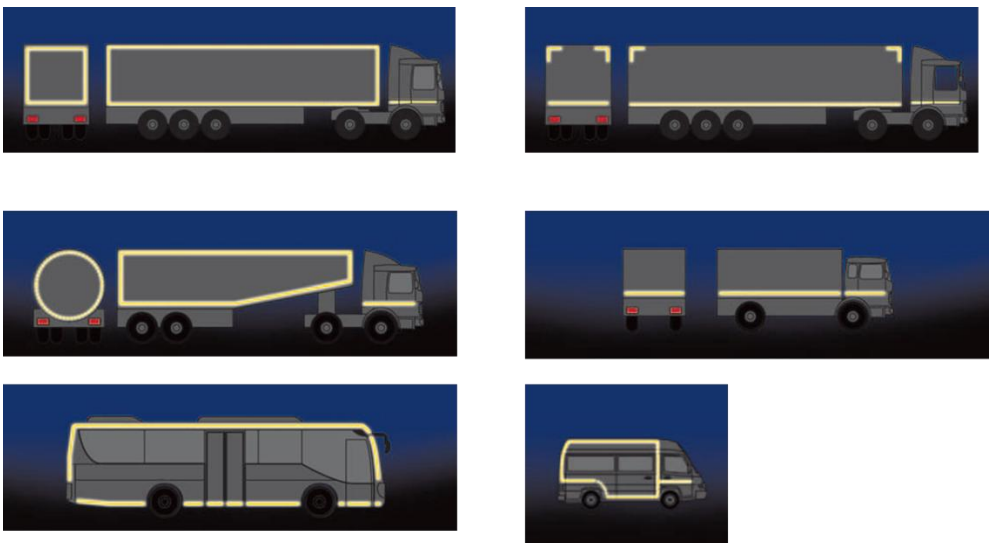


Figure 2 - Show some possible ways of vehicle contour marking appliance
Source: Vehicle contour marking - 3M

Figure 3 - Show different visibility of two vehicle – one vehicle is with contour marking and the other is without contour marking
Source: Faculty of Transport and Traffic Sciences

Table 1 shows the minimum values of the coefficient of retro-reflection R' (ECE - Regulation 104) are drawn up. The requirements for the "red" material were added later into the Regulation.

Table 1 - Shows minimum values for the Coefficient of Retro-Reflection

Minimum values for the Coefficient of Retro-Reflection R' / ($cd*m^{-2}*lx^{-1}$)					
Entrance angle	β = 5°	β = 20°	β = 30°	β = 40°	β = 60°
Color					
White	450		200	90	16
Yellow	300		130	75	10
Red	120	60	30	10	

Source: Conspicuity of Heavy Goods Vehicles - Final Report

Retro-reflective material in conformity with UN/ECE-R 104 is sold by the three manufacturers at approximately the same price. Material prices of roughly € 33 / per square meter (3M foil) were indicated. The manufacturers could not give any concrete details about the costs of installation. The retro-reflective material is normally installed by companies which have been accordingly trained by the manufacturers. The manufacturers stated that the retro-reflective material is very durable and resistant even to high strains while cleaning the heavy good vehicle, e.g. with steam-jet cleaners. Retro-reflective material installed at fixed bodies of HGV is given a warranty of seven years. A three-year-warranty is given by the manufacturers for retro-reflective material attached to new canvas covers. The retro-reflective material for canvass covers differs from that for fixed bodies insofar as it has to be flexible. Such retro-reflective material is offered by the manufacturers Reflexite and 3M. The mentioned manufacturers offer their own products for contour-markings of HGV independently of each other (See table 2). The products meet the requirements of UN/ECE-R 104. Product specimens are attached in Annex F. The products differ e.g. in the set-up of the material or by the different arrangement of reflective structures.

