Mechanics Transport Communications
Academic journal
ISSN 1312-3823
issue 3, 2011
article № 0544
http://www.mtc-aj.com

WORLD INNOVATIVE CONCEPTS IN THE FIELD OF PUBLIC TRANSPORTATION USAGE FOR RIGA CITY PUBLIC TRANSPORT SYSTEM SUSTAINABILITY

Antons Patlins, Nadezhda Kunicina, Leonids Ribickis
Antons.Patlins@rtu.lv , Nadezda.Kunicina@rtu.lv , Leonids.Ribickis@rtu.lv

Institute of Electrical Engineering and Electronics, Faculty of Power and Electrical Engineering, Technical University, Riga, Latvia, Kalku str.1, LV-1658
LATVIA

Abstract: *In the article world experience is analyzed in the field of public transport sustainable development. The possibilities to use worlds experience to make Riga city public transport system safer and sustainable were discussed. Over the last few years, scientists, transport operators, industry, and policy makers throughout Europe have developed a wide range of innovative concepts for making urban transport more efficient and sustainable. Despite significant progress, a number of barriers, especially the lack of coordination of innovation activities across countries and cities, low levels of dissemination, unavailability of guidance on transferability and limited integration with mainstream transport policies, have prevented these concepts from being widely deployed. In the article we talk about Riga city passenger transport system sustainability and analyze it by 3 sustainability pillars. First of all - passenger friendly interchanges for Riga city, which play a crucial role in supporting the growth of public transport usage. As second we can talk about provision of travel information en-route for Riga city public transport users. And last but not least is ecology-friendly transport system.*

At the end of the article authors make their conclusions about possibility to use positive worlds experience to make Riga city public transport system more sustainable.
Keywords: *Dual-mode, infrastructure, sustainability, city transport system, public transport, co-modality, public transport sustainable development, safety, passenger friendly interchanges, mobile travel information services.*

INTRODUCTION

Social importance of urban passenger transport is indisputable. Moreover, the external effect generated by urban passenger transport is not confined to the city, and has an impact on the socio-economic development of the region and even the country. Urban passenger transport is an essential component of any economy.

A high rate of motorization in recent years, of the population and social significance of public transport increases. Negative consequences of the increasing number of private cars on the streets are traffic jams, pollution, security problems, and lack of places for parking. Solve these problems in the world by upgrading public transport, development of the street network, taking into account the provision of his priorities, and selected bands based on the structure and the technical level of the vehicles. The implementation of telematic application in public transport system, allows to monitor and to improve transport flow in real time regime. In Riga at the moment intelligent transport system is on developing stage. There is e – ticketing system and automatic location detection in public bus network.

THE COMPANY "RIGAS SATIKSME" IS PROVIDER OF PUBLIC TRANSPORT SERVICES IN RIGA

The company "Rigas satiksme' provides public transport services in Riga, offers various types of transport for rent, as well as manages the parking-lots of Riga municipality.

From May 1, 2009, only electronic payments are accepted in Riga public transport.

The company has implemented and maintains an integrated management system (IMS), which fully meets the requirements of ISO 9001:2008 and OHSAS 18001:2007 standards and is evaluated as efficient.

According to statistical data, public transport of "Rigas satiksme" carried 133399525 passengers in 2010 [1]. So we can calculate average passenger flow per vehicle per day in 2010 usung formula:

$$(1) \qquad X=P/V/Y$$

Where:

X - Average passenger flow per vehicle per day in 2010;

P – Number of passengers carried by Rigas satiksme in 2010;

Y – Days in the year 2010 = 360.

V - Number of vehicles used by Rigas satiksme in 2010;

$$(2) \qquad V=(T+t+B)$$

Where:

T – Number of tram vehicles used by Rigas satiksme in 2010;

t – Number of tolleybus vehicles used by Rigas satiksme in 2010;

B – Number of bus vehicles used by Rigas satiksme in 2010;

So, we have average: 133399525/(252+346+478)/360 = 344 passengers per vehicle per day carried by "Rigas satiksme" in 2010.

The amount of passengers, seeking traffic information in the web is growing. In 2010, the webpage of "Rigas satiksme" at www.rigassatiksme.lv was visited more than 6 million times. Transport news, ticket prices and other information related to our company was requested more than 15 million timers, but public transport schedules looked through more than 41 million times. This issue leads to improving passenger service via web, allows to use web in planning and management of traffic.

