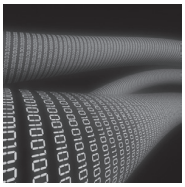

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Telematic Applications – Key to Improve the Road Safety

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ABSTRACT

The transport forms an inevitable condition for the management and effective working of the economics and the society as a whole. Its wide range of use and quick development are often considered to be the main reasons of undesirable side effects on the environment. A growing number of cars on roads and highways contributes substantially to the air pollution. Therefore the international and national organizations are trying to find ways and mechanisms how to improve the environment together with the extension of traffic network. The cumulating problems of the unfriendly environmental impacts of transport should be resolved. The problems are being solved with an active approach, which is oriented to the prevention or early elimination. The solving of these problems belongs to the sphere of Resort of Transport and Environment. It is necessary to focus on this way prior to the after-effects solving.

KEYWORDS: Telematic Application, Fatalities, Enviroment

1. Introduction

The challenge of the EU in this area is to reduce the emissions and the energy consumption due to transport activities, in order to avoid or to reduce the related environmental impacts (mainly the air pollution in urban areas, with the consequent effects on human health and on local and regional environment, and the production of greenhouse gases), without affecting the economic growth. In other terms the challenge is a sustainable growth of transport.

A majority of accidents is caused by the fact that someone misses something in a critical point in time. According to IT experts, there are approx. three million bits of information attacking the human mind every second. The human brain, however, is able to process 16 incentives in a second. The actual reception is dependent on the attention. Psychologists say that a healthy and relaxed person is able to receive up to 6 impulses in 1/10 second but this number drops to around 2-3 while driving. Speed and traffic situation complexity is also important. It is essential that the driver appropriately filters the relevant impulses and rejects the irrelevant ones, e.g. pedestrians on the sidewalk or billboards. In contrast to other means of transport, the participants in the road traffic are now always experienced professionals. [2]. As is apparent from the traffic accidents, more than 95% of accidents is caused by human error, neglecting driver's responsibilities, incorrect assessment of situation and his/her abilities etc. The operational measures, which are mainly in the field of organisation, regulation and traffic control, are an inseparable part of the traffic/transport system. It is a condition to effective utilisation of transport vehicles, transport routes and provision of steady, safe and efficient traffic. Efficient transport services are crucial from perspective of the competitiveness of European industry. Transport contributes greatly to its growth, but also creates negative externalities, which are, for instance, estimated for 1,1% of the European GDP [10]. Overload of the roads constantly increases and deprive the GDP of more than 1%. In the meantime, safety has increased significantly, but the situation is still not satisfactory. [8] Looking ahead, the expected reduction of the number of fatal accidents should continue until 2020 with the aim to reduce their number about 75% of the state in 2001.

The Slovak Republic as a full member of the European Union respects the recommendations of the European Commission in the

sphere of road safety and is trying to accomplish them. Slovakia has not succeeded in meeting the obligations despite a great effort to prepare legislative and technical conditions for achieving the goal to reduce consequences of road accidents in 2010 which was to reduce the death toll by half and which was adopted when entering the European Union. (see Figure 1).

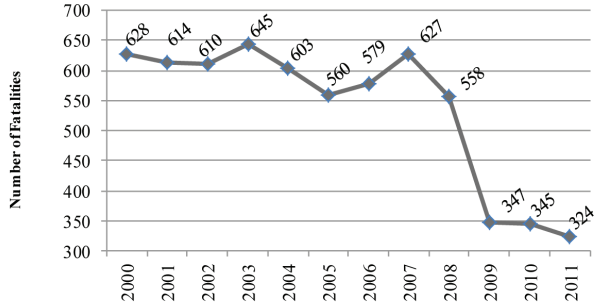

Fig. 1. Death toll in the Slovak Republic in the given period [10]

The development of transport in all its sectors is linked with the integration to the advanced countries and with developing of the society. Year by year, the number of vehicles is increasing on the roads as well as new drivers and with this situation is associated lot of negative effects. The number of road accidents and their consequences increase in the consequence to lack of conditions for the realization of transport education, low discipline, aggressive driving, violation of fundamental duties and low legal awareness of drivers and other participants of road traffic. [5, 7]

Traffic accident rate as a serious social problem requires a comprehensive and effective solution that shows features of a coordinated and aimed procedure by all stakeholders and institutions with a broad public support. [3]

2. Introduction

The environmental impact of increased road traffic can be seen in local, regional and even global merit. Basic negative factors are the production of harmful smokes from internal combustion engines, pollution of the air, water and soil, the noise and vibrations from traffic operation also the taking up of valuable soil for transport connected buildings.

