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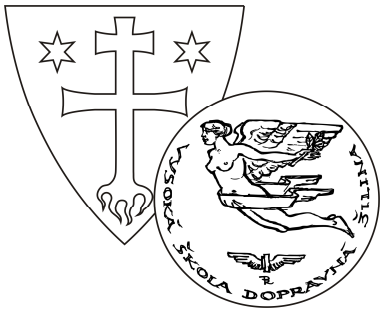

TRANSCOM 2009

8-th EUROPEAN CONFERENCE OF YOUNG RESEARCH AND SCIENTIFIC WORKERS

PROCEEDINGS

SECTION 1

TRANSPORT AND COMMUNICATIONS TECHNOLOGY

ŽILINA June 22 - 24, 2009
SLOVAK REPUBLIC

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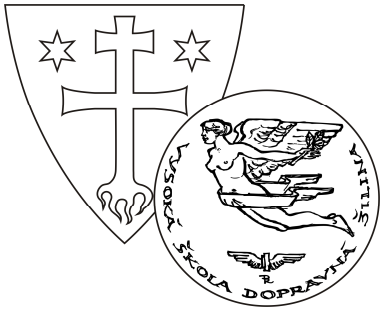

TRANSCOM 2009

8-th EUROPEAN CONFERENCE
OF YOUNG RESEARCH AND SCIENTIFIC WORKERS

under the auspices of

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&

Prof. Ing. Ján Bujňák, PhD.
Rector of the University of Žilina

SECTION 1

TRANSPORT AND COMMUNICATIONS TECHNOLOGY

ŽILINA June 22 - 24, 2009
SLOVAK REPUBLIC

Edited by Emília Imrišková, Peter Brída

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TRANSCOM 2009
8-th European conference of young research and scientific workers

TRANSCOM 2009, the 8th international conference of young European researchers, scientists and educators, aims to establish and expand international contacts and co-operation. The main purpose of the conference is to provide young scientists with an encouraging and stimulating environment in which they present results of their research to the scientific community. TRANSCOM has been organised regularly every other year since 1995. Between 160 and 400 young researchers and scientists participate regularly in the event. The conference is organised for postgraduate students and young research workers up to the age of 35 and their tutors. Young workers are expected to present the results they had achieved.

The conference is organised by the University of Žilina. It is the university with about 13 000 graduate and postgraduate students. The university offers Bachelor, Master and PhD programmes in the fields of transport, telecommunications, forensic engineering, management operations, information systems, in mechanical, civil, electrical, special engineering and in social sciences.

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CONTENTS

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University of Žilina, Žilina, Slovak Republic

The Problems of Daily Flight Schedule Extrapolation

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Abstract. This article deals with problems of daily flight schedule extrapolation which is one of key issues when performing computer simulations of future airside and landside traffic flows. For this purposes, we developed an MS Excel based tool that allows user to predict future airport traffic as well as its hourly distribution. The tool algorithm was designed to be used for traffic forecast at any airport no matter the size of airport and passenger throughput as it allows user to define the airport capacity ceiling.

Keywords: flight schedule generation, traffic forecast, airport capacity, traffic flows

1. Introduction

One of long-term research activities at Air Transport Department of University of Žilina aims at modelling of airport landside traffic flows. Thanks to our knowledge in this field we have been involved in several EU framework projects (e.g. Aeronautical Study on Seamless Air Transport - ASSET) as well as projects for commercial airport operators (simulations of passenger flows in Brno Tuřany and Bratislava Airport terminals). Our expertise also lies in the field of air-ground intermodality and modelling the traffic flows within airports' catchment areas.

While preparing the simulation models for the analysis of passenger flows within both airports' catchment areas and airport terminals, we have encountered a problem concerning the forecasting and modeling of future traffic.

All known simulation models are designed to simulate traffic during typical busy day. This fact unveils the problem of extrapolating daily traffic to the future. All studies dealing with traffic forecasts are aimed at predicting annual traffic growth. However, in real operation, the link between annual traffic and traffic during peak days or peak hours is very weak. In other words, peak days or hours reveals the airports' infrastructure bottlenecks.

This fact led us to deal with this issue. We have developed a model that based on available statistic data can randomly generate flight schedules reflecting past, current or future traffic including its hourly distribution.

The model is currently calibrated for Bratislava airport operations using the available input data from 2007 and 2008. However, the model can be used for any airport but it would require in-depth traffic analysis of the particular airport.

The flight schedule is the most important input parameter when modeling the airport operations as it contains crucial information regarding hourly distribution of traffic, airlines, aircraft types, their seat capacity, load factors etc.

The main aim of this paper is to describe the logic of the Flight Schedule Generator tool. By means of this article we will also illustrate the ability of the tool to reflect the real traffic distribution which can be considered as the tool validation.

2. Assumptions and Input Data

2.1. Input Data

The Flight Schedule Generator tool randomly generates flight schedule based on following data:

- Hourly distribution of traffic, i.e. hourly distribution of arrivals and hourly distribution of departures were gathered analyzing traffic during 3rd, 4th, 33rd and 34th week of 2007 (the busiest winter and summer weeks in Europe).
- Airline business models' market share is represented by existing airline business models, i.e. traditional airlines, low-cost airlines and charter airlines. We assume that if some air carrier leaves the market, other carrier from the same market segment will overtake its market share. The flights operated by traditional or low-cost carriers are considered to be scheduled flights and the flights operated by charter carriers are considered to be irregular or charter flights. This information was gathered analyzing traffic during the 5 busiest days of 2008 (data provided by Bratislava airport).
- Origins and destinations relevant data were gathered analyzing traffic during the 5 busiest days of 2008 (data provided by Bratislava airport). From the airport operations' point of view, it is only important if the aircraft flies from/to Schengen area or not and if it is domestic or international flight. These factors influence the sequence of processes during passenger handling. The model also considers if the origin/destination is seaside resort or if it flies from/to inland airport. This factor influences share of business and leisure passengers on scheduled flights. The analysis of origins/destinations was performed separately for each particular airline business model.
- Aircraft mix is another important input as the aircraft size directly influences the passenger throughput. We have performed analysis of the aircraft mix for each particular operator using the traffic data of the 5 busiest days of 2008 (data provided by Bratislava airport).
- Turnaround times have direct impact on actual departure times. These were analyzed for each particular aircraft type using the traffic data of the 5 busiest days of 2008.
- Delay information is used for estimation of scheduled times of arrivals and departures. The delay analysis was based on the traffic data of the 5 busiest days of 2008 (data provided by Bratislava airport).

2.2. Traffic Forecasts

For the traffic flows extrapolation to the future the data regarding expected traffic growth is required. There are three world-wide recognized institutions dealing with research on future traffic: EUROCONTROL Statistical Forecast Service (STATFOR), Airbus and Boeing. These institutions regularly issue future traffic trends publications offering the expected evolution of air transport market in particular parts of the world [2], [3], [4], [5] and [6].

3. Flight Schedule Generator Algorithm

Based on available traffic data the Flight Schedule Generator stochastically generates daily flight schedule. The model is based on the principles of Monte Carlo simulations which means that each iteration provide user with unique daily flight schedule. The following flow chart depicts the logic of the algorithm used in Flight Schedule Generator.

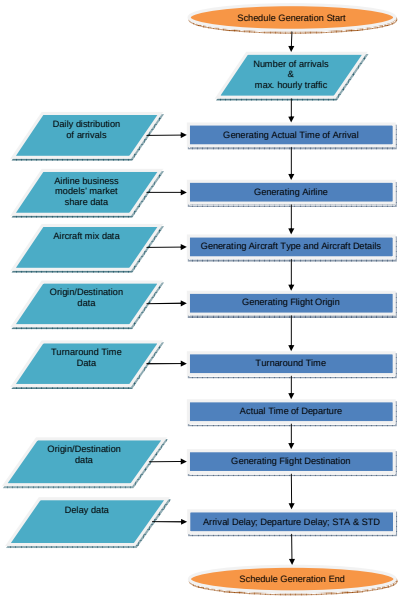

Fig. 1. The Flight Schedule Generator algorithm

The model also considers the possible capacity constraints. When the traffic at airport reaches its ceiling during the peak hours the traffic peaks are more widely spread throughout the day and the traffic fluctuation is becoming less significant. In the model, it is possible to define the maximum number of arrivals per hour. After each iteration, the model checks, if this number for particular arrival and particular hour was not exceeded. If the model finds out that the hourly capacity would be exceeded, it will perform additional iteration and assign the arrival to other part of day.

4. Model Outputs

Every single iteration provides user with detailed flight schedule that can be imported into various simulation tools. The user interface also enables visual validation of each randomly generated flight schedule before it is used for further analyses.

The following charts depict the comparison of actual hourly flight distribution and hourly flight distribution generated by the tool.

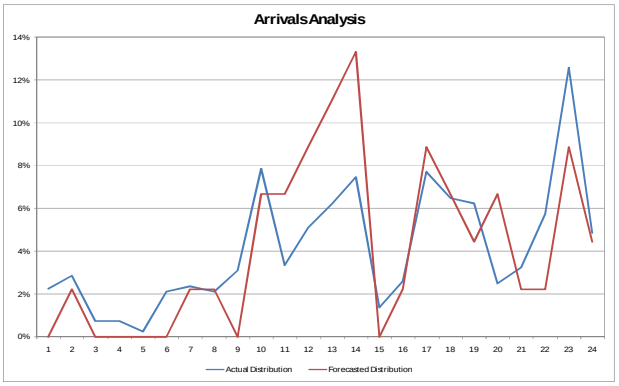

Fig. 2. Comparison of actual and generated arrival flight schedule

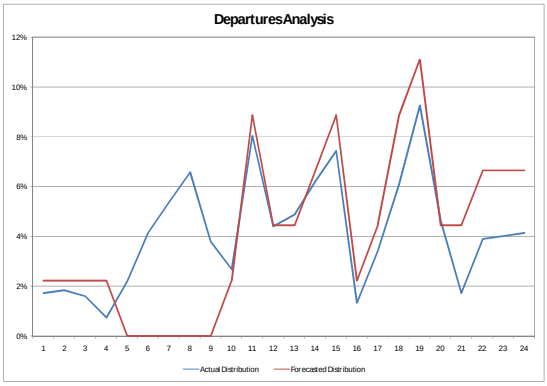

Fig. 3. Comparison of actual and generated departure flight schedule

5. Conclusions

The Flight Schedule Generator tool fills the gap in the market and supplements the existing simulation tools with the ability to estimate future traffic distribution.

The current version of the tool assumes that the airline share, aircraft mix and other parameters remain same while the traffic grows. However, some changes in airport traffic mix can be seen as the airports grow (e.g. as the airport grows so do the average size of aircraft using the airport etc.). Therefore, the further tool development shall be aimed at continuous research in this field and model algorithm should become more sophisticated taking into account these trends.

Mature Flight Schedule Generator could be very reliable tool allowing airport designers and airport managers to perform precise traffic forecasts in terms of hourly distribution of flights during peak days.

Acknowledgement

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The Green Way of Postal Industry

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Abstract. As the world becomes more concerned about carbon emission, global warming and sustainability of the planet, the environmental positioning of the postal industry will become a bigger issue. The article discuss about duty and environmental efforts of postal industry in single countries.

Keywords: Gogreen, greenhouse effect, CO2 emissions, environmental efforts, environment friendly.