The most popular were public transport schedules, followed by information on prices and types of tickets and e-ticket.

On "Rigas satiksme's" website it is possible to find all current information about the company, public transport services in Riga city, public transport routes and schedules, as well as tickets.[1].

Such interest from passengers as well as good internet access quality in Riga allows implementing services based on internet for service of passengers.

ENVIRONMENTAL SUSTAINABILITY, ENVIRONMENTALLY SUSTAINABLE TRANSPORT

That is why vitally important is availability of environmental pollution data. The ability to gather, manage and process such data enables a local authority to fully understand the impact of transport in its city or region. The concept is potentially transferable throughout Europe. Provision of such data in meaningful formats can be used to agree policy decisions, and can be presented to the public to help them make informed travel choices. Using Environmental Pollution Data in Traffic Management can improve: the understanding of the true environmental impacts of traffic, the attractiveness of green transport policies and use of alternative non-motorized modes (walking, cycling), the policy and travel choices which can make a measureable difference to health quality at the local level, both in the short and long term, the compliance with EU Air Quality and Noise legislation.

Environmentally sustainable transport can be defined in two ways:

− as the application of environmental sustainability to the transport sector or to elements of this sector

− as the environmental pillar of sustainable transport, which make necessary the definition of the concept of sustainable transport.

There is no generally accepted definition of the term ‗sustainable transport‘ (like its synonyms ‘sustainable transportation‘, ‘sustainable travel‘ and sustainable mobility‘). The expression is often used in order to describe all forms of transport which minimise environmental impacts, such as public transport, car sharing, walking and cycling, as well as technologies such as electric and hybrid vehicles and biofuels.

While conceptualising sustainable transport using the 'three E‘s' of environment, equity, and economy is widely accepted according to Hall (2002, 2006), the problem with this approach is that it has the potential to perpetuate the status quo by only focusing on change within the transport sector to the exclusion of change across sectors. Transport is only one sector and it must work in conjunction with other sectors or areas - such as energy, manufacturing, and housing / land use - if system transformations are to be made towards sustainable development (Hall, 2006). In other words, a sector such as transport or agriculture cannot be characterised as sustainable or unsustainable, because it is not independent from the other sectors. However, transport can be characterised either to contribute or not to contribute to the sustainability of society, all other things being equal. A good illustration of this here is biofuels: From a transport point of view, biofuels are or could be sustainable (considering only transport energy), because it could be a renewable source of energy. But if the production of biofuels is made to the detriment of the diet of a large part of the world population, biofuels cannot be characterized as sustainable [4].

Currently, air quality in the city of Riga is poor, so it's time to seriously think about how to reduce the number of vehicles in the city center. Currently, the company “Rigas Satiksme” opens up a number of new paid parking in the city. The aim is to optimize the traffic in the city, especially on streets with heavy traffic of public transport. It is important to streamline the flow of cars and arrange parking so that motorists can drive up close to objects of interest to them. Occurs road markings, setting machines and commissioning of new sites. But paid parking is not a panacea for traffic congestion, and therefore not a solution gassed air. The public transport system need for more effective projects, such, for example, “Park & Ride”, many of which have long been developed and are just waiting in the wings. This will ease the load on the city's transport infrastructure and improve air quality and environmental situation in general. Therefore, the draft “Park & Ride” should be considered as stage of development of a network of urban passenger transport in the long term sustainable development.

It is also important to integrate the passenger train network in urban passenger transport system, as train runs without any delays and congestion. Increasing the number of bicycles and bicycle infrastructure development. This process will also be promoted by the integration of a passenger trains into urban public transport system in Riga.

The development of telematic application and uptaking of such solutions in city transport allows making traffic regulations in future in on – line mode, to monitor and even prevent concentration of pollution in “weak points”.

An example of telematic tools application for Riga city is well-described in [3].