Significant external costs are caused by: [8]

- accidents, generating a whole range of costs which are only partly covered by mutual risk insurance schemes (loss of life, medical care and disabilities sustained by victims, loss of production, etc.).
- air pollution, emission of particulate matter, carbon monoxide, lead, volatile organic compounds, nitrogen oxides and sculpture dioxide, damaging health, the environment and buildings.
- climate change, greenhouse gases (mainly carbon dioxide – CO2) have an enduring impact on the earth's climate, resulting in increased desertification, raised sea levels, serious harm to agriculture and other destructive environmental and health-related side-effect.
- noise, transport generates noise, which adversely affects humans in a variety of ways, causing disturbances, stress and more serious health problems.
- congestion, more vehicles are being added to already dense traffic flows, particularly car traffic flows, paralyzing the system and leading to substantial wastage for all users. Congestion makes the entire transport system inefficient.

Total external costs (excluding congestion costs, with climate change high scenario) are amounted to 650 billion €, being 7.3% of the total GDP in EU 17 (5%). The most important mode is road transport, causing 83,7% of total cost, followed by air transport, causing 14% of total external costs. Railway transport (1,9%) and waterways (0.4%) are of minor importance.

In road transport, climate change is the most important cost category with 30% of total cost, if high shadow prices are used. Air pollution and accident costs amount to 27% and 24%. The costs for noise and up- and down-stream processes each account for 7% of total costs. [4]

3. Telematic Applications in the Road Transport

Well-working control systems, affecting transport in residential areas or rural zones, improve the steadiness of traffic flows and reduce the numbers of accidents, congestions, psychic overload of drivers and improve the comfort and quality of transportation. Three-layer hierarchy is suggested for applications in road transport. In the hierarchy of town systems, the first layer is defined by individual transport nodes (traffic light systems on crossroads, parking systems, tunnel management systems etc.). The second layer is management at the area level. The third layer is constituted by head offices which are the highest stage in the hierarchy and contains several areas.

Traffic management systems combine the new and existing traffic managements as well as control systems for the optimization of traffic flow on motorways and urban and suburban expressways. Primary feature is the integration of traffic control subsystems (e.g. signalization, motorway and transit control systems) and the provision of dynamic checking in real time in a way that reflects the changing traffic conditions. In the urban areas this represents so-called "intelligent communication" to be used by the "intelligent vehicle" [2].

An important function is the providing of wide range of information to drivers and passengers in the vehicles which allows more effective utilization of road network. Information about direction, routes and driver services are sent directly into the vehicle. Information about transport congestions as well as information regarding dynamic navigation en-route is dependent on the communication link between the vehicle and main office. This information can be transmitted anytime as a continuous traffic monitoring. The knowledge of intensity provides realistic and immediate picture of traffic situation. Accurate and current information about traffic intensity at individual sections, announcements on accidents, dynamic route information that

can be supplemented with other type of information, e.g. parking options, recommendations to detours, hotels etc. are sent to other participants of the transport process. The question is how much information is the driver able to process to react optimally. The goals of mobile systems for dynamic direction finding are:

- to navigate drivers and to recommend a place for joining a lane according to current traffic intensities and average speed of traffic flow;
- to reduce the length of queues;
- to eliminate aggressive behaviour of drivers;
- to reduce negative externalities through optimal en-route navigation.

The main objectives of transport telematics are to offer to traffic users' intelligent services, which must be considered at several levels and they are:

- services to travellers and drivers,
- services for infrastructure administrators,
- services for transport operators (carriers),
- services for public administration,
- services for security and rescue system,
- services for financial and control institutions.

The basic components of transport telematic systems include the following fields:

- Electronic payments,
- Management of security and rescue measures,
- Management of traffic processes,
- Management of public passenger transport,
- Support at management of means of transport,
- Support of people's mobility,
- Support of supervision over adherence to regulations,
- Management of freight transport and forwarding agents.

4. Transport and Traffic Database

Assistance systems are the main challenge. They are based on communication (data exchange) not only among vehicles themselves but also vehicles and infrastructure. These so called Intelligent Assistance Systems promise great benefits in the sphere of efficiency of transport systems and road safety. These benefits include mainly increase the capacity of the road network, reduce congestion and pollution, shorter and more predictable time of driving, improving traffic safety for all participants of road traffic, lower operational costs for vehicles, better organization and management of road networks.

So what is a Co-operative System? These are in fact a very recent development in the area of ICT-based road transport applications. Examples of systems under development include traffic control and management systems; intersection collision warning applications; weather and road condition warning systems; route guidance to avoid traffic congestion and, consequently, wasting fuel; as well as information tools, for example advice on the location of nearby car parks with available parking spaces. Communications among vehicles (called vehicle-to-vehicle communications) and also two-way communications between vehicles and Information and Communication Technologies incorporated into the road infrastructure (called vehicle-to-infrastructure communications or, infrastructure-to - vehicle communications) are crucial for the delivery of such applications. The usefulness of co-operative road transport applications is very much dependent upon achieving a critical mass of vehicles installed with the equipment and the technologies needed to deliver the desired services. The road infrastructure must also be extensively fitted with the necessary sensing, communications, and information devices. Crucially, ensuring communications between all elements in the system is necessary, and an agreed Communications Architecture is essential for this. Developing of such architecture is one of the important research objectives and so that is being pursued in Europe, research that will help to ensure world leadership for Europe's road transport sector. What is more, this architecture will also provide the means of delivering a coordinated and integrated European input to the development of standards.