1. Introduction

The **greenhouse effect** is the process by which absorption and emission of infrared radiation by atmospheric gases warms a planet's atmosphere and surface. Human activity has changed the natural balance of these gasses. The atmospheric concentrations of CO2 and methane have increased by 31 % and 149% respectively since 1750. Because the postal industry is based on transportation, it contributes to the levels of CO2 in the atmosphere and the climate change. [2]

2. The Green Way of Postal Industry

Postal companies across the world are going green by embracing the latest environmental strategies to lower their CO2 emissions and reduce their contributions to landfill. [1]

One of the most ambitious plans has **Japan Post** which is looking at replacing the company's short-distance vehicles with zero-emission electric cars. The Japan Post cooperate with Mitsubishi and Nissan which are leading the way in developing technology behind electric cars that require large batteries and extensive charging times to travel. But commercialization of this technology should be possible within two years. [1]

American postal firm USPS has seen it focus on the quality of packaging used every day. USPS save up to 15000 metric tons of carbon emissions a year by selling only 100 % recyclable envelopes and packaging. USPS also use water-based inks for stamps which are more friendly to environment. The company looking at ways to optimize emission levels generated by its transport network. It prefer transports on the ground – by train or road rather than by air. Even it is going back to the old-fashioned method of delivering by foot. The company has a computer program that optimizes route design and will reduce the length of postal round by up to 12 %. UPS piloting other types of fuel technologies such as hybrid fuels and hydrogen fuel cells and is upgrading its facilities energy consumption by branching out into renewable resources (e.g. wind turbines). Company seeks to meet a target of a 30 percent reduction in energy by 2015. [1]

According to **Post Europe**, an organization that optimized postal operations in Europe, postal services in Europe produce approximately from 8 till 11 mil. tons of CO2 each year. [1]

On 9 March 2007 (at the European Council), leaders of state agreed on a comprehensive package of measures on climate change and energy policy, going above and beyond all previous commitments. [3]

Its targets include:

- Reducing greenhouse gas emissions in the EU by 20% by 2020, and by 30% if international agreement is reached.
- Improving energy efficiency by 20% by 2020.
- Raising the share of renewable energy to 20% by 2020.
- Increasing the level of bio-fuels in transport fuel to 10% by 2020. [3]

Postal operators appear in particular to focus on:

- Increased automated sorting limiting mail transport in mail collection and transport between sorting centers.
- Improved transport fleet, with cleaner vans using less fuel and producing less waste.
- Restructuring of the sorting structure to capture more automated mail processing while at the same time limiting physical mail exchange through development of hybrid mail.
- Use of packaging materials which are more environment friendly and can be re-used.
- Reducing use of energy in postal premises within the framework of a waste management policy.[3]

The examples below illustrate some of the main themes which have drawn interest of national postal operators on environment policy and implementation since 2004. [3]

The Austria and the U.K. are country where are implemented several technological tools.

Austrian Post (AP) recognizes its corporate responsibility to achieve a more prudent use of natural resources and implements measures to relieve the burden on the environment and limit the use of natural resources. Since of the November 2006, it has been testing the use of gas-powered vehicles, whose CO2 emissions are 10% below those of their diesel-powered counterparts. Moreover, the vehicles tested emit virtually no nitrogen oxide. [3]

In 2006, the company started testing the use of pure vegetable oil as a fuel for lorries. One lorry which was converted for this purpose has already driven 100,000 kilometers without any difficulty. They were partly equipped with soot particle filters. In the future, AP will continue to focus on incorporating eco-friendly features when modernizing its vehicle fleet.

In order to avoid the waste of natural resources all printers in the company were converted to a “pay per page” system, so that the individual departments themselves will have to bear the burden of printing costs in the future. In order to savings in energy and natural resource AP prefer black and white print as well as double-sided printing. Moreover, empty toner cartridges are collected and subsequently refilled. [3]

Austrian Post initiated a pilot project to establish a special rubbish collection system. The goal is to cut the quantity of residual waste by implementing targeted waste separation and recycling. Waste collection is carried out by the existing logistics network, so that no additional pollution is caused by the transport of the waste materials. [3]

The Royal Mail Group Ltd in the **United Kingdom** wants to run businesses that take responsibility for minimizing their impact on the environment. Currently the strategy is divided into next five key themes: ethical supply chain management, fuel and transport, building energy, waste and water. Their six environmental targets by 2010 are:

- A reduction in normalized Group wide fleet fossil fuel usage by 14% from actual level.
- A reduction in energy consumption for building energy use by 10% from actual levels.

- An increase in the usage of renewable energy to 50% of total building energy use by.
- A reduction in the normalized quantity of containerized solid waste sent to landfill by 25% from current levels.
- A reduction in normalized water use by 5% from current levels. [3]

Hungary's Magyar Posta and **La Poste in Belgium** testing hybrid and electrical vehicles – quadricycles – for delivering mail in city centres. This project seeks to address not only air but also noise pollution in urban areas. [1]

In Norway, **Posten Norge** (PN) is also working hard to reduce the CO2 emission from its transport fleet and has plans to reduce its emissions by 10 % during the next five year. The PN´s delivery staff, truck drivers and van drivers have been trained in eco-efficient driving. In 2007 the company adopted a route optimizing software, which has resulted in reduced driving distances and lower fuel consumption. This program can reduce 2 or 3 % of emissions. Posten Norge is also part of a European climate programme for the postal industry. [1]

In the **Czech Republic** in accordance with the stipulations of the Waste Act, were drafted waste management plans for individual regions and their fulfillment will be continuously checked by a specialized section operating under Czech Post's headquarters. In 2006, the tasks stipulated by law in the area of packaging management, especially the mandatory collection of used packaging and its re-use were secured via hiring an authorized packaging firm. [3]

La Poste in **France** implemented a number of strategic measures over the period 2005-2007. These include an action plan to cut CO2 emissions by 5% relative, and contain energy and water consumption. The Group is also involved in the goods transport task forces formed by, local government to advice on urban transport route-planning. [3]

In the **Finland,** most of Itella's environmental impacts are related to greenhouse gas emissions. In the spring of 2007, Itella pledged to cut its carbon dioxide emissions by 10% by 2012 (compared to 2007). To achieve this target, Itella aims to reduce its vehicles' fuel consumption through transport planning, driver training and alternative fuels, as well as reducing energy consumption in its buildings. [3]

Internal environmental performance can also be improved by making recycling and waste management more efficient and through purchase management. Better external environmental performances can be achieved by providing customers with logistics services for the reuse and recycling of products and their packaging, and by creating information logistics services enabling the transmission of data in a non-physical format. [3]

In the **Sweden** are strategic environmental efforts focused on transportation. According to the Swedish Environmental Protection Board approximately one third of the carbon dioxide emissions in Sweden come from the transportation sector. The overarching aim of Posten's environmental efforts is to reduce greenhouse gas emissions from its transportations. Posten will reach its 2007 target of 175 000 tons by systematically improving the environmental effectiveness of its operations. Less road and air transport combined with increased train transportation results in lower carbon dioxide emissions per transport kilometre. The majority of economy mail is transported via railroad between Posten's large terminals. Posten's rail transport fulfils the Swedish Society for Nature Conservation's requirements for a Good Environmental Choice. Environmentally conscious drivers use smartest vehicles available. All Posten drivers are trained in fuel-Efficient driving techniques, which contribute to reduced carbon dioxide emissions and lower fuel costs. The use of vehicles with better environmental performance is increasing throughout the entire Posten group. Posten has environmental requirements for all procured transportation services. [3]

Norway Post, together with eight other European Postal Companies, has committed to decrease CO2 emissions by 10% during the next five years. The environmental programme will mainly be oriented towards environmental improvements for transport, buildings,

machines, eco-friendly products, increased use of renewable energy and fuel with low CO2 emissions. [3]

In 2005, **Deutsche Post** signed a far-reaching partnership agreement with the United Nations Development Programme (UNDP) and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). One of the goals of the planned partnership between the UN bodies and Deutsche Post World Net is the swift organization of logistic support when disaster strikes. [3]

Carbon Management Deutsche Post World Net is responsible for managing the carbon credits for gogreen shipping products and services. Its primary responsibilities are accounting for carbon credits; monitoring the gogreen production scheme; ensuring that the supply and demand of carbon credits are matched; and documenting that used credits are retired. [3]

In 2002, the United Nations World Food Programme (WFP) and **Netherlands's** TNT launched a partnership aimed at a single common goal: fighting world hunger. Annually, WFP provides food aid to an average of 90 million people including 56 million hungry children, in more than 80 countries. TNT's Express division is introducing a new packaging line designed, stated the Netherlands-based global company to better protect shipments from damage, promote the TNT brand across the globe and support the company's environmental effort. TNT, which produces 50m packaging items per year, is first deploying its new parcels and satchels in Europe and the Middle East. The new envelopes are available worldwide. [3]

The **Internatioal Post Corporation (IPC)** has embarked on a pilot scheme that it hopes will see other postal companies go green. IPC monitoring and measurement system enable to the postal companies to evaluate their environmental performances according to specific criteria. IPC want to by equalizer and mentor administrations for companies which just starting to think about the environment. [1]

3. Conclusion

Gogreen is the name of the range of low-carbon and carbon-neutral shipping products and services. With Gogreen, shipping is either carried out on the growing fleet of alternative fuel and advanced technology vehicles, or transport-related emissions of carbon dioxide are offset by a combination of internal and external initiatives. Business and retail customers in Europe can today choose from a variety of carbon neutral and low-carbon shipping options. The Gogreen effort in postal industry is not fall behind the other industry.

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University of Žilina, Žilina, Slovak Republic

Critical Infrastructure in Transport

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Abstract. Infrastructure in Slovak Republic is very vulnerable and switch over resulted from high dependency on technology and supply energy. It's necessary to realize, that except for actual threat number one – terrorism exist a lot of genuine risks and threats (flood, earthquake, fire...). Next risks resulted from standard operation in industry and economic, from production, transport, spending of goods and services. Disturb important objects of critical infrastructure (next CI) for reason terrorism attack, or natural and technology catastrophes on our area it always could mean big losses on lives and properties. The currently running processes of the security of the CI are not good enough that's why it is necessary to take measures that help to minimize the impact of these measures in the maximum possible way.

Keywords: critical infrastructure, threat, transport, terrorism.

1. Introduction

We started to meet with the concept of critical infrastructure not long time ago and this rapid expansion began in the mid-90s and consequently after events that happened on 11th September 2001 in New York. However every country has a different kind of view at the CI and for this protection; thanks to the geographic differences (flood – Netherlands, tsunami – Asia, hurricane - Cathrina). In the past, we could see many times, the meaning of CI failure as a consequence extraordinary Events because of natural catastrophes or terroristic attacks (New York, Madrid, London).That's why is very important because of the security, to emphasise importance of protection and prevention of CI. It shows that if we want to protect community and keep natural running of the state, we have to protect CI in the first place or to minimize all of the possible risks, so the potential failure will have the least impact on the population and fluent state running. Arrangements to define, prepare and protect of CI they are coordinated across all Europe – Europe critical infrastructure.

1.1. Critical Infrastructure in Slovakia

National infrastructure – organizations and institutions (especially state administration, jurisdiction), objects, systems (data systems, transport system, information and communications systems), machinery, services (banking, bank by mail, healthy...), which its function is necessary for securing political and economy fluent state running.

The main definition of IC includes the part of the National Infrastructure (productive systems, non-productive systems and services) that damage or isolation could have a relevant influence of the state security, economic, public administration, the security of basic necessities of life of population or the fulfillment of international obligations.