PUBLIC TRANSPORT CO-MODALITY FOR SUSTAINABLE DEVELOPMENT OF PUBLIC TRANSPORT SYSTEM IN RIGA CITY TRANSPORT SYSTEM

The integration of railway transport in Riga city public transport control is important for passenger’s service, using existing recourses. However the integration of transport control systems just started developed in 3 years. The first implemented system was bus control system – ASOS. The using of transport control procedure for co– modal transportation of passengers in Riga city is very important. The dynamic control for transport modes in pre - defined time interval and composite the final control procedure for each transport mode and harmonize the motion with aim to arrive transport in time and harmonize railway and public transport motion. An effective tool of research of problems of optimum control is the principle of a maximum by Pontryagin's Maximum Principle representing a necessary condition of optimality in such problems. The procedure deals with, consists of two main parts: operating procedure in this case, routing of passenger’s flow and object of control in this case passenger’s transport. The objects of control are divided in three levels: transport means, a vehicle, or all system of public transport of city etc. can be considered. The operating kernel since occurrence of problems of control has undergone evolutions from the elementary regulator to modern informational systems – intelligent transports system. All this is described in [2].

Development of electronic fare payment and the expansion of its integration with the train can be a very useful tool for both passengers and carriers.

Necessary to create a convenient interchange points equipped with electronic displays for passengers. It is important to create an electronic travel planning, with the ability to calculate both travel time and cost, as well as showing the possibilities of using public transport, and combine it with hiking. Provision of such services may be through WEB and mobile communications.

EFFICIENT PLANNING AND INCREASING THE CAPACITY OF EXISTING INFRASTRUCTURE

A more efficient use of city space, allocated to transport improves overall performance of all the passenger transport system. Efficient planning and use of infrastructure, as god as passenger-friendly interchanges and good traffic management, "green and clean" concept usage, allocated to public transport, helps to make public transport system more sustainable.

Putting into operation trolley buses with diesel generators has allowed more intensive use of existing infrastructure, as eliminated the need for tightly bound routes to the padded contact network. For example, trolleybuses with diesel generator successfully use not only roads without the equipment power cords, but also elements of the tram infrastructure - public transport stops (Fig.1.). More recently, the same stop use also the bus route Nr.22 plying between the airport and downtown. It provides both an efficient co-modal transport and the densest use of infrastructure. With such a busy transport network it is important to plan scheduling and compliance with settlement and schedule traffic by drivers.

Fig. 1. *Trolleybus Nr 9 with a diesel generator, use tramway infrastructure - stop.*

PASSENGER FRIENDLY INTERCHANGES FOR RIGA CITY

Passenger friendly interchanges for Riga city play a crucial role in supporting the growth of public transport usage. The benefits of this concept are social and subjective rather than numeric. Passenger friendly interchanges are capable of: minimizing overcrowding and congestion, helping the efficient use of space, optimizing the design and location of key facilities, increasing passenger satisfaction and increasing public transport modal share. A well-designed passenger friendly interchange should bring certain benefits, like functionality, increased safety, higher capacity, increased passenger satisfaction, attractiveness to people, even if they are not attracted to use it for a trip.

PROVISION OF TRAVEL INFORMATION EN-ROUTE FOR RIGA CITY PUBLIC TRANSPORT USERS

This can be via on-board units, variable message signs, e-kiosks on street and at stations, and personal mobile devices. Mobile Travel Information Services (MTIS) enhance convenience and confidence when travelling by various transport modes, particularly public transport. This concept can be transferable all over Europe, if information is tailored to the local (or national) context. It provides extra flexibility for the traveler and stronger feelings of being in control of the journey. Key conditions for implementation are: understanding of end user needs and requirements, a viable business model, identification of appropriate technologies and outputs and strong political support.

SAFETY SYSTEM + LIDAR

One technology that is being implemented into autonomous as well as modern vehicles is LIDAR. Due to its many applications, LIDAR is used in various fields. LIDAR is often used in atmospheric observations because it's able to measure distance, speed, rotation, and chemical composition/concentration of a substance [5]. These abilities make LIDAR a key component in autonomous vehicles. It is used to gather information about other cars on the road as well as other objects in its surroundings. More specifically, LIDAR can be used to detect the distance, direction, and speed of nearby vehicles. By analyzing the information provided, the computer can calculate the risk factor of the current situation to determine if the car should take any action. Possible actions include the following: adjustments to the speed, changes in lane position, or emergency reactions such as rapid and full force application of the brakes. LIDAR is an important and powerful tool. But is merely a piece of the detection technology in the car, it works in a team with other sensors to gathering information about the car's surroundings and mapping out its environment [6].