Table 2 - Shows specifications for contour-marking material

	Product / Colors		
	White	Yellow	Red
Avery Dennison	V-6700	V-6701	V-6708
Reflexite UK Limited rigid structure canvass	VC104 white rigid grade curtain grade	VC104 yellow rigid grade curtain grade	VC104 red rigid grade curtain grade
3M Deutschland GmbH rigid structure canvass	Series 983-10 white Series 987-10 white	Series 983-71 yellow Series 987-71 yellow	Series 983-72 red Series 987-72 red

Source: Conspicuity of Heavy Goods Vehicles - Final Report

4. LEGISLATION RELATED TO THE VEHICLE MARKING

In 1958 an Agreement was signed, formally titled "Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions". All participating countries agree on a common set of ECE regulations for type approval of vehicles and components and their reciprocal recognition.

The UNECE has overseen the harmonization of vehicle regulations related to heavy vehicle visibility: UN Reg. 48 - The Installation of Lighting and Light Signaling Devices and UN Reg. 104 the Uniform Provisions concerning the Approval of retro-reflective markings. UN Reg. 48 regulates the requirements on the installation on lighting and light-signaling devices. It governs the visibility requirements of the rear and the side of a heavy vehicle and applies to categories like M, N and trailers equal to category O. The regulation prescribes the colors to be used; white or yellow to the side and red and yellow to the rear. It provides detailed guidance on full, partial or line contour markings and how these should be applied. Table 3 presents a brief summary of the categories administered by UN Reg. 48. optional and mandatory conspicuity markings.

*Table 3 - **S**hows optional and mandatory conspicuity markings for vehicle categories according to UN Reg. 48*

SCOPE	PROHIBITED	International categories: M1 O1	Passenger cars Trailers less than 750 kgs
	OPTIONAL	International categories: N1 N2<7.5 tons O2	N1: Vehicles used for the carriage of goods with a maximum mass not exceeding 3.5 tones N2:<7.5 tons Vehicle used for the carriage of goods with a maximum mass exceeding 3.5 tones but not exceeding 7.5 tones O2: Trailers with a maximum mass exceeding 0.750 tones but not exceeding 3.5 tones
	MANDATORY	International categories: N2>7.5 tons N3 O3 O4	N2>7.5 tons Vehicle used for the carriage of goods with a maximum mass exceeding 7.5 tones but not exceeding 12 tones and above 6 m in length and 2.1 m in width N3: Vehicle used for the carriage of goods with a maximum mass exceeding 12 tones and above 6m in length and 2.1 m in width O3: Trailers with a minimum mass exceeding 3.5 tones O4: Trailers with a minimum mass exceeding 10 tones

Source: Improving road safety by increased truck visibility

The provisions of UN ECE Regulation 104 apply to the approval of retro-reflective markings designed to increase the visibility and recognition for heavy and long vehicles and their trailers explaining the performance requirements. Contour markings are classified as type “C” and the intention of placing retro-reflective tapes on the side and at the rear of the vehicle is to make its shape and dimensions fully visible for other road users.

Retro-reflective tapes used on heavy vehicles and their trailers shall meet the strict requirements defined in UN ECE Reg. 104 which include photometric and colorimetric specifications, dimensional properties and physical and chemical testing expectations. Contour marking materials tested and approved according to UN ECE Reg. 104 shall have the approval mark printed on the surface of the tape showing classification ‘C’, country where the approval was granted and the approval number. This regulation also offers guidance for the marking shape and mounting requirements.

In Europe, governments tried to minimize the negative impacts of heavy vehicle accidents by introducing a national legislation, but as new technologies and borderless trade evolved there was a crucial need to harmonize the international requirements which led to a new European Directive 2007/35/CE, effective from July 2008. The European Union has decided to implement mandatory conspicuity markings for heavy goods vehicles and trailers in all member states from July 2011. The technical, application and performance requirements follow UN Regulations 48 and 104. This is an excellent example of how the adoption of the high performance retro-reflective sheeting for usage in vehicle marking has resulted in another safety improvement for many road users.

5. IMPACT OF HEAVY VEHICLE VISIBILITY ON TRAFFIC SAFETY

Numerous reports are available about the effectiveness of visibility markings aiming at reducing rear and lateral collisions. Visual perception is limited at night which results in relevant information not being received and more attention being required of the motorist. In this situation, trucks, which normally move relatively slowly, represent a potentially dangerous obstacle, especially since the fatality rates for drivers of passenger cars involved in accidents with them are very high on account of the high mass of the trucks. About 40% of road accidents take place at night, dawn or dusk in spite of the fact that not more than a third of the traffic is on the roads (compared to day-time driving). It can be concluded that driving at night is at least twice as dangerous as during the day. (Schmidt - Clausen 2000).