Slovakia has defined the sections of CI as a follows :

- Energetic (electric energy, gas, oil/ petroleum)

- Water (Supply of drinking water and potable water)
- Food (Agricultural production, food production)
- Health (hospital Care, protect of public health)
- Transport (road transportation, air transportation, railway and water transportation)
- Information and Communications systems (data systems, radio and satellite communications)
- Public policy and internal management (state administration and autonomy, jurisdiction)
- Industry (industrial production)
- Finance (management of public finances, banking)

Operation of the following areas is determinated by the proper functioning of the entire base network systems and services that make CI:

- Security of state, population and property of citizens
- Basic necessities of life, health and well-being of the population
- Management and governance of state
- The economy
- Operation of strategic systems

The most important risks which endanger CI are:

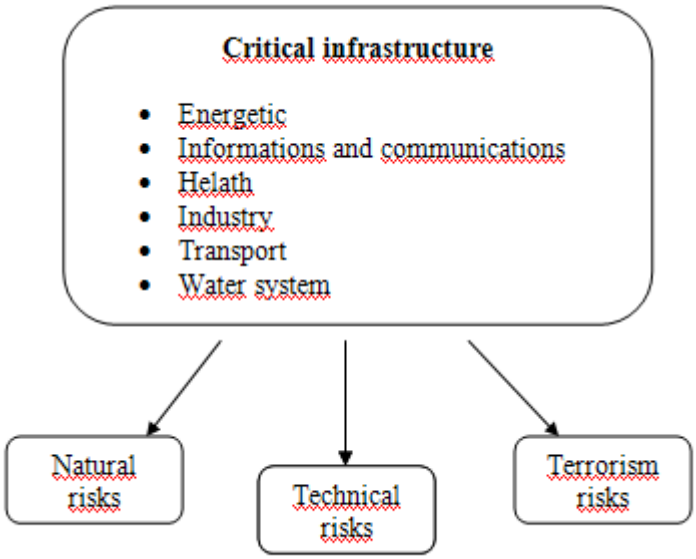

Fig. 1. The important risks which endanger critical infrastructure

2. Critical Infrastructure in the Transport

Transport became the most favorite target of terroristic attack over the last years. The most serious attacks of air transport happened in New York on 9th September 2001, where civil aircraft was used for the attack with huge devastating consequences. Also, there can not be forgotten the attacks aimed to public transport (London-Underground, Madrid-railway transport, that are very attractive target to terrorists because of high transport capacity.

The transport sector includes:

- Trajectory and rail transport
- Road transport
- Inland water transport
- Civil aviation

The Element of CI – is an element of whose destruction or violation (mainly as a consequence of terroristic attack) can have negative influence to any section of national security. Collapse of one system may cause damage or collapse of another system that can have far-reaching consequences.

CI in transport we will call the name transport critical infrastructure (next TCI). The target of the road transport and into the elements of road TCI belong the highways, selected first-class roads, bridges, tunnels and information cables. The National Highway Company and Slovak Road Administration keep them in efficient conditions throughout the year. The violation or destruction would have a serious impact on moving the forces, catering supply and industry transportation.

If we take into the account the density of road network in Slovakia, we can say that if the absence of large-scale destruction or damage of roads doesn't happened, it will be possible to determinate alternatively roads. It's not easy to indicate the roads that would be integrated in TCI and their disposal would have an impact on the smooth running.

Mainly because of frequent traffic accidents that can slow down the transfer on these routes. Protection of bridges and tunnels rests in partial road checks by video cameras. Protection of bridges would be suitable by increasing prevention of transporting dangerous goods because it is eliminated but unfortunately unrespected.

Fig.2 Road transport infrastructure source: internet

3. Conclusion

The target of the protection and the security of the IC means to cut down the risks of threat to the existence and stability of elements of CI and also to turn around possible attacks of elements of CI or at their system of the protection and the security.

The first step of the security legislative framework is to keep it at the National and the International level. The security and the prevention should be the next step how to make more effective way to minimize the risks. The CI is linked in with other sections and industries that need to be keep in collaboration with all of them (making connection of public and privacy

sector). Decrease vulnerable of Slovak Republic is problem of long-time character. Therefore its necessary accept conception, which will be lead to increase preparedness of Slovak republic to face threats.

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Cybercrime as Threat to Telecommunication Systems in Transportation

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Abstract. The aim of this contribution is to outline legal framework and fundamental security issues related to telecommunication and telecommunication devices in particular utilized in transportation and also to provide outputs suggesting solutions of those issues. Selected legal and information technology concerns related to the topic are being discussed as well.

Keywords: Cybercrime, Transportation, ITC auditing.

1. Introduction

When talking about telecommunication and criminal acts committed by means of information technology (also called "cybercrime"), it is necessary to stress out that computer criminality is soaring and it is becoming a serious issue in all aspects of day-to-day life, not excluding transportation. The times we smiled at thriller movies where an evil is trying to manipulate telecommunication satellite in order to threaten governments or his competitors are gone for good. Computer crime is a today's phenomenon involving organized criminal groups rather than weird bored hackers. What's more, special regard must be taken in case of terrorism activities in this field as originally military organizations have increased their technology awareness level. As the internet and computer systems already became an inevitable part of the nation's life, attacks on these information veins can be expected in the near future. Solutions brought by the world's most advanced IT technology players should be of the highest interest.

2. Cybercrime and Its Impacts on Information Systems

2.1. Definition of Cybercrime

In general, cybercrime includes criminal acts committed with a computer, as well as new types of offenses that lack any parallels with non-computer crimes. Neither the Convention on Cybercrime [1] (the Convention) provides definition of what the cybercrime exactly means; only an indirect definition of the term has been established by the Convention's procedural provisions describing it as a criminal offence committed by means of a computer system, while the computer system means any device or a group of interconnected or related devices, one or more of which, performs automatic processing of data pursuant to a program. The U.S.

Department of Justice defines computer crimes as "any violations of criminal law that involve a knowledge of computer technology for their perpetration, investigation, or prosecution." Exact statistics on the extent of this phenomenon proved to be illusory due to the difficulty in adequately defining computer crimes. Statistics also are untrustworthy because of victims's failure to report such. The aggregate annual losses to businesses and governments are estimated to be in the billions of dollars [2].

2.2. Types of Attacks Against Information Systems

The EU Commission's Proposal for a Council Framework Decision on attacks against information systems [3] differentiates the attacks in the following way:

(a) Unauthorized access to information systems. This offence is called hacking. A hacker is trying to establish an unauthorized access to a computer or network. It appears in various forms, e.g. exploiting inside information, attacks, password interception. A malicious intent to steal, modify or destroy data is often connected with such attacks as well as avoidance of some payment being a condition for accessing a website.

(b) Disruption of information systems. Denial of service is a typical form of this type of attack. It attempts to overload web servers or internet service providers with automatically generated messages. A study has calculated that a recent attack caused damage worth several hundred million EUR, as well as intangible damage to reputation.

(c) Execution of malicious software that modifies or destroys data. The most known type of malicious software is a virus. Some damage the PC itself, whereas others use the PC to attack other networked components. Other types, so-called logic bombs can be inactive until activated by some event such as a specific date, where they can cause damage by altering or deleting data. The Trojan horse appears to be inoffensive, however, when opened it releases an attack. A worm does not infect other programs as a virus does, but creates copies of itself, which consequently create even more copies and eventually overload the system.

(d) Interception of communications.

(e) Malicious misrepresentation.

Information and telecommunication networks maintained by the governmental authorities are one of the mostly attacked systems. Nowadays the attacks are being performed by individuals or groups due to various reasons, e.g. eagerness to prove one's computer skills, hatery against particular governmental institutions or misuse of sensitive data for commercial purposes. Terrorism as a day-to-day experience proved its ability to surprise countries that are meant to be "secure" with sudden and menacing attacks on their vital targets. As can be seen, the technological prehistory of those groups should be quickly forgotten and new aims for attacks can be expected. Therefore, technological enhancement of the information and telecommunication systems must be an issue of concern to both governmental authorities and businesses.

An important role in the development of modern information technologies and electronic communication systems is played by private companies which perform threat assessments, introduce programs for the fight against crime and develop IT solutions for the prevention of cybercrime. Industry has displayed a very positive attitude in assisting public authorities in the fight against cybercrime [4].

2.3. Importance of Information and Communication Systems in Transportation

Emphasis on development of information and telecommunication systems in transportation is a logical result of efforts of the international community to ensure improved safety of goods and persons subject to transportation as well as protection of the environment. In this respect, early legislative movements in the field of sea freight are a typical accomplishment which found its shape in the International Convention for the Safety of Life at Sea (SOLAS), 1974 whereby its Automatic Identification System (AIS) created a basis for further developments in the sea freight telecommunications and recently the Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC (the Directive) with the purpose "... to establish in the Community a vessel traffic monitoring and information system with a view to enhancing the safety and efficiency of maritime traffic, improving the response of authorities to incidents, accidents or potentially dangerous situations at sea, including search and rescue operations, and contributing to a better prevention and detection of pollution by ships." [5] The Directive's main goal is to promote a well organized SeaSafeNet which is a European-wide electronic information system with the task to deal with ship movements and cargoes.[6]

On the other hand, development and protection of information and telecommunication systems must not be a fetish leading to enormous control of the information traffic. Even though the applicable legislation gives certain powers to governmental authorities, in particular police forces, prosecution or courts to breach the general principle of privacy applied to information flow, there have to be legislative measures taken to assure a necessary minimum of privacy. A good example of such a protection measure had been established by the Article 15 of the Convention: each party to the Convention shall ensure that the establishment, implementation and application of the powers and procedures to control the information flow are subject to conditions and safeguards provided for under domestic law, which shall provide for the adequate protection of human rights and liberties, including rights arising pursuant to obligations it has undertaken under the 1950 Council of Europe Convention for the Protection of Human Rights and Fundamental Freedoms, the 1966 United Nations International Covenant on Civil and Political Rights, and other applicable international human rights instruments (...).

As we discussed before, current legislation provides for a framework for implementation of technical solutions preventing cybercrime or at least minimizing risks connected with interference into telecommunications. Businesses and governments have to play on the same side of a playground and establish safe communication channels in the field of transportation to be step ahead of their malicious counterparty.

2.4. Information Systems Auditing as Tool for Risk Assessment in Transportation

In order to fulfill the goal discussed above, all transport businesses, governments and other involved organizations should periodically perform complete risk assessments of their ICT (Information and Communication Technologies) systems and appliances and implement adequate internal regulations as to help managing significant risks. The need to perform such assessments had always existed, however, the urgency has arisen recently. It is the role of auditors to make sure that potential risks were not overlooked, nor underestimated. Since ICT systems nowadays play a crucial role in most of transport businesses, protection of these systems and the information stored by them is a must. Physical security controls over facilities that house ICT systems and store sensitive information need to be consistently applied. The same statement concerns logical security controls over ICT systems. Enormous growth in the processing speed of computers has helped to increase the productivity of transport businesses. It is the same processing power growth that exponentially magnifies the significance of ICT

systems protection in worldwide proportions. Internal company audit managers and internal audit committee members, but also the management executives should be able to understand how adequate risk assessment of critical ICT systems in their organizations can be accomplished. Otherwise, they are risking being held personally responsible in case their organizations suffer significant losses as a result of inadequate controls over critical ICT systems. Unfortunately, many internal auditors are not familiar with techniques and resources that they should use to perform efficient audits of company ICT systems. Especially smaller organizations do not have specialized information systems auditors on staff nor sufficient financial resources to cover outsourced services of controls over critical ICT systems and related processes. In such cases the organizations are facing significant risks by leaving gaps in their control environments.

3. Conclusion

The contribution identified telecommunication systems in transportation as a new possible aim of malicious attacks, in particular attacks to be performed by criminal groups with terrorist goals. Focus should be kept not only on "classic" safety issues, but also cybercrime issues have to be considered along with focus on internal risk audit as an important preventive measure .

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Relocation of Temporary Segregated Areas as a Means of Reducing Horizontal Inefficiency of Flights

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Abstract. The finite nature of the airspace as an essential resource in aviation calls for an optimal utilisation in a way that would ensure operation without inducing higher costs for military as well as civil airspace users. Any exclusion of airspace segments to military means creating 'obstacles' that have to be avoided by civil flights; this results in horizontal inefficiency of flights. Simultaneous repositioning of the segregated areas could reduce the inefficiency and improve airspace utilisation. The initial results of analyses, that use an algorithm developed for this purpose, show considerable potential reduction in extra flown distance.