LIDAR systems are similar to radar in the sense of detection technology. However, unlike radars which emit microwaves or radio waves, LIDAR works by sending out pulses of light [8]. The pulses of light are made up of particles that are scattered in all directions due to collisions with molecules in the environment as they travel. Some of the light is sent back through backscattering; which is when waves or particles are reflected towards the direction from which they originated [5]. Once the backscattered light returns, the LIDAR uses a telescope to collect and send the particles to a photodetector. There are several types of photodectors, which are devices used to detect light. In this case, the type of detector known as a photodiode would be used. It first converts the light to a readable wavelength, at which point it begins transmitting the light outwards away from the source. Next, it reads the amount of light that is returned to the transmitter and the change in time between the two events. This change in time can be multiplied by the speed of light in order to calculate the distance to the unknown object from the LIDAR system. It can also determine other characteristics of the object including size and relative shape based on analysis of the returned light [7]. In principle, the way LIDAR operates is very similar to the way that radar operates, but both are still necessary for a successful autonomous vehicle. LIDAR has a range between 1 kilometer and 100 kilometers and is able to analyze a large volume of space with "fine spatial resolutions in short periods of time" [8] and has proven to be more precise than radar in some applications [9].

Theory is very important in developing technology; however, if the theory cannot be applied to realistic situations then it is useless. So it goes for the autonomous vehicle. The Department of Defense's Advanced Research Projects Agency (DARPA) held a competition in 2007 as a proving ground for state of the art autonomous vehicles. The competition, called the Urban Challenge, required a fully autonomous vehicle to navigate a 55 mile course through an urban environment with other manned and unmanned vehicles, while obeying California State driving regulations [7]. Carnegie Mellon's Tartan Racing Team placed first in the competition with their robot "BOSS". This robot is a perfect example of an autonomous vehicle. It employs a total of 18 radar and LIDAR sensors to map out its environment and safely navigate the road [7].

While radar and LIDAR are each useful tools separetely, the combination of them in a coordinated system is necessary to provide enough information to operate a sophisticated unmanned machine. The BOSS robot provides a concrete illustration of radar and LIDAR systems working together and using analytic properties such as the Doppler shift to accomplish a real-world goal. When mapping the environment of the vehicle, information is split into three categories. The first is the road, the path that the vehicle must follow. The second category encompasses static, or nonmoving, obstacles such as buildings or parked cars. The final category is for dynamic, or moving, obstacles including people or cars that are moving and may obstruct the path in front of the vehicle [7]. Parked cars could be potentially hazardous because they can change states from static to dynamic if someone decides to pull out in front of the vehicle. Specific radar and LIDAR sensors are specialized for the task of tracking a moving car in front of the vehicle; in this case the Doppler shift can be applied to the incoming data to monitor the speed of the target vehicle. Another radar sensor has a 360-degree field of vision and therefore is used to help create an instantaneous map of the nonmoving objects all around the vehicle. All of the data is compiled from the 18 different sensors and based on this data; multiple potential movements for the vehicle are calculated [7]. The robot uses special programs to analyze the possible decisions and choose the best one. It keeps making decisions about small movements many times per second and these small movements come together to create the driving motion of the vehicle. The motion appears fluid and continuous to an observer because the time between the decisions is so small that it is not detectable. BOSS proved to be the most successful unmanned robot in the Urban Challenge, a feat that would not have been possible without the aid of radar and LIDAR detection technologies [6].

Implementation of telematic components, such as specific sensors, based on LIDAR application (Fig. 2) allows to improves of public transport system flexibility. The components involved in autonomous vehicle can be divided into several categories based on their functionality, as shown in Figure 2 below.

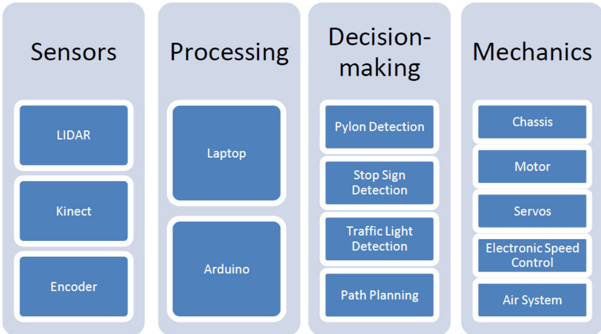

Fig. 2.. *Breakdown of System Components*

All of these categories work simultaneously to collectively allow the vehicle to recognize and identify obstacles in order to plan and execute the most reasonable route through the course, while ensuring the highest standard of safety at all times [10].

CONCLUSIONS

Positive worlds experience usage in the field of public transportation can make Riga city public transport system more sustainable.