The National Highway Traffic Safety Administration USA (NHTSA) has studied the effectiveness of retro-reflective conspicuity tape on heavy trailers. (Morgan 2001) In an effort to quantify the effectiveness of the retro-reflective tape requirement on heavy trailers, NHTSA made arrangements with the Florida Highway Patrol and the Pennsylvania State Police to collect data and compile statistics on whether or not retro-reflective tape was installed on heavy trailers involved in crashes. Data was collected on 10,959 cases in these two states. The study concluded that the usage of retro-reflective tapes on trucks was effective and significant reductions could be achieved in side and rear impacts. In dark conditions defined as dark: not lighted, dark: lighted, dusk and dawn periods, the use of retro-reflective tape reduced overall side and rear impacts into heavy trailers by 29 percent. In dark-not-lighted conditions the use of retro-reflective tape reduced side and rear impacts by 41 percent. The study also declared that severe crashes were decreased by 44% and that the use of reflective tapes was especially effective in rain and fog conditions.

The German technical University of Darmstadt had also conducted an examination of night time and day time accidents between a test group comprising 1000 vehicles equipped with contour markings and a control group of 1000 vehicles without such measures. After 2 years of the installations the conclusion was drawn that 95% of night time collisions could have been avoided if trucks of the control group would have had retro-reflective visibility markings. The results of increased truck visibility demonstrated that 41% reduction of rear end crashes and 37% decrease of side impacts could be achieved by applying reflective, outline markings on heavy vehicles. The data analysis had also confirmed that the risk of an accident between truck and car was 30 times greater without conspicuity markings. (Schmidt - Clausen 2000).

Studies have shown that contour-marking of HGV (Heavy goods vehicle) provides the highest degree of conspicuity and significantly reduces the reaction time of car-drivers. For an optimal marking of HGV, it is recommended to equip the side and rear with a contour-marking. At least 80% of each side should be marked. In cases where contour-marking is impossible, a marking with a line/double line is recommended. In specific cases, a marking with a flexible cable is advisable. It is recommended to perform the contour-marking according to the examples given in UN/ECE-R 104. With colored material, the effectiveness substantially decreases, with yellow by 40% and with red by 80%.

Equipping a truck and a semi-trailer with retro-reflective tapes would cost approximately €1,500 which is a low cost intervention. Investing into making trucks safer would save more on economic costs than the money charged for the material and application, and would definitely have a positive impact on saving more lives on our roads. Expected results of the mandatory application of contour marking in Croatia are shown in table 4 (table

show quantity of accidents and their possibility of avoiding by using contour markings on heavy good vehicles).

Table 4 - Show statistics of accidents with commercial vehicles and to avoid the same

Statistics of accidents with commercial vehicles and to avoid the same			
For EU-15	Accidents	The possibility of avoiding	
Accidents	**4531**		
Died	**402**	**165**	**41%**
Heavier injured	**2159**	**857**	**40%**
Easier injured	**4904**	**1838**	**37%**

Source: Vehicle contour marking - 3M

6. CONCLUSION

The readily available vehicle and road markings technologies should be leveraged to improve road safety for all road users. The adoption of the high performance, UN ECE 104 certified retro-reflective tapes for usage in vehicle visibility marking is another safety improvement for both heavy vehicle drivers and other road users. A review of the relevant ADR standards needs to be undertaken to take into consideration the latest technology and the global best practice to evaluate the mandatory introduction of visibility markings for heavy vehicles. Croatia is also a signer of the International Convention on traffic safety, and also committed to accepting of international standards. Based on these commitments the Republic of Croatia has issued an Order of the retro-reflective homologation mark for heavy and long vehicles and their trailers (NN 99/00). On the basis of the European statistics on traffic accidents, it was observed that the long and heavy vehicles and their trailers, buses and other motor vehicles are very dangerous traffic participants. Therefore, the international community is working hard to increase safety, and to have standard forms to increase visibility of vehicles in traffic, has developed new systems of protection contour marking, all in order to increase traffic safety. In Croatia all newly registered Heavy goods vehicle and their trailers and also long vehicles and their trailers must be marked from (01.10.2011.) with Contour marking. This is ensured by modifying Article 39 Regulations on the technical requirements of vehicles and supplementing Ordinance of technical tastings of the vehicles. Contour marking with retro-reflective materials is a means of conspicuity of the vehicle silhouette respect the vehicle type. Studies have shown that contour-marking of heavy good vehicles provides the highest degree of conspicuity and significantly reduces the reaction time of car-drivers.