Keywords: horizontal, inefficiency, temporary segregated area, TSA, reduction, relocation.

1. Introduction

The civil-military co-existence is a crucial part of the European airspace and air traffic management (ATM) system. As both sides have their needs and, more importantly, right to make use of the available resources to desired extent, these resources have to be used in the best possible way. The finite nature of the airspace as an essential resource calls for an optimal utilisation in a way that would ensure operation without inducing higher costs for either of the players and would rather lead to more cost-efficient operation while respecting the requirements of both sides. Combined with the expected high traffic growth in the following years, although possibly not as rapid as has been observed recently, optimisation of airspace design in Europe is going to turn into a challenge.

The main problem results from the fact that military traffic imposes limitations to the civil traffic, and vice versa. While both having their own and often very specific requirements, commercial flights and military activity practically cannot exist in the same place at the same time. This has led to establishment of segregated airspace units delegated to military operations; these are either based on permanent 'exclusion' from the airspace for civil aviation flights or on temporary segregation of a block of airspace for military users. However, such exclusion of airspace segments means creating 'obstacles' that have to be avoided by civil flights, and thus it is very likely that the originally planned route length for such flights increases. This induced, negative effect is called horizontal inefficiency and it currently represents a considerable issue in the whole ATM system (although not the whole effect is caused by the civil- military co-existence).

This article will briefly describe the potential benefits of a simultaneous relocation of temporary segregated areas (TSA) within an observed region.

2. Military Operations and Flight Inefficiency

2.1. Military Training Areas

There are several types of reserved airspace used by the military which can be classified according to the activity taking place within the particular area, and the level of manageability from the ATM point of view. The ATM manageability is in fact the expression of the extent to which a training area is considered a shared airspace. States are obliged to have the manageability information included in their Aeronautical Information Publications (AIP). The level of manageability is linked to the accessibility to civil traffic. Apart from Prohibited, Danger and Restricted Areas, where the ATM manageability is either none or can be achieved only in specified times, the Temporary Reserved Areas (TRA), TSA and Cross-border Areas (CBAs – effectively a TSA established over national boundaries) are highly manageable.

2.2. Manageability of shared areas

ATM manageability can be explained as the level of sharing a particular part of airspace between the civil and military operations. The manageable areas are normally available for pre-tactical management with the availability to civil traffic announced at least several hours in advance. In addition, once assigned to civil traffic, they cannot be revoked without previous consultation with the air traffic control units. On the other hand, areas not manageable at all (or permanently prohibited) cannot be used by the civil traffic during the published hours of the activation.

In between the two types of area described above are the partly manageable areas which are subject to tactical management where real-time activity is well known through co-ordination between the appropriate civil/military control units. These areas are assigned and revoked to civil traffic in real-time operations without previous advice.

2.3. Flight (in) Efficiency

As stated in [1], “flight efficiency is a major performance issue, with significant economic and environmental impact. Flight efficiency will need to improve significantly for air navigation services to play their part, albeit small, in ensuring the sustainable growth of aviation.” It is obvious that any deviation from the optimum horizontal trajectory of a flight means additional flight time, fuel burn and costs to airspace users. In addition, excess fuel burn also impacts the environment through CO_2 emissions.

En-route flight inefficiency is effectively the extra distance flown. For any city pair, it is possible to compare the direct route length and the actual route length. The difference between the two figures would then be the route extension that is not desirable.

Since en-route extension of flights incurs considerable costs to users (at system-wide level), a European flight efficiency target has been set and adopted. According to this goal, the European average route extension per flight should be reduced by 2 kilometres per year until 2010. The average en-route extension in 2007 that relates to the efficiency of the en-route network was 33.4 kilometres.

[1] also concludes that there is a need to “review real time operations, identify best practices and raise civil-military coordination for tactical air traffic control and airspace management to best practice level, especially in the core area”; and “to reinforce commitment to DMEAN, in order to have more dynamic pre-tactical airspace management and air traffic flow management”.

Military activities and the subsequent allocation of airspace segments to military users are a major contribution to the en-route flight inefficiency described earlier. The activation of a TSA means that its availability to civil traffic is limited or none, and any routes originally planned through the active TSA have to be amended to avoid any collisions of civil and military operations. It is therefore necessary to find a suitable solution that would support the recommendations provided.

3. Relocation of Segregated Areas and Potential Benefits

The proposed methodology involves simultaneous relocation of several TSAs in a particular region, i.e. determining new positions of existing areas while maintaining their shape, in order to reduce the inefficiency of civil flights. If applied in practice, this whole process would be performed in pre-tactical phase according to the traffic demand and traffic flows in the observed region.

The potential benefits of this approach have been analysed using actual flight data in European airspace. For the purpose of the analysis, an algorithm has been developed by the author that is able to process the flight data, create traffic flows and to determine new positions of the TSAs that exist within an observed region, with respect to the identified flows. The parameter that is calculated throughout the iteration is the length of trajectories for flights and their count (hence the relevance of flows), which is consequently compared to the original lengths. The output is the new positions of the 'obstacles' that would represent the largest reduction of route extensions.

Performing such analyses is highly dependable on the available computing power; similar analyses can currently be performed in small scale only (the maximum successfully tested observed area until this point was an airspace segment of 200x200 nautical miles) and with a relatively small number of obstacles to be 'moved around' (equivalently, the maximum number was 4). Naturally, the modelled airspace segment and the inside obstacles reflected an actual part of European airspace.

Initial runs of the computations have shown that the saving in terms of flown distance that could be achieved is up to 14% of the original route extension. Further analyses are required to support the approach but it is apparent that the potential benefits are not negligible.

4. Conclusion

Flight efficiency remains a major issue in the current ATM system. With a large number of military areas in place and growing traffic density, it is necessary to look for solutions to the current civil-military situation and to push it to another level. The presented approach may prove to be a basis for the way forward as long as the dynamic allocation of airspace is concerned. Further work is needed in this field but the initial results show that the improvements can be substantial.

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Properties of Mineral Filler Ariseing in Technological Process of Production Mineral Mix Asphalt

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Abstract. A huge amount of 'dispensable' material, i.e. reclaimed dust which is left over from the aggregate dedusting system during the production of mineral mix asphalt in the plant. The possibility of applying the dust as useful material is connected with the necessity of conducting the research determining its properties. Two types of dust have undergone the research; i.e. those being left in the dedusting system on the mineral mix asphalt factory and those left after the process of rinsing the rocks in the mine. In order to compare the possibilities of applying them both as the substitute filling with mineral mix asphalts and as the binder in the reclaimed foundation applied in foamy asphalt technology. The results of the research lead to a conclusion that, depending on the properties, dust is an effective binder used in the reclaiming technology with foamy bitumen or, possibly, with substitute filler used in mineral mix asphalt.

1. Introduction

Dust is left as 'waste' material during the process of producing mineral mix asphalt, i.e. during the aggregate dedusting process and during the production of aggregates in mines (whilst crushing the rocks and rinsing the aggregate).

The development of the road system, building new motorways, expressways, regional roads together with the renovation of existing roads is connected with the production of mineral mix asphalt on a wide scale. The amount of mineral filler proportionally increases with the amount of mineral mix asphalt which is produced (the material is fully obtained from bag filters in aggregate dryer gas scrubbing system whilst producing mineral mix asphalt [1]).

The issue of reclaimed dust application has occurred only recently due to the fact that dedusting systems applied in coating plants of older types such as the wet scrubber and cyclones caused greater air pollution. Strict environmental regulations have been imposed to determine the amount of industrial dust emitted to the atmosphere as 100mg/m3. The above-mentioned regulations require the introduction of an alternative dedusting system, i.e. bag filters. Virtually all amount of dust will be kept.

The amount of dust left over by plants is strictly related to the following:

- the kind of material used for producing mineral mix asphalt (a larger amount of dust is left over during the aggregate drying process when the aggregate is softer like, e.g. limestone, than when using harder material, e.g. basalt or quartzite;
- the composition of the substance on the level of projecting mineral mix asphalt, the research of chippings (sifting → the fraction <0.0075 of dust);
- the planned application of mineral mix asphalt – the largest amount of dust is left over during the production of substance planned as foundation and lower construction layers; it is connected with the possibility of applying aggregates of lower quality and

Approximately from 10 to 30 kg of dust can be reclaimed after two-level dedusting, which takes place during the production of one ton of mineral mix asphalt [4]. The asphalt mixing plant produces ca. 250,000 ton of mineral mix asphalt (during the eight-month production cycle, which gives ca. 2,500 – 7,500 tons of dust. Therefore, both

- kinds (e.g. according to the class – grindability in the Los Angeles drum; according to the kind – the content of grains smaller than 0.0075 mm).

from the ecological and economical point of view the application of the dust is the most appropriate solution. Because of the above-mentioned aspects, the application of dust lowers the costs of storage, transport (which is done in the same manner as with the transport of mineral filler), and will reduce the cost of making the construction layers.

2. The Methodology and the Research of the Properties of Dust

Four kinds of dust were the object of research, which are illustrated in Table 1. Three of them are the kinds of dust obtained from the process of aggregate dedusting in asphalt mixing plants (dolomite, limestone and gabbro); whereas the fourth type is dust obtained from the process of rinsing the quartzite aggregate in mine.

Dust type	The composition of mineral mix asphalt	The percentage of the main mineral
D (dolomite)	dolomite 7/12	około 85,0% pyłów dolomitowych (MMA przeznaczona na warstwę ścieralną/wiążąca KR1-2)
	dolomite 2/7	
	dolomite mixture 0/4	
	natural sand	
	filler	
L (limestone)	limestone 2/8	ca. 87% of limestone dust (mineral mix asphalt For friction/course binder course KR 1-2)
	limestone 0/2	
	natural sand	
	filler	
Q (quartzite)	quartzite	100% of quartzite dust
G (gabbro)	gabbro 8/11	ca. 77% of gabbro dust (mineral mix asphalt planned for friction course)
	gabbro 5/8	
	gabbro 2/5	
	limestone 0/2	
	filler	

Table 1. The researched types of dust.

The following researches have been conducted in order to determine the functionality of dust:

- structural density (Mg/m^3) – (PN-76/B-06714/02);
- pH – acidity, alkalinity – with the use of acidometer;
- Blaine's actual area (cm^2/g) – (PN-EN 196-6);
- the contents of clay minerals – with the use of methylene blue indicator ;
- the grain composition of dust – the aerometric method (sand fraction – f p – grain diameter from 0.075 mm to 0.2 mm; dust fraction f п – grain diameter from 0.002 mm to 0.075 mm; clay fraction f i – grain diameter less than 0.002 mm).

The idea of the research was to present dust properties in the process of dedusting as regards its usefulness to mineral mix asphalt, repaving processes and soil stabilization.

The results of the Blaine's method actual area research have been illustrated in Fig. 1. The findings on the maximum actual area are the following (from the highest to the lowest findings): limestone dust (L), gabbro dust (G), and dolomite dust (D), respectively. The lowest finding has been observed in the case of dust obtained from the quartzite aggregate rinsing process (Q).

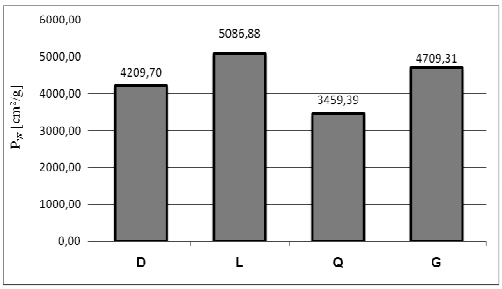

Fig. 1. The actual area researched with Blaine's device.