Cooperative systems for transmitting information in real-time use communication among vehicles (Vehicle-to-vehicle) and between vehicle and infrastructure (Vehicle-to-Infrastructure) hold the promise of major improvements in the efficiency of the transport system, improve safety for all road users and increase the convenience that the mobility provides. The work on cooperative systems started in Europe in the fifth and sixth Framework Programme CVIS (Cooperative Vehicle-Infrastructure Systems) is a major European research and development project aiming to design, develop and test the technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure.

Cooperative Vehicle-Infrastructure Systems CVIS – benefits are (to):

- increase road network capacity,
- reduce congestion and pollution,
- shortened and more predictable journey times,
- improve traffic safety for all road users,
- lower vehicle operating costs,
- more efficient logistics,
- improved management and control of the road network (both urban and inter-urban),
- increased efficiency of the public transport systems,
- better and more efficient response to hazards, incidents and accidents.

5. National System of Traffic Information

Establishment of the NSTI is needed to achieve a significant reduction in traffic accident rate. The main objective will be the ensuring the greatest temporal and territorial extent of road network passage and improve safety and traffic flow through a reliable, functional, efficient and safe road transport system. [1,10]

National system of traffic information: Complex system environment for collection, processing, sharing, publishing and distribution of traffic information and traffic data on:

- current traffic situation on the road network,
- the network of road communications, components and equipments,
- environment for administration and operation of applications and systems over the traffic information and traffic data in connection with uniform geographical model of road network

Main goals are to:

- provide serviceability of road network.
- increase safety and continuity of road traffic and
- minimise negative impacts from road traffic.

The ensuring of the road network passage means to have continuously updated traffic information and traffic data of all phenomena or events that partially or fully limit passage or negotiability of the network in some areas or sections, directly or indirectly affect the safety or continuity of the road traffic.

It is important to present the domains of National system of traffic information, which are:

- Generation and collection of information,
- ITS of big agglomerations,
- ITS of main roads.

On the 14th of January, 2009, The Slovak Government admitted the „Programme of support of development of ITS ". The total investments are calculated on 118,8 mil. €. Issue of Slovak road administration is included in the Operational Programme Transport for years 2007 to 2013. Under the terms of the European framework, there is specified Action plan for the deployment of ITS in Europe and Directive 2010/40/EU on the framework for the deployment of ITS in the field of road transport and for interfaces with other modes of transport.

National system of traffic information has lot of benefits that are needed in Slovakia. We can classify to the general benefits, which are:

- reduction of traffic accidents and their consequences,
- global increase of road safety,
- decrease of road users´ delays, reduction of travel time and increasing of traffic fluency,
- direct influence on road users behaviour, motivation for responsibility,
- support of effective deployment of information technologies, ITS and telematics systems into the transport segment,
- establishment of local, regional, national and international interoperability in the area of: traffic information and traffic data, information exchange on current traffic situation, sharing of road network information, traffic control and so on,
- establishment of conditions for development of Tran European road network and enhancement of traffic operation.

We cannot forget the roads users and some important benefits that follow from National system of traffic information. The main benefits for road users are:

- aims of the project from point of view of driver – reach the destination: safe, continuously, quickly, directly at reasonable costs and by the quality roads,
- reduction of travel time of persons and freight (bottleneck, flow congestion, crossroads),
- reduction of accident risk (critical accident localities) – safer driving,
- reduction of fuel consumption and emissions,
- availability of traffic information, continuity of ITS services,
- planning of shipping (multimodal),
- optimisation of routes (time, costs),
- less time delay, vehicle wear,
- more effective rescue systems.