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MOBILE LASER SCANNING METHOD FOR ROAD MARKINGS DATA COLLECTION

ABSTRACT

Recently, mobile laser scanning (MLS) has emerged as an efficient means to acquire massive 3D point clouds along urban road corridors for the several applications such as building footprint reconstruction, facade modeling and road traffic inventories. A mobile laser scanning (MLS) system allows direct collection of accurate 3D point information in unprecedented detail at highway speeds and at less than traditional survey costs, which serves the fast growing demands of transportation-related road surveying including road surface geometry and road environment. This paper presents all the possibilities of mobile laser scanning, especially identifying traffic signalization (traffic signs and road markings) using the reflectivity information provided by the lidar sensors. As one type of road feature in traffic management systems, road markings on paved roadways have important functions in providing guidance and information to drivers and pedestrians.

KEY WORDS

mobile laser scanning, sensors, georeferenced video, traffic signalization

1. INTRODUCTION

Road administrators require more and more objective information's about their network and its surrounding environment for various purposes: disaster management, urban planning, tourist guidance or simply road network management are some of the applications that demand precise city modeling and interpretation. Industry also needs 3D reconstructions of large areas; map providers for navigation systems now include semantic data in their bases that can be interfaced in warning or driving assistance systems, mobile communication development needs data for radio waves coverage analysis *etc.* Many companies and research labs have then focused in the last decade on the acquisition of mass data, developing many acquisition platforms. Road network surveying generally implies aerial or satellite multi spectral images processing but these approaches suffer from a lack of precision regarding road geometry, although they provide a good classified overview of processed areas (Hatger and Brenner, 2003) (Samadzadegan et al., 2009). Some research teams have therefore promoted

fusion between terrestrial and aerial data (Früh and Zakhor, 2004), requiring an existing digital elevation map of the area to be processed.

City modeling is generally performed by means of vehicle borne lidar and cameras (Zhao and Shibasaki, 2003) (Deng et al., 2004) (Boström et al., 2006); these works however do not apply on road geometry or characterization. Some companies, cartographic institutes and laboratories developed road dedicated vehicles, using inertial systems and 3D lidar sensors in order to provide interpreted road environments. StreetMapper (Barber et al., 2008) focus on elevation models, ICC (Talaya et al., 2004) use stereo and (Ishikawa et al., 2006) monocular images for automatic processes, finally (Jaakkola et al., 2008) process lieder data as image for extracted different kinds of road markings. (Goulette et al., 2006) only provide automatic lieder data segmentation, performing classification of acquired scans in road, trees or obstacles. The acquisition speed is nevertheless very low and the developed method cannot deal with rural roads, as road extraction implies curbs.

2. SYSTEM FOR MOBILE LASER SCANNING

The car-mounted mobile laser scanning system (mobile lidar) has become a cost-effective solution for capturing spatial data in complex urban areas at the street level quickly and accurately. In particular, mobile lidar can acquire three-dimensional (3D) dense-points, which enable easier building facade reconstruction, man-made object extraction, 3D city modeling, street-scene modeling, and visualization than most other methods. In most cases, the interpretation of 3D lidar point clouds is the first step of the above mentioned tasks.