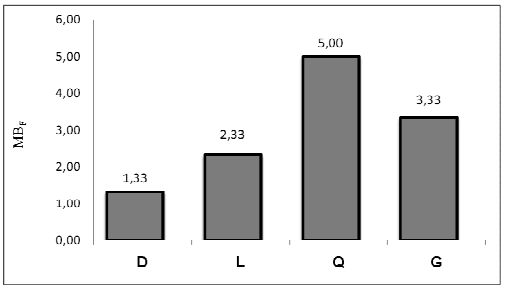

Fig. 2. The findings on methylene blue MB_F for dust.

The findings on methylene blue indicator, which depicts the amount of clay minerals have been portrayed in Fig. 2. Dust marked with Q contain the largest amount of clay elements. Dust obtained from dedusting process have a minute amount of MB_F.

Research conducted to measure the pH level has confirmed the research on acidity/alkalinity of rocks. Q-type dust is the most acid, with pH<4,5. Other types of dust match the findings of pH>6,6 as either inactive or alkaline. The results have been shown in Fig. 3.

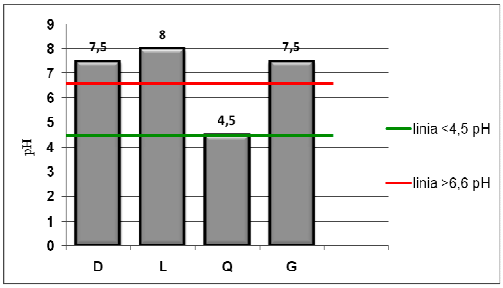

Fig. 3. The findings on pH of dust.

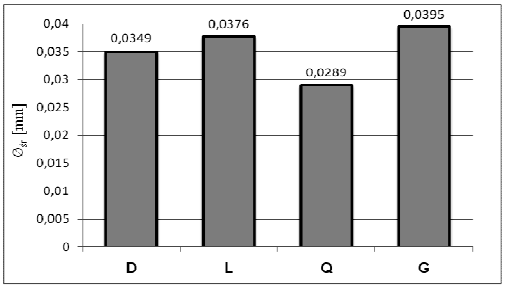

Fig. 4. The findings on the average diameter of dust $Ø_{av}$.

On completing the research of granulometric composition determined by a depositional method (Prószyński method) it can be assumed that the tiniest types of dust are: quartzite, dolomite, limestone, and gabbro dust, respectively. The average diameter of grains Øav has been depicted in the following formula [3]:

$$\phi_{sr} = \frac{\phi_{16} + \phi_{50} + \phi_{84}}{3} \quad (1)$$

in which:

Øn (n=16, 50, 84) – the grain diameter taken from the cumulative curve on the distribution of grains, which corresponds with the exchange of dust fraction (its amount in the sample is 16, 50, and 84 %, respectively).

The following conclusion can be drawn from the data present in Fig. 4: dust types A, B, and D have similar findings on Øav; whereas the findings on Øav of quartzite dust from the aggregate rinsing process are much lower when taking the diameter of grains into consideration.

Having analysed the research mineral dust types, the conclusion to be drawn is as follows :

- the substitute filling – its application depends on the actual area measured by Blaine's method (Pw = 2,500 – 4,500 cm^2/g), and the methylene blue indicator (MB_F < 10). The requirements are met by dolomite dust as well as quartzite dust due to Pw and MB_F; however, too high level of acidity can cause the decrease in adhesion. The L-type dust together with G-type dust have too large actual area, which is over 4,500 cm^2/g
- the fine-grained material is highly applicable and indispensable during the reclaimed foundation in the foamy asphalt technology. Because of being fine-grained the L, D, Q, and G-types of dust can have a major role in mineral mixture mixed with asphalt and, thus, forming "scattered reinforcement".

3. Conclusion

The following conclusion can be drawn on the basis of the conducted researches on types of dust obtained from the dedusting processes:

- the Q-type of dust (obtained from rock rinsing processes) has the lowest figure as regards the average diameter ;
- the findings on the actual area of mineral dust can be influenced by the planned destination of the produced mineral mix asphalt (construction layers) and the kind of aggregate (softer aggregates have higher friction level in the Los Angeles drum; that is why, dust obtained from this aggregate can have a higher level of diffusion); the types of dust obtained from limestone have had the highest level of Pw, the other ones are G, D, and Q-types of dust having lower levels of Pw, respectively;
- the application of dust as a substitute filling is connected with the limiting area (Pw = 2,500 – 4,500 cm^2/g) and methylene blue indicator (MB_F < 10). The D, and Q-types of dust can be applied as substitute fillings on the basis of the above-mentioned conditions. However, the acidity of Q-type of dust (pH = 4,5) can cause the decrease in adhesion of dust with asphalt ;
- the application of D, L, Q, and G-type of dust in the reclaimed foundation in foamy bitumen technology is possible due to a huge demand on fine-grained material technologies (< 0.075 mm)

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Assessment of the Lifecycle Processes in Air Navigation Services by the Key Performance Indicators of the Safety Management

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Abstract. The Safety Management in operational environment of the Air Navigation Services (ANS) provision has naturally been affecting the performance of relevant process. The indicators of these managerial actions can be used as means for evaluation of the particular efficiency. The intention to create homogenous conditions for development of the European Air Transport System, especially European Air Traffic Management, provides an opportunity for identification and harmonized application of common principles. This article contains a basic structural view on processes related to the lifecycle of ANS, their regulation and supervision in terms of safety performance indication.

Keywords: Air Navigation Service (ANS), Key Performance Area (KPA), Key Performance Indicator (KPI), lagging indicators, leading indicators, safety.

1. Introduction

The management of high safety level in provision of the ANS is an issue to be taken into account with all respect to functional elements and their relationships. Implementation of the process approach in operational framework of the ANS provides managerial tools for control of relationships between the organizational units and partners in effective manner [1]. Obviously, the air traffic safety must not be compromised by any optimization of the processes and has to be maintained at the highest possible level.

One of the general managerial functions should be oriented to sharing information on performance objectives, to monitoring of their achievement and to reaching common understanding on the best practices on safety, efficiency and capacity, on the current performance achievements and on the planned performance objectives.

2. Key Performance Areas

Taking into consideration the framework of ATM/CNS, eleven KPAs have been proposed in line with [2] endorsed by the 11th Air ICAO Navigation Conference (2003) [3]. There are [4, 5]:

- Safety
- Overall efficiency
    - Cost-effectiveness

- Quality of service
  - Flight efficiency
  - Predictability
  - Flexibility
- Capacity

- Other key performance areas
  - Access & Equity
  - Environment
  - Participation by the ATM community
  - ATM Security

The following objectives are associated with the safety key performance area:

- To evaluate the ability of the Air Traffic Management (ATM) system to maintain or reduce the number of accidents or serious incidents related to ATM in reference to established fundamental principles governing the investigation of aviation accidents and incidents independently of traffic growth;
- To evaluate the incident reporting process inside air navigation service providers and the level of transparency of the reporting;
- To evaluate the maturity level of Safety Management Systems of air navigation service providers and to identify and share best practices.

3. ATM Safety Key Performance Indicators

Based on revision of the existing procedures and practises two main types of high-level KPIs have been identified [6]. There are:

Lagging indicators – measurement of number and severity of safety related events (e.g. safety occurrences, such as accidents, incidents, system outages etc.) which have happened. The effectiveness of mitigations means are also taken into consideration of the measurement. These indicators measure the outcome of the service provision which characterise performance historically. Their evaluation could be done periodically or triggered by the event. The meaning of lagging indicators reflects the consequences of actions taken previously.

Leading indicators – are identified principally through the comprehensive analysis of the organisations (providers, regulators, States). They are designed to help indication whether the providers, regulators and supervisors have applied processes and actions that are effective in lowering the risk of ANS provision. They are usually considered as the driving factor of lagging indicators.

There is an assumed relationship between these two factors because improvement of performance in the leading indicator will drive better performance in the lagging indicator.

It is acknowledged that some KPAs might not be mature enough for immediate performance measurement due to a lack of robust and commonly agreed KPIs. For safety, a progressive approach is proposed. Initially, development of safety metrics will concentrate on the higher level indicators. However, there is strong commitment to build a model of lower level indicators. Existing regulations should be used and clear reporting requirements together with roles and responsibilities should be defined. The safety maturity assessment is based on data and information collected through suitable means. Review of safety regulation performance is also a vital part in the measurement of overall aviation safety performance. While safety oversight is the responsibility of each individual State, any failure to meet the required standards can threaten aviation safety on a global scale [7].

4. Lifecycle of Air Navigation Service

An operational relationship between the ANS Provider and the service user has been created, executed and cancelled in direct reliance on all phases of the service lifecycle. Because the service lifecycle, as a process, has repeated several times during evolution, it is important that the quality of service follows the user requirements and the safety level of service provided is stabilized or having an increasing tendency. The lifecycle is determined by time sequence and order of the particular elementary processes. Considering the social-technical character of modern ANS and operational environment where these services are provided, the particular phases of the service lifecycle can be structured as follows:

Concept of service provision. The operational need of ANS provision is analysed and evaluated during this stage in conditions of wider context, especially from the functional, institutional and economical point of view.

Specification of requirements on service provision. The determination of timeframe of the service provision with respect to meaning for the user (lifetime) and to requirements on quality of service is a significant part of this stage. An estimation of lifecycle costs, specification of inherent requirements on future functions and the characteristics of ANS are also included.

Design and development of the service. This stage is resulted by the detailed proposal of service delivery with specification of resources and means for its establishment and provision.

Service establishment. This process is oriented on the direct establishment of real functions, especially in technical, operational and social area in order to create a functional entity suitable for direct implementation into the operational environment.

Introduction into operational use. The functional integration of ANS into the operational environment and additional activities related to the assurance of reliable service provision is carried out during this stage. It also means the beginning of service operational use. Declaration of fulfilment of the intended use - validation [8] is a part of the related processes.

Service maintenance. The real use of indented service provision is performed during this stage. In order to achieve required lifetime and stable quality of service the relevant activities have to be carrying so the parameters of operational conditions to be maintained in defined limits (preventive maintenance). Because, it is important to use the potential deposited into the service provision at the beginning, the service change management composes a part of these processes. However, the implemented changes can not significantly modify the original character, either purpose or meaning of the provided service.

Service cancellation. Generally, the requirements on continuity of ANS provision have to be considered in this context, especially from the air traffic safety point of view. Assessment of the service unavailability is also important in cases if real close operational relationship between the provider and the user has been established.

5. Identification of the Executable Processes

Safety targets are derived to meet either political, strategic, regulatory, industry safety objectives or management performance. A cautious approach in setting targets should be taken because, if targets are set too early in the process, or if they are unduly correlated with other performance indicators, the whole process may be threatened [6]. The starting point for setting targets should be leading indicators and subsequently with improved maturity of the system the targets for lagging indicators.

The ANS Providers carry out their activities in complex conditions in interactive relationships among parties concerned. Due to this reason it is necessary to clearly identify competencies for particular processes. From the top to down, there are following prime processes:

- ANS Safety Regulation
- ANS Provision
- ANS Safety Supervision

In principle, these prime processes should be carried out by the independent subjects. According to [9] the strict separation of service provision from its regulation and supervision is required. From the real application point of view, the sub-processes can be logically interlinked. Basic sub-division of them can be as follows:

ANS Safety Regulation: Safety targets definition, Safety regulations issuance.

ANS Provision: Carry out of the ANS lifecycle processes (as specified in chapter above).

ANS Safety Supervision: Safety audit preparation, Safety audit performance, Safety audit evaluation, Formal authorisation of ANS provision.