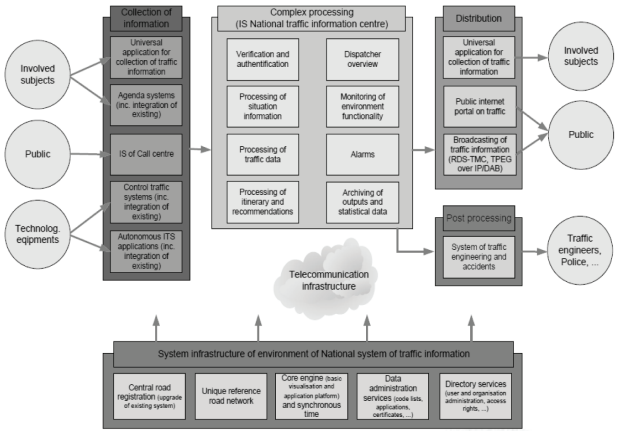

Fig. 2. Structure of the national system of traffic information [1]

Economical benefits of the project are: [1]

- Reduction of travel time of persons – 2016: 2,6 – 2026: 3,6 mil. hours per year).
- Reduction of travel time of freight – 2016: 718 – 2026: 976 thous. ton.hour per year.
- Reduction of accident rate (social costs) – 50% decrease of fatalities (in 15 years) or 14 mil. EUR: 2016/17,2 mil. EUR: 2026 per year.
- Reduction of fuel consumption – aprox. 2,8 mil. EUR per year.
- Reduction of air pollution (NOX, SO2, NMVOC, PM2.5) – 3,55 mil. EUR: 2016, 3,67 mil. EUR: 2019, 2,4 mil. EUR: 2026.
- Reduction of climate impacts – aprox. 200 thous. EUR per year.
- Total benefits - 2016: 59,9 mil. EUR – 2026: 90,5 mil. EUR.
- Project is not generating financial revenues.

6. Conclusion

Future European road users will benefit from improved road safety, reduced traffic congestion and more environmentally friendly driving, all enabled by the deployment of Co-operative Systems. It is very important for achieving these benefits - the common and standardised means of communications between the various parts of such systems, whether these components be located in vehicles or in the road infrastructure. This will ensure that equipment from different manufacturers will interoperate in a safe and secure manner. The means of delivering safe, secure, and interoperable Co-operative Systems is a common Communications Architecture,

which will provide a basis for wide scale deployment of these systems in Europe. [10]

Recently, the growth of road transport is a attendant phenomenon of development, which manifests in a significant growth of negative impact of transport on the environment, growth in congestion in conurbation and growth in traffic accidents, similar both in developed countries, and in conditions in the Slovak Republic.

Forthcoming Action Plan of ITS aims to:

- decrease transport congestion by 25% and increase the quality of travel,
- increase transport safety by 25% and thereby contribute to the overall European goal to reduce number of death people by 50%,
- reducing CO2 emissions by 10 %, mainly in urban areas.

Effective transport of passengers and freight is becoming a serious problem of the whole society and it is required that state administration takes steps towards this issue. Ignoring these issues induces higher public expenditures for solving the consequences.

The new millennium is marked by globalization of economy and transport is undoubtedly an important part of this development. The main contribution of the implementation of ITS systems and services from the social point of view is the transport safety increasing.

The public sector should financially support such telematic applications which will increase the comfort for the user of transport services, improve the traffic management and reduce the accident rate. Furthermore, the public sector should support the development of technologies for timely saving of lives and the reduction of consequences of serious injuries caused by accidents via technology that diminishes the negative externalities and adds to the increase of quality of public mass transport of passengers.

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Bibliography

[1] HRUDKAY K.: National system of traffic information and benefits for SMEs. In: Seventh framework programme Baltic to Balkan network for logistics competence, Opatia, Croatia, (2011)

[2] KALAŠOVÁ A: Introduction to transport telematics. In: Collection of articles from the ITS Conference 2007, ISBN 978-80-254-0207-8. – 5, Bratislava (2007)

[3] KRCHOVÁ Z.: Využitie teórie chaosu v doprave, In: CMDTUR 2009, zborník z 5. medzi-národnej konferencie, 4.-5.11.2009, Žilina, str. I – 118-122. Vydala Žilinská univerzita v Žiline v EDIS – vydavateľstve ŽU, ISBN 978-80-554-0132-4, Žilina (2009)

[4] KUPČULJAKOVÁ J.: Preference městské hromadné dopravy. Mezinárodní Masarykova konference pro doktorandy a mladé vědecké pracovníky 2010. 6.-10.12.2010 Hradec Králové. Sborník příspévků [elektronický zdroj]: CD.Magnanimitas, ISBN 978-80-86703-41-1. str. 1303-1307, Hradec Králové (2010)

[5] ONDRUŠ J.: Methodology of Acceptance Feasibility Survey of Urban Road Pricing. In: Transcom 2009, Section 1., University of Žilina, ISBN 978 -80-8070-692-0, Žilina (2009)

[6] SCHREYER CH., SCHNEIDER CH.: External costs of transport update study, International Railway Union, ISBN 2-7461-0891-7, Paris (2004)

[7] European Comission, http://www.ec.europa.eu

[8] Ertico, ITS Europe, http://www.ertico.com

[9] Ministerstvo vnútra Slovenskej republiky (in English: Ministry of Interior of the Slovak Republic), http://www.minv.sk

[10] European Union, http://www..car.-to-car.org