In France1, they developed an acquisition vehicle for road surveying consisting in a very precise positioning system, a CCD Color camera and 4 linear scanning sensors. The positioning system consists in a Trimble Omnistar 8200-Hp GPS receiver, combined with an Ixsea LandINS inertial measurement unit. This association delivers filtered 200 Hz GPS data and can support GPS outages up to 300s while presenting very small drifts (0.005◦ for pitch and roll, 0.01◦ for heading, 0.7m in the x-y plane and 0.5m for the z coordinate). Orientation data are given in a North East Up reference, and GPS positions are translated in a metric coordinates system using the adequate conic projection. As an imaging system, they use an AVT Pike F-210C, a CCD color camera which provides Bayer filtered high definition images, with a frame rate up to 30 Hz. Instead of a constant rate they decided to set the camera such as it takes an image every n meters (n is generally set to 5 m, but can be adapted depending on environment). Four SICK LMS-291 are installed on the roof of the vehicle (Figure 1). These Laser range sensors provide 180◦ scans (with 0.5° angular resolution) up to 60 Hz scan rate. Their sensing maximum range reaches 80 m with a 10 mm error and they also can output reflectivity values (Figure 2). Three of them are looking to the ground with different orientations, the fourth one being oriented towards the sky, in order to capture building facades or trees (Figure 3). These sensors are controlled by the vehicle speed, stopping the acquisition when the vehicle is stopped.

[1] VIAMETRIS, Maison de la Technopole, 6 rue Leonard de Vinci, BP0119, 53001 Laval cedex, France, www.viametris.fr

Figure 1 - Shows vehicle equipped with lidar and cameras while figure 2 shows "Front" and "Sky" lidar sensors cones of view
Source: Road extraction and environment interpretation from lidar sensors (Laurent Smadja, Jerome Ninot and Thomas Gavrilovic)

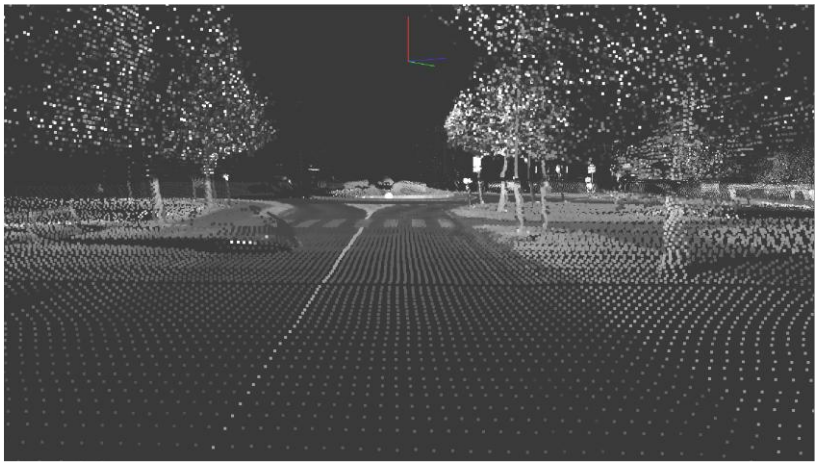

Figure 3 - Shows 3D world with reflectivity data
Source: Road extraction and environment interpretation from lidar sensors (Laurent Smadja, Jerome Ninot and Thomas Gavrilovic)

Every data are acquired and time stamped using ^{RT}Maps software, on a single on-board computer (Pentium IV, 2GHz) with adequate disk space.

3. PREVIOUS STUDIES

There are few road boundaries detection methods using only lidar range sensors. A well-known paper (Kirchner and Heinrich, 1998)[2] settles a horizontal lidar in order to detect guardrails. A third polynomial road boundary model (with no first order term) is used to approximate clothoid curve and an extended Kalman filter processes successive scans. The Kalman prediction is performed using the steering angle and vehicle speed and the correction stage assumes a radial error model. This approach inspired many other research teams despite of being limited to roads presenting guardrails or curbs: another method uses a lidar oriented towards the road and looks for curbs in successive scans (Wijesoma et al., 2004)[3]. They

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assumed that each scan is ideally composed with different "flat" .phases: horizontal as the sidewalks and the road, vertical as the curbs borders. A predicted point is computed from the previous two range measurements on a frame, large prediction errors indicating phase changes. The extracted segments are fitted by lines then further analyzed to provide potential curbs.