6. Conclusion

Position of the ANS Provider in the air transport systems has been significantly impacted by its capability to manage the safety related issues. This can effectively evaluated by the lagging safety indicators. However, the air traffic safety has to be managed in a wider scope mainly in cooperative relationships with Safety Regulator and Safety Supervisor. Their portion on the safety management effectiveness can be evaluated by the leading safety indicators. The safety maturity assessment and overall processes performance measurement represent the possible solution which details can be further developed. All of them enable to react flexibly on dynamically changing conditions resulted from the operational needs and ensures the achieved air traffic safety level, as well.

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Reinforced Road Embankment Movements

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Abstract. The counter-fort walls based on composite soil reinforcing system are subjects of deformations caused by field work deployment, neighbor construction activities, erosion and soil compacting effect. The present study compiles the deformation measurements of counter-fort walls (Armovia®) realised on the highway D47 objects, 8246 and 7280. The objective of present study is to quantify and analyze the wall deformations, where the impact of difficult geological environment (mining activity) may also be present.

Keywords: reinforced soil, geo-mesh, D47 highway format, Armovia®.

1. Subject of Interest

The structures are located on the D 47 highway between 146.600-155.140 km and situated in the cadastre of Ostrava-Svinov. Mining effects in the territory can be believed to have disappeared. The certified Armovia® structures were used there. The face components are large split concrete panels laid on a strip footing. The carrying component is a one-axis geo-mesh, Tensar 120 RE. The mesh starter is anchored into the rear side of the face component. The mesh starter is backfilled with soil and set to a length specified in the project Fig. 1. Crusher-run materials (0-63c) from the Bohučovice quarry was used for backfilling and the remaining part of the highway embankment was filled by the tailing. The embankment is 9.187- 10.091 m high.

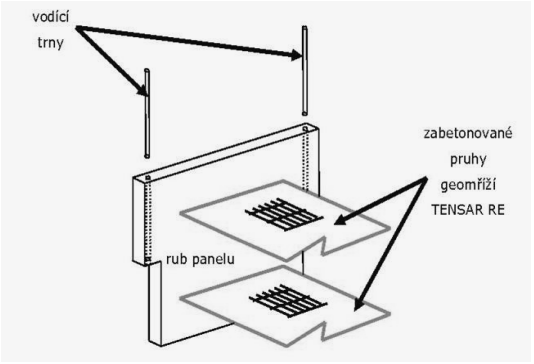

Fig. 1. Armovia® system

2. The Monitoring Station

In order to monitor the behaviour of the wall structure, the monitoring station was extended – from SO 8246 to SO 7280. The monitoring station consists of 19 profiles (in three height levels) that monitor spatial deformations and 11 bench-marks to monitor subsistence. The Baltic vertical system, after adjustment, was used for the height measurements. The topography measures was attached to JTSK- LVS – flyover Rudná. Following parameters are monitored in the structures:

- subsidence
- transversal and longitudinal shifts of points referred to the axis of the structure

Below listed surveying methods have been used. 1st order levelling (PN) with a closed traverse was used for the vertical surveying. Reflecting shields in individual profiles were measured in the method of transition points due to landscape configuration.

3. Stability Model

The geotechnical model was carried out on the boundary of both objects and is represented by the most significant measured settlement (point G6). Here, the height is 8,8m and the length of geo-grids is 10m (from back of wall). The width of geo-grid stripes is 1,30m. The spacing between the stripes decreases downwards from 0,80m to 0,40m. The input data are defined by geometrical parameters, backfill material properties as well as geotechnical parameters of the substratum. The total length of model is 100m. The model includes the substratum bed of 28,0m (after levelling). The phreatic surface was reached at 2,60m and stabilised at 1,45m. The axial elasticity stiffness EA_G adopted in the model is 35kN/m for Tensar 120 RE and 100kN/m for BaseTex 800/100.

Model's chronological stages are:

- Tension-deformation analysis of the background at the start of on-site works.
- Tension-deformation analysis of the background and in the body of the wall at the end of on-site works.
- Tension-deformation analysis of the background and in the body of the wall during monitoring.
- Settlement prediction.

4. Results and Solutions

4.1. Evaluation of Geodesy

It results from all measurements and analyses that the most exposed sites are located at ends of the structures. So far the movements were caused by construction activities, this means the construction of the structure itself and/or neighbouring buildings. The results have proved so far that the structure is stable without extreme movements that might impair its function.

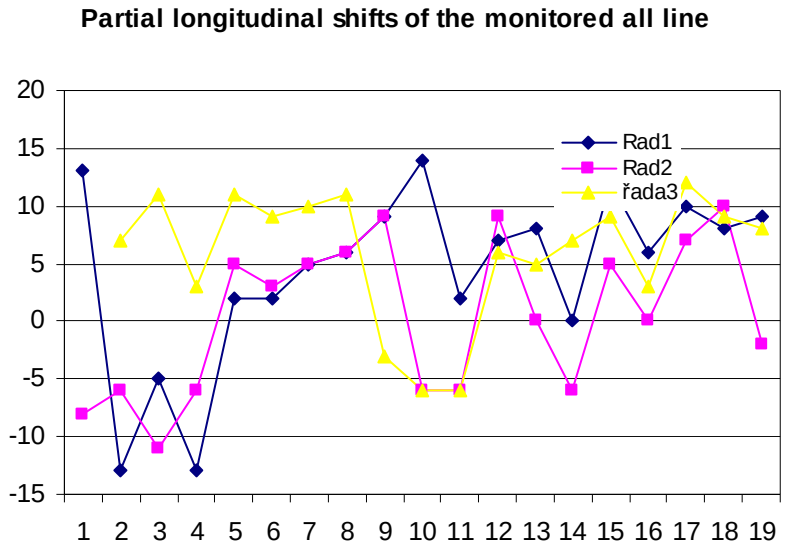

Fig. 2. Partial longitudinal shifts of the monitored all line

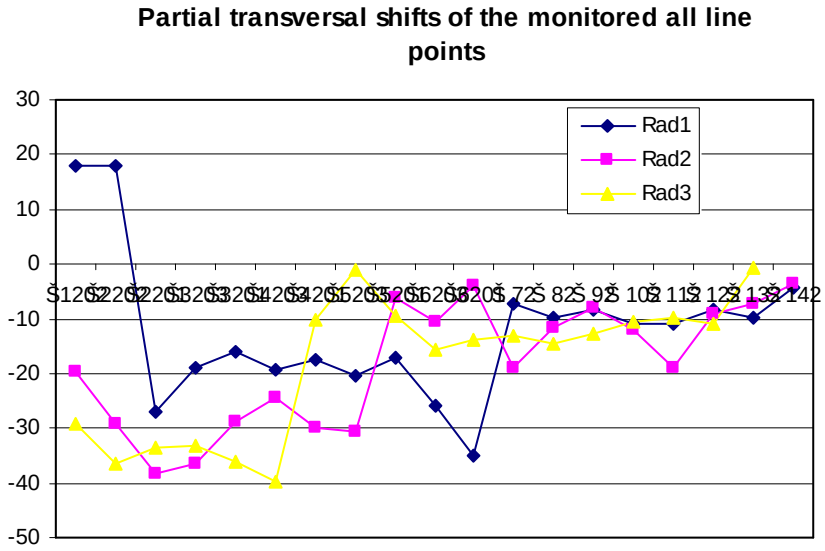

Fig. 3. Partial transversal shifts of the monitored all line points.

4.2. Comparison of on-Site and Experimental Data

The figure 4. shows a slight discrepancy in the interval of 35-625 days. The reason of this is, most likely, due to different real and modelled wall construction advancement. Outside of this interval the modelled data fits to the measured data. At the date of the last measurement (05.11.2008), the settlement was 195mm representing 93% of 10 years predicted value (210mm). The object stability is subject of the Czech standard ČSN 736133, where the

minimal degree of stability, for our kind of object , Fs ≥ 1,2. The model, showing the stability of 1,66, is therefore within the standard limits.

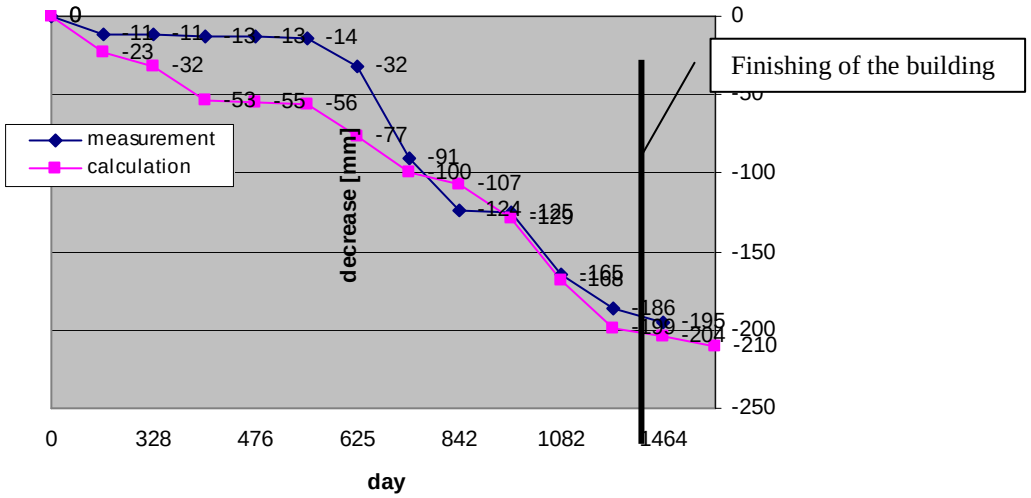

Fig. 3. point G6 settlement time related progression (measured and modelled data).

5. Conclusion

Further observations should be carried out in order to find out whether construction stays stable. Also, additional monitoring will provide information about traffic-induced loads. A maximal collection of information about the time related structure characteristics would confirm the object type and construction issue choice.

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Evaluation of Railway Stations as Part of Basic Implementation Time Discrete Train Formation

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Abstract. Paper submitted the evaluation of the railway stations by the multi criterions evaluation. The evaluation of stations is a very important element in determining investment in technical equipment stations using technology for time-discrete train formation on railway network.

Keywords: time discrete train formation, marshalling yard, multi criterions evaluation.

1. Introduction

European Commission and governments of European countries declared in the documents aim to shift part of the volume of freight transport from road to rail. This transfer should occur in particular in order to lessen environmental pollution, reducing the number of traffic accidents with fatal consequences and elimination of congestion on the road network in areas of large cities. One of the tools by which this transfer will be possible to address is improving the flexibility and railway cargo carriers in the transportation services segment, each wagon shipments. It is necessary that for this purpose was created the right conditions, and these measures are known in the past to get back lost customers by offering innovative services offered. However, the provision of services does not mean an automatic transfer of the volume of freight transport from road to rail. It should handle the entire technological process, so that the service was acceptable from the perspective of the customer and acceptable cost for the carrier. Requirements for the rapid, safe and affordable transport time for the customer may also provide a model of "just in time". As a starting point to assume the technology is time-discrete train formation *("night jump"*) in the light of the limitations of infrastructure and technological progress in all types of stations on the infrastructure. Typology stations for time-discrete train formations are:

1. operative marshalling yard
2. railway satellite station
3. and the loading station, where it is possible to wagon loading and unloading shipments.

2. Time discreet train formation

Trains, however, and they form only in a specified period during the day compliance with exact time-table, which is based on customer requirements for the implementation of the cost of handling the day-time in working days.

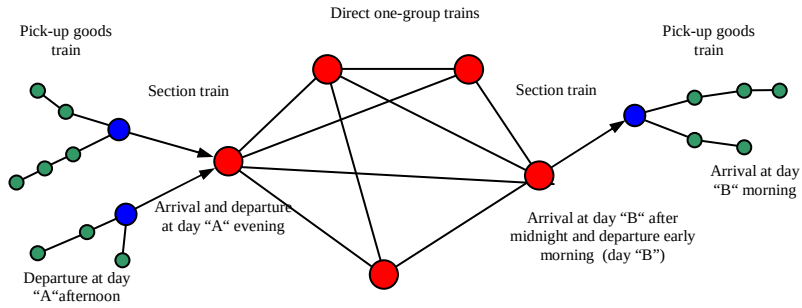

Fig. 1. The figure caption is of the style Description; the figure itself is of the style Figure.