Telematic system improvement and application of new solutions (like LIDAR) allows maintaining safety level of public transport in heavy traffic conditions.

REFERENCES

[1] The webpage of "Rīgas satiksme" www.rigassatiksme.lv

[2] Patļins A., Kuņicina N., Galkina A., Ribickis L. Development Railway and City Transport Control Procedure for Co – Modal Transportation of Passengers // Revitalisation of Economy - New Challenge for European Railways. EURO - Zel 2010., Slovakia, Žilina, 26.May-27. June, 2010. - pp 207-217.

[3] Patļins A., Kuņicina N., Galkina A., Ribickis L. //Development Passengers Transfer Procedure for City Transport in Riga // 17-th ITS World Congress Busan 2010, Korea, Busan, 25.-29. october, 2010.

[4] Robert Joumard, Henrik Gudmundsson. Indicators of environmental sustainability in transport.An interdisciplinary approach to methods.INRETS report, Recherches R282, Bron, France, 2010. http://cost356.inrets.fr

[5] Paschotta, R (2010). "Photodetectors" RP Photonics Consulting GmbH. [Online]. Available: http://www.rp-photonics.com.

[6] Kyron Abraham Jr. , Steven Comer. Artificial Vision: Detection Technology of the Autonomous Car. University of Pittsburgh, Swanson School of Engineering, Eleventh Annual Freshman Conference.

[7] Darms, M. (2008, January). "Vehicle detection and tracking for the Urban Challenge." Carnegie Mellon University Robotics Institute [Online]. Available: http://www.ri.cmu.edu/pub_files/pub4/darms_michael_2008_1/darms_michael_2008_1.pdf

[8] Kovalev, V. (2004). Elastic Lidar: Theory, Practices, and Analysis Methods. Hoboken, New Jersey: John Wiley & Sons inc.
[9]Markoff, J. (2011, October 9). “Google cars drive themselves, in traffic.” New York Times.[Online]. Available: http://www.nytimes.com/2010/10/10/science/10google.html?_r=1
[10] Design and Implementation of Ψmon, autonomous robot car. Enggenious ρ-Botics. University of Calgary, International Autonomous Robot Racing Competition and Exhibition 2011.

СВЕТОВНИ ИНОВАТИВНИ КОНЦЕПЦИИ В ИЗПОЛЗВАНЕТО НА ОБЩЕСТВЕНИЯ ТРАНСПОРТ ЗА УСТОЙЧИВО РАЗВИТИЕ НА ГРАДСКАТА ТРАНСПОРТНА СИСТЕМА В РИГА

Antons Patlins, Nadezhda Kunicina, Leonids Ribickis

Institute of Electrical Engineering and Electronics, Faculty of Power and Electrical Engineering, Technical University, Riga, Latvia, Kalku str.1, LV-1658
ЛАТВИЯ

Ключови думи: *два вида транспорт, инфраструктура, устойчиво развитие, транспортна система на града, обществен транспорт, интермодалност, устойчивото развитие на обществения транспорт, безопасност,удобни за пътниците прехвърляния, мобилни услуги, информация за пътуването.*

Резюме: *В статията се анализира световният опит в областта на устойчивото развитие на обществения транспорт. Обсъждат се възможностите за използване на световния опит, за да стане градската система за обществен транспорт в Рига по-безопасна и устойчива. През последните няколко години учените, транспортните оператори, индустрията и политиците в цяла Европа разработиха широка гама от иновативни концепции за по-ефективен и устойчив градски транспорт. Въпреки значителния напредък, редица бариери, по-специално липсата на координация на иновационните дейности в различните страни и градове, ниски нива на разпространение, липсата на насоки за прехвърляне и ограничена интеграция с основните политики в транспорта попречат тези концепции да бъдат широко използвани. В статията се говори за устойчивостта на Рижката градска пътническа транспортна система и се анализират три стълба на устойчивостта. Първо – удобни за пътнически смени в град Рига, които играят решаваща роля в подкрепа на растежа в използването на обществен транспорт. На второ място може да се спомене предоставянето на информация за пътуване по маршрутите в Рига на потребителите на градския обществен транспорт. И накрая, но не на последно по важност място, е екологичността на транспортната система.*

В края на статията са направени изводи относно възможността за използване на положителния световен опит, за стане системата на обществения транспорт в град Рига по-устойчива.