The "flat road" approach has also been tested by Kim (et al., 2007.)[4], that ensure a robot positioning through a curb detection. Noticing that, due to the larger point density in front of the range sensor, the most represented line is the road, they performed a Hough Transform on the scan data. Curbs are then extracted as the extreme points surrounding the road. An apparently faster approach uses histogram thresholding to detect curbs (Aufrere et al., 2003.)[5], from a side oriented lidar sensor, and via a modular algorithm. A maximum contrast approach is then used as curbs present a different illumination than road and sidewalk. Different approaches use a multi-layer lidar sensor. Dietmayer (et al., 2006.)[6] presents two aspects of road detection with an 6 layers lidar, two of them being dedicated to lane following; this part is performed by correctly setting the sensor sensitivity, as asphalt present a small reflectivity compared to road markings. Besides, they present an object detection by segmenting each scan with an adaptive threshold, the classification being performed through the object dynamic analysis (Sparbert et al., 2001). These obstacles are further eliminated so as not to disturb the road extraction process. Assuming an equal curvature for left and right sides and considering several curvature hypotheses, the road is extracted by finding the solution that minimizes the number of candidates between the road boundaries.

The authors of "Road extraction and environment interpretation from lidar sensors"[7] finally classify the road type from the estimated width, and discard unlikely object classifications. Starting from the observations they developed a two-step road detection algorithm which processes the front lidar scans. This algorithm is based on different uses of RanSaC method (Fischler and Bolles, 1981)[8]. Extracted road boarders and centers are then processed and provide useful information about road geometry, such as road width or road curvature.

Also, test of MLS (mobile laser scanning) data was carried out in survey area of Xiamen Island, a part of the City of Xiamen, which is a major city on the southeast coast of China. The data[9] were acquired on 23 April 2012 by a RIEGL VMX-450 MLS system, which was smoothly integrated with two RIEGL VQ-450 scanners with laser pulse repetition rates (PRR) up to 550

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[8] Fischler, M. A. and Bolles, R. C., 1981. Random sample consensus: A paradigm for model fitting with applications to image analysis and automated cartography. Communications of the ACM 24(6), pp. 381–395.

[9] Haiyan Guan , Jonathan Li, Yongtao Yu, Cheng Wang, Michael Chapman , Bisheng Yang ; Using mobile laser scanning data for automated extraction of road markings.

kHz, an IMU/GNSS unit, a wheel-mounted Distance Measurement Indictor (DMI), and four high-resolution cameras. This integrated set of the VMX-450 MLS system was mounted on the roof of a vehicle travelling at an average speed of 50 km/h. The two RIEGL VQ-450 laser scanners were symmetrically configured on the left and right sides, pointing toward the rear of the vehicle at a heading angle of approximately145°.

4. IDENTIFYING OBJECTS TO SCAN

In general, off-ground urban objects can be divided into man-made and nature objects, whereas man-made objects are referred to a variety of buildings, traffic facilities, power lines, poles, and cars, while nature objects are referred to vegetation. The approach for identifying man-made objects from natural objects consists of three steps: the preprocessing; the extraction of seed points for man-made objects; and the extraction of man-made objects

In the preprocessing, ground points are detected by analyzing the height histogram (Yao et al., 2010[10]) and are further delivered to a surface fitting algorithm (Gridfit Algorithm) to obtain a ground level raster. The vertical distance of each point to the ground level is calculated as the height above the ground level (AGL - altitude above ground level). Man-made objects can be separated into three classes according to the AGL height: 1. Fences or cars whose AGL heights are less than two meters; 2. Buildings whose AGL heights are larger than two meters; and 3. Power lines hanging in the air and having the lowest AGL height of five meters. In the vertical dimension, different objects could co-exist. For instance, a vehicle might be parked under a tree, while branches of a tree grow over the fence. This leads to error detection when using the method of projecting 3D points on a horizontal accumulator used in Hammoudi (2009)[11]. To overcome such deficiency, the off-ground points of MLS data are divided into three layers according to the AGL height.

The second step aims to extracting seed points of man-made objects in each height layer. The ideal is rooted in the fact that man-made objects feature geometric regularity like vertical planes, while vegetation reveals a huge diversity of shapes and point distribution. If 3D points are projected onto 2D horizontal plane, the position where man-made objects are located will indicate a large accumulation density.