After loading of wagons in the afternoon the first day of their collection is carried out in the main marshalling yard via satellite station. Subsequently, it starts processing the target sets of trains and creation of starting direct one-group trains to all other major marshalling yards. These trains leave in the evening hours.The second day (day B), for remote sessions, exceptionally, the third day (day "C"), coming to main marshalling yard distance trains from other major marshalling yards to shunting. Their wagons are passed on to the section trains via satellite stations to stations base network.One of the main objectives to optimize train formations now is establish the optimal number of main marshalling yards.

3. Location main marshalling yards

The issues of location of marshalling yards in the time discrete formation of freight trains are generally characterized as the problem of placing depots (centres etc.) Network, which must simultaneously take into account several factors underlying the choice of placing a yard. From the number and location of these stations in turn depends overall transport performance of collection and distribution of shipments wagon. However, the optimization criterion is minimizing the total transport performance of collection and distribution, expressed in the observation unit.

Transport network represents the structure (graph), where a finite set of points called the points and final set of lines connecting some vertices representing a connection edges. Each peak in the network is assigned nonnegative number (weight peak), which reflects the importance of the peak. The edge of the examined transport network represents the track section connecting two adjacent vertices. Each edge is valued nonnegative number, which represents the weight of the edges. Weight the edges should correspond to the coefficient of difficulty of each track section between the neigh boring peaks.

4. Multi criterions point evaluation

The task is to select a mathematical model of the points (theoretically appropriate) those that are best suited to the location of a marshalling yard. Given the above factors affecting the choice of placing a yard in the top as to be considered when designing the methodology, it seems best to use to evaluate the peak group of multi-criterions point evaluation.

Methods of multi-criterions evaluation can be generally used for comparison and subsequent selection of any objects on the basis of several variables. Because of its ability to synthesize several different variables (features) into a quantifiable summary variable are particularly suitable for analyzing the status of the object (a yard) on the network. Make it

possible to compare a set of several objects on the basis of several characteristics of their activities and determine the sequence location of analyzed objects.

The basis of evaluation is to multi-criterion baseline matrix of objects and their characteristics. Objects represent all the points (vertices) on the network.

When starting the matrix structures of objects, it is necessary to follow these steps:

1. Selection of objects included in the analysis file.
2. Added so-called „Model station“ to the list of objects.
3. Choice of indicators characterizing the object.
4. The choice of the weights of individual indicators.
5. Establishment of the baseline matrix. (Tab.1)

To the matrix is also a fictional station (so-called "model station"), which all evaluation factors criterion meets in full. Then the value x_{m1}, ... , x_{mn} are maximally. Background objects matrix is in Table 1.

indicators / **station**	a_1	a_2	...	a_i	...	a_n	$\sum$
1	x_{11}	x_{12}				x_{1n}	$\sum_{i=1}^{n} a_{1i}$
2	x_{21}	x_{22}				x_{2n}	$\sum_{i=1}^{n} a_{2i}$
...	...						**...**
j				x_{ji}			$\sum_{i=1}^{n} a_{ji}$
...	...						**...**
m-1	$x_{m-1,1}$	$x_{m-1,2}$				$x_{m-1,n}$	$\sum_{i=1}^{n} a_{m-1,i}$
m (model station)	x_{m1}	x_{m2}				$x_{m\,n}$	$\sum_{i=1}^{n} a_{mi}$

Tab. 1. Establishment of the baseline matrix of objects

Explanatory note to the matrix:

$a_{1,...,n}$ - individual evaluation factors;

x_{ij} – value of the *i-th* variable in the *j-th* object;

n – number of indicators;

m *-1* – number of objects included in the initial matrix;

m – model station.

Aim of multi-criterions methods of evaluation methods is the transformation and fusion of the different indicators into one summary variable (the resulting characteristics), fully indicating the level of individual objects in a set of tested objects. By the overall level (importance) of the peak, respectively. Suitability for placement of a yard is a summary indicator of the peak.

Summary indicator of peak - peak rate, which is given a weight (importance), which is calculated as the sum of one hundred times the share of the point’s assessment of individual factors, each a sum a point evaluation so-called model station. Remuneration will reflect the percentage of each peak with respect to a model station.

$$Kj = \frac{\sum_{i=1}^{n} a_{ji}}{\sum_{i=1}^{n} a_{mi}}.100 \quad ; j \in 1,...,m-1 \tag{1}$$

Where:

Kj – coefficient of *j-th* peak;

$\sum_{i=1}^{n} a_{ji}$ – valuation point the amount of *j-th* peak;

$\sum_{i=1}^{n} a_{mi}$ – valuation point the amount of peak model station.

Summary indicator peak thus expressed the importance of the investigation and the point will have a substantial impact when deciding on the allocation of a yard to the peak. It is therefore important to choose the characteristics (variables) that best suit the specifics of the problem, therefore, take into account all factors that influence and determine the choice of location in the centre of the point.

5. Conclusion

The result of that assessment methodology formation yard is the possibility of classifying the various stations on the network as vertices of an oriented graph. Using graph theory is to determine the criteria for the assessment of individual stations, which will be used in further investigations formations role as a sub step comprehensive problem.

The appropriate technology movement in implementing the proposed railway transport enterprise can provide a service that will contact existing customers and attract new ones, respectively previously lost customers. The continuity of the art and the global trend of innovation, it is not possible to maintain the old ways of management and organization of traffic on the railways, but it is necessary to exploit the advantages offered by technological advances in science and technology. It is necessary to constantly seek new opportunities to improve the services provided.

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Concept of Aviation and Road Safety Study Programme

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Abstract. Increasing the level of safety, or alternatively maintaining the high levels is one of the priorities in every transport mode. In aviation as well as in road traffic, neglecting safety standards can lead to catastrophic events. Determining causes of any such occurrence, which inter alia is a step towards more consistent prevention, is a process undertaken by highly-qualified experts. This article outlines the proposal and justification for a second-grade study programme with focus on the topic mentioned.

Keywords: aviation, road, safety, study programme.

1. Introduction

The problem of aviation occurrences investigation and becoming an experienced person in this field is closely linked to potential over-capacity in terms of human resources involved in this process. This is especially true where the number of occurrences falling under the responsibility of a single investigating authority is too small. This issue, or main element hindering the establishment of a specialised study programme can be eliminated to some extent through co-operation with another type of transport, thus extending the covered area and specialisation of graduates. An example of such universality is the Australian Civil Aviation Safety Authority which also covers investigation of naval accidents/incidents. This article deals with the concept of study programme aimed at raising qualified specialists in the field of combined aviation/road safety, which would be applicable in the conditions of Slovak Republic.

2. Aviation: Safety and Occurrences

In general, occurrences in aviation are an inevitable part of air traffic. Despite the efforts to increase the levels of safety, a total elimination of occurrences is not possible due to various reasons, e.g. continuing growth of air traffic and subsequent increase of traffic density, different cultures with respect to achieving and maintaining standards of safety etc. Investigating occurrences is a complex, often time-consuming process that requires concentration on details, and that has to be carried out responsibly and in a qualified way.

2.1. Types of Occurrences

The following list defines the types of occurrences as set out by [1]:

- 'accident' means an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

1. a person is fatally or seriously injured as a result of being in an aircraft, or direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or direct exposure to jet blast, except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

2. the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories; or for damage limited to propellers, wing tips, antennas, tyres, brakes, fairings, small dents or puncture holes in the aircraft skin; or

3. the aircraft is missing or is completely inaccessible;

- 'serious incident' means an incident involving circumstances indicating that an accident nearly occurred;
- 'incident' means an occurrence, other than an accident, associated with the operation of an aircraft which affects or would affect the safety of operation.

2.2. Safety and Aircraft Operators

It is absolutely essential for aircraft operators, mainly airline companies, to ensure maximum safety for their passengers and staff. If an occurrence takes place, the usual consequence is that the airline has to improve its image in the eyes of the general public as potential customers. The psychological impact on market potential can eventually cause considerable revenue losses to carriers, and/or additional costs for image improvement. Minimisation of occurrences, which can be achieved through high in-house safety culture to large extent, is an important factor of commercial and operational performance of every air carrier.

2.3. Occurrences in the Slovak Republic and the Role of Civil Aviation Authority

In 2008, the number of occurrences in Slovakia that were recorded and investigated was 245, excluding 52 incidents that occurred out of the Slovak territory. In these accidents, 6 persons were deceased and 7 injured [2].

The responsible authority for investigation of accidents/incidents in Slovak Republic is the Civil Aviation Authority’s Department of Accident Investigation.

3. Road Safety

Road accidents are undoubtedly a negative concomitant of social development and increasing number of road vehicles. Therefore, they are constantly in the centre of attention due to the irreplaceable losses of human lives and injuries, but also due to significant material and environmental damages/losses.

3.1. Road Accidents in the Slovak Republic

58,996 road accidents were recorded in 2008 in Slovakia; in these events 558 people were deceased and 10,988 were injured. The positive point in these statistics is that all three indicators mentioned have marked a decrease in comparison to the previous year [3].

3.2. Investigation of Road Accidents in the Slovak Republic and its Legal Background

Investigations of road accidents are undertaken by authorised experts in the field of road transport. An authorised expert is a natural or legal person appointed by the State to perform activities according to the Act Nr. 382/2004 Coll. and who is listed in the registry of authorised experts.

An authorised expert has to comply with the following requirements (as stated in [4]):

- Expertise exam (Professional exam): The exam is covered by the Ministry of Justice of the Slovak Republic or an institute appointed by the Ministry. The applicant takes the exam in front of a expert committee of 3 members. It comprises oral and written part, and an expert testimony.
- Expert minimum: The purpose of the minimum, which is covered by an institute, is gaining the basic knowledge required for the expert's activities. The content of such 'course' are basics of relevant laws, methodology of performance etc. Similarly to the exam, the minimum is ended with a written and oral test.
- Successful graduation from a specialised course: The content of the specialised education is the application of theoretic knowledge in the given field. The syllabus as well as the whole course has to be approved by the Ministry. Such course is provided by the Department of Road and Urban Transport at the University of Zilina.
- Length of professional career: The applicant has to prove that he has been active in the respective field for the required period, as given by the Regulation.
- Documents proving possession of equipment necessary for the performing professional activities.
- Final exam: To be listed in the register, the applicant has to successfully pass the final exam.

As is apparent from above, achieving full qualification of an authorised expert is a challenging process that requires specialised education and preparation. Therefore, the aim of the newly proposed study programme would not be achieving this qualification but raising highly-qualified, versatile individuals. An authorised expert has the choice of being assisted by specialists in the field of his expertise, which is one of the options of getting the potential graduates into practice.

4. Outline of the Proposed Study Programme

The profile of a graduate of the new study programme should ensure that the graduate has the necessary knowledge in the field of air transport and road transport, and should constitute a good basis for further education in safety-related areas. The specialised subjects currently offered by the Department of Air Transport and Department of Road and Urban Transport at the University of Zilina cover the requirements for the qualification level; a suitable combination of subjects would allow for an attractive study programme.

After gaining the basic knowledge for studying technically-focused programme, the composition of the subjects should primarily contain aspects of operation of aircraft and road vehicles, vehicle design, traffic routes/roads, technology of transport. Special attention should

be paid to legal aspects and relevant legislation. On the other hand, economic questions would not have to be considered to similar extent, although they should not be wholly excluded.