The last step provided seed points of man-made objects in the three layers. Every cluster formed by seed points corresponds to an individual urban object. They will be distinguished to different types of objects at first. As indicated in step of pre-processing, cars and fences exist only in the lower layer, while power lines can only be found in the upper layer, and building points could be found in every layer.

[10]Yao, W., Hinz, S., Stilla, U., 2010. Automatic Vehicle Extraction from Airborne LiDAR Data of Urban Areas aided by Geodesic Morphology. Pattern Recognition Letters, Vol.31, no.10, pp. 1100-1108.

[11] Hammoudi, K., Dornaika F. and Paparoditis N. 2009. Extracting building footprints from 3D point clouds using terrestrial laser scanning at street level. In: Stilla U., Rottensteiner F., Paparoditis N. (Eds) CMRT09. IAPRS, Vol. XXXVIII, Part3/W4, Paris, France, 3-4 September, 2009.

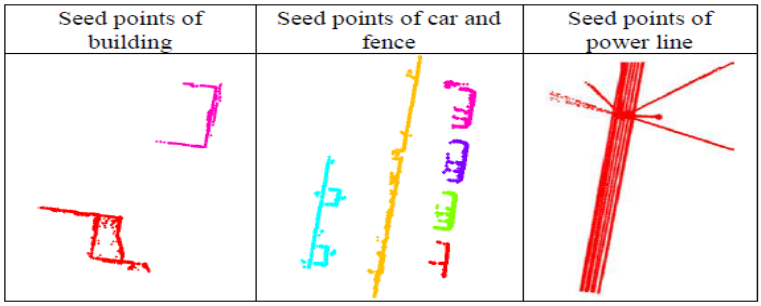

Figure 4 - Show approach for identifying man-made objects from natural objects

Source: Automated detection of 3D individual trees along urban road corridors by mobile laser scanning systems Wei Yao and Hongchao Fan

5. ROAD MARKINGS MLS DATA COLLECTION

Road signs are designed to present a high reflectivity; on figure 3, where the points reflectivity is displayed as a gray level, we can observe white areas, corresponding to license plates or road signs. Using a simple threshold on reflectivity value then on the size of the resulted areas, we can easily extract road signs in the virtualized environments (Figure 5). The sign areas can further be projected on image in order to perform optical fine extraction and recognition.

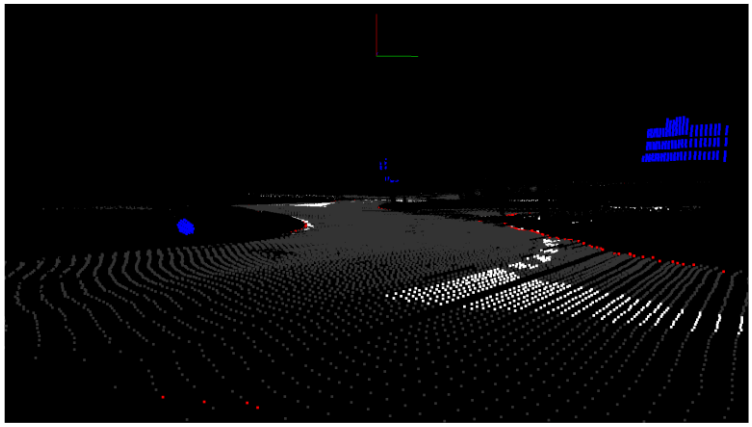

Figure 5. - Shows road signs displayed in blue and road markings displayed in white color (mobile laser scanning)

Source: Road extraction and environment interpretation from lidar sensors (Laurent Smadja, Jerome Ninot and Thomas Gavrilovic)

With a correctly extracted road and using the reflectivity data, we can also extract road markings trough a simple thresholding. As claimed (Dietmayer et al., 2006[12]), asphalt presents a much lower reflectivity than road markings so that threshold determination is quite easy. Nevertheless, this approach can in some cases be less robust than image processing methods, as it highly depends on marking reflectivity, which is faster deteriorated than white painting. In the most cases, road markings show linear features and have dimensions of known width and length. To extract road markings from the point clouds filtered by two-step filter operator, a georeferenced reflectance intensity image was firstly generated. Then, the 4-connected regions of the georeferenced intensity image were labeled for detecting the regions of road

[12] Dietmayer, K., K¨ampchen, N., F¨urstenberg, K. and Kibbel, J., 2006. Roadway detection and lane detection using multilayer laserscanner. In: Proceedings of International Conference on Robotics and Automation, Orlando, FL, USA, pp. (on CD - ROM).

markings. For each 4-connected region, a set of parameters namely, the area of each 4-connected region, the area, length, and width of the minimum bounding box of each 4-connected region, and the ellipse with the same second-moments as the 4-connected region were calculated, respectively. Figure 6 shows segmentation of the point clouds of a road. An interpolation method is first used to generate a georeferenced feature image of the point cloud which helps to isolate the points of road surfaces. Then, an algorithm is used to separate these points within a range according to their strength of reflection. The separated points are further segmented to remove non-road points based on height threshold. Finally, the outlines of road markings are extracted (we get the cadastral of road markings or traffic signs) the segment points using the semantic knowledge of road markings.

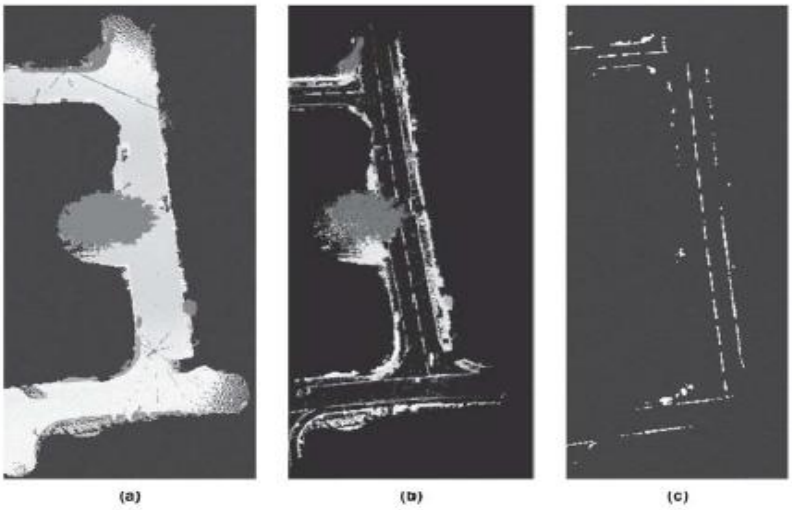

Figure 6 - Shows segmentation of the point clouds of a road: a) Original point clouds; b) Filtered result by reflectance intensity; c) Filtered result by height
Source: Automated extraction of road markings from mobile lidar point cloudsB Yang, L Fang, Q Li, J Li

6. CONCLUSION

Automated restitution methods for object acquisition have gained more and more importance in the last years. Mobile laser scanning (MLS) is the latest approach towards fast and cost-efficient acquisition of 3-dimensional spatial data. Scanning objects using a 3D-laser scanner operating in a 2D-line scan mode from various different runs and scan directions provides valuable scan data for determining the angular alignment between inertial measurement unit and laser scanner. Field data is presented demonstrating the final accuracy of the calibration and the high quality of the point cloud acquired during an MLS campaign. The mobile laser scanning technology achieved the best performance evaluation, where a detailed data analysis, data collection, mobile laser missions, modelling and interpretation, system geometrical corrections for the location and orientation also have been conducted. Next to automatic image matching, laser scanning, often also referred to as LiDAR (light detection and ranging), has revolutionized 3D data acquisition for both, topographic as well as close range objects. In contrast to the “classical” manual data acquisition techniques, like terrestrial surveying and analytical photogrammetry, which require a manual interpretation in order to derive a representation of the sensed objects, these new automatic recording methods allow an automated dense sampling of the object surface within a short time. Mobile lidar technology is a widely accepted tool providing exceptionally efficient data collection of high accuracy for various surveying applications. Prior conducting the performance

evaluation, the research investigates the mobile laser behavior and recognition capabilities with respect to polyethylene city infrastructure materials.

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