The proposed subjects would be as follows:

Suitable subjects from current study programmes	
Road transport:	Air transport:
Transport engineering	Meteorology
Electronics road vehicles	Mechanics of flight
Transport legislation	Air navigation
Road and urban communications	Flight instruments
Engines of road vehicle	Aircraft design
Design of road vehicles	Aircraft powerplants
Technology of cargo haulage	Design and operation of airports
Technology of public mass transport	Air traffic management
Road vehicle testing	Aircraft maintenance
Forensic engineering	Air law

Tab. 1. Proposed subjects

5. Conclusion

The syllabus of the proposed study programme should ideally contain also new safety-oriented subjects. The aim of this programme is not to 'compete' with other, established study programmes or to create a duplicate one, but to create a highly specialised profile of a graduate that could be a valuable contribution at various positions related to aviation and road safety. Such graduate should have a good starting position at the labour market since safety in a top priority. In air transport, the question of safety is a very sensitive topic and safety in road transport has been stressed lately due to dramatic increase of traffic volumes.

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Sea Transport and the Suez Canal

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Abstract. The Suez Canal is one of the most important sea routes in the world. It connects the Mediterranean and the Red Sea. It shortens voyage of ships which carry cargo between Europe and Asia more than 10 000 kilometres.

Keywords: Suez Canal, navigation, voyage, tankers, container ships, Suezmax.

1. Introduction

The Suez Canal which connects the Mediterranean and the Red Sea is one of the most important sea routes in the world. It shortens voyage of ships between Europe and India more than 10 000 kilometres. Before it was opened in 1869 ships which had carried cargo between Europe and Asia had had to navigate round the Cape of Good Hope or cargo had been unloaded on the coast of the Mediterranean Sea and had been transported on the land to the coast of the Red Sea.

It is situated in northeast of Egypt and it separates the African continent from the Sinai Peninsula which belongs to Asia. The canal which is 193 kilometres long has no lock chambers because of minimal sea level between the seas. It consists of navigation canals and three lakes - Lake Timsah, Great Bitter Lake (it divides the Suez Canal into northern and southern part) and Small Bitter Lake.

2. Construction of the Suez Canal

The Suez Canal (Fig. 1) is not the first canal which allows navigation of ships between the Red and the Suez Sea. The first canal in this region was built in 18th century BC by ancient Egyptians who connected the Red Sea with the Nile delta which flowed in the Mediterranean Sea. This canal disappeared because it was blocked by sediments especially in the Nile delta.

At the end of the 18th century Napoleon´s engineers made a project of the canal which would connect these seas. The project was not realised because of engineers' mistake. They thought there was a difference of sea level (about 10 metres) between the Mediterranean and the Red Sea.

In the 1830s Ferdinand de Lesseps, a French engineer and diplomat, had a project of the Suez Canal made to Alois Negrelli, an Austrian designer. After he had received a concession for the construction of the Suez Canal, the construction of the Suez Canal was started by the Suez Canal Organisation in 1859. Investors of the Organisation came from France, Italy, Austria, Egypt, Russia and the USA. The construction took 10 years to finish; it was opened on 17th November 1869. Its budged was overdrawn more than twice, about 20 000 workers died because of bad work conditions and illnesses.

3. Navigation on the Suez Canal and Ships Suezmax

3.1. Navigation on the Suez Canal

When it was first opened in 1869 the canal was 8 metres (26 feet) deep. Its width was 22 metres (72 feet) at the bottom, from 61 to 91,5 metres (200 and 300 feet) at the surface. Because of its narrowness and tortuousness it has had to be excavated and dredged several times.

The present depth of the canal is 23,5 metres, the width at the surface is between 300 and 365 metres, width at 11 metres is 210 metres. Maximal draught of ships is 20,7 metres (68 feet) and maximal deadweight is 210 000 tons.

Navigation of ships starts in the Egyptian sea port Port Said which lies on the coast of the Mediterranean Sea. It continues to the canal through Lake Timsah, Great Bitter Lake and Small Bitter Lake to the Egyptian sea port Suez which lies on the coast of the Red Sea. Overall length of the canal is about 193 kilometres.

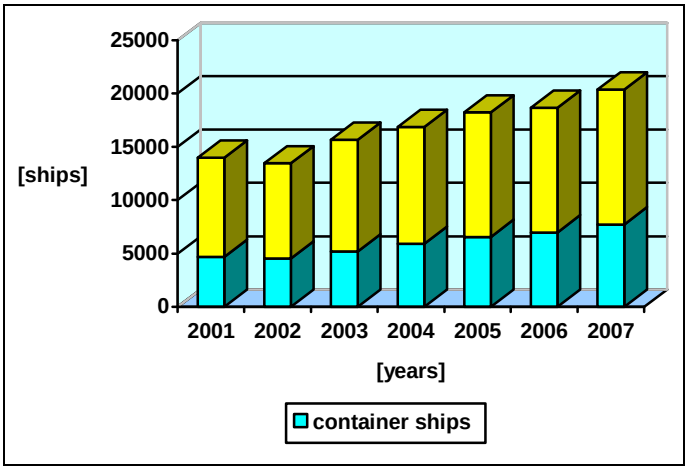

Fig. 2. Transit through the Suez Canal [3]

Transit through the Suez Canal rises per year (Fig. 2). In 2007, 20 384 vessels crossed the canal (of which 7 718 vessels were container ship) - an increase of 9,22 per cent over the

previous year. They carried 710,1 million tons of cargo – an increase of 12,97 per cent over the previous year [3]. The canal is especially used by tankers which carry petroleum from the Persian Gulf to Central and Western Europe.

3.2 Suezmax Ships

The term Suezmax is used for ships which can sail through the Suez Canal. These ships are particularly tankers which carry petroleum from Near East to Europe. Their deadweight is about 150 000 tons and their maximal width is 46 metres.

Limitations for ships which sail through the canal are:

- draft, that is ships which have draft more than 20,74 metres (68 feet) cannot sail through the canal,
- air draft, that is the distance from the water line to the highest point on the vessel, cannot be more than 68 metres (223 feet) for these ships because of the Suez canal Bridge (Fig.3).

Fig.3. Suez Canal Bridge

4. Suez Crisis

The Suez Canal was opened in November 1869 and the opening of the canal did not bring immediate revolution in commerce, although it shortened the voyage from Europe to India by 4000 to 5000 miles. As the canal presented the shortest naval route to India, it attracted interests of Great Britain. Thus, Britain intended to take part in the management of the canal. In 1875, the government of Britain, led by Benjamin Disraeli, bought almost majority of the shares from Khedive, Ismail. As a result of this transaction, the Suez Canal switched from Franco-Egyptian to Franco-British ownership. This was understandable because the main principle of foreign policy of Great Britain was the expansion of her empire. The most important part of the British Empire was India. Making use of her naval superiority, Great Britain intended to control all the important strategic posts along the routes of communication connecting the Atlantic with the Indian Ocean. The canal was the most important factor in shaping of British foreign policy and the control over the canal largely contributed to Great Britain's predominant position in world affairs in the time before World War II.

4.1 The Suez Crisis of 1956

The cooperation between Egypt and the Soviet Union indicated that the influence of the Soviet Union in the area of the Middle East would rise. The United States attempted to

diminish the Soviet influence by promising a loan /56 million dollars/ for building of the Aswan High Dam. In May 1956, Egypt formally recognized the People's Republic of China and consequently the United States and Great Britain refused to provide financial support to Egypt for the Aswan High Dam. As a result, Egyptian President Gamal Abdal Nasser ordered nationalization of the Suez Canal. This took place in July 1956. Nasser also founded the Egyptian Canal Authority which replaced company that was privately owned. The shareholders of the Suez Canal were mainly from France and Great Britain. As a result, Britain and France planned armed intervention against Egypt. However, The United States strongly disagreed with plans of France and Britain and warned them that the military operation could worsen the situation.

The invasion started on October 29, 1956. Britain and France were supported by Israel. As a result of the conflict, the canal was closed for six months and was opened again in April 1957.

To conclude with, it can be said that the Suez Crisis significantly weakened the influence of Britain and France in the region and only increased the popularity of Gamal Abdal Nasser in Egypt.

4.2 Six Day War

In June 1967 another conflict called Six Day War started between Israel and three Arabian states (Egypt, Jordan and Syria). During 6 days these Arabian states were defeated by Israel. As a result of the admit Egypt lost control under the Sinai Peninsula and Gaza and closed the Suez Canal until 1975. It became the border between Israel and Egypt.

During its closing tankers had to sail around the Cape of Good Hope. Shipyards started to build super tankers. Their displacement increased up to 500 000 tons at the draft 30 metres. After the canal was opened these tankers could not navigate through it because of their draft.

5. Conclusion

In spite of the fact that the Suez Canal has been closed twice since its opening, it is one of the most important sea routes for vessels in the world. It is mainly used by super tankers which carry petroleum from Near East to Europe.

In 2007 this sea route (between Europe and Asia) overtook the transpacific route (between America and Asia) and became the largest containerized trading lane with 27,7 million TEUs [4].

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Approaches to Calculating the Rate of Tolls for Piece Shipments

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Abstract. Toll is a fee which is required to pay for the distance traveled in a specified section of road vehicle. This fee depends on the type of vehicle, number of axles of vehicle weight and road categories. In the carriage of piece shipment determination of rate of tolls is havier because useful vehicle mass is not fully utilized by one package. This article shows how toll rate is calculated in the Czech Republic and Germany.

Keywords: Piece shipment, toll rate, toll system.

1. Introduction

Degree of road and wear are increased with an increase in traffic. To obtain some part of the funding for the reconstruction of communications has introduced charging for certain sections of roads – highways. The electronic toll collection is an electronic payment of the amount calculated according to category of vehicle for the distance traveled in a specified section of road. Defined sections of roads may be used by vehicles with the total weight of 3.5 t or combinations of vehicles with the total weight over 3.5 t designed for the transport of goods and vehicles to enable the transport of more than nine persons including the driver, after the payment of tolls for the use of these limited sections of roads .

The method of selection of electronic tolls to use roads already underway in several countries in Europe. The largest tolling system have countries: the Czech Republic, Austria, Germany and Switzerland. The first two countries enjoy microwave system, two other satellite system.

The amount of the toll fee per 1 km distance traveled depends on many factors such as emission class of vehicle used, number of axles of the vehicle, the vehicle capacity weight.

2. Tolling System – Czech Republic

Czech Republic bordering with Germany and Austria, which acceded to the charging of highways and expressways communications goods vehicles form of tolling. Subsequently, it has been a sharp increase in transit journeys through the territory of the Czech Republic, where even the charging scheme was introduced. Based on this fact, the Czech Republic decided to address this situation and from 1.1.2007 introduce electronic toll collections on motorways. From 1.1.2008 to already charging network including 200 km of 1st class roads.

In determining of the rates for each kilometer is accepted not only the emission class of vehicle used and number of axles but also take the parts into account the communication is

what the carriage. For this reason the rates are divided into two main groups. The first group contains the rates for highways and the second one for 1st class roads.

Table toll rates (€/km)					
Emission class under Euro II			Emission class Euro III and above		
Number of axles					
2	3	4<	2	3	4<
0,085	0,136	0,199	0,063	0,107	0,155

Tab. 1. Rates of toll charges for highways. [1]

Table of toll rates (€/km)					
Emission class under Euro II			Emission class Euro III and above		
Number of axles					
2	3	4<	2	3	4<
0,04	0,066	0,096	0,029	0,052	0,074

Tab. 2. Rates of toll charges for 1st class road. [1]

2.1. General Setting of Toll Rates

Average rate of tolls for the highways

$$S_{DR} = \sum_{i=1}^{n} (x_i \cdot y_i) a \,. \qquad (1)$$

S_{DR} average toll for a highways
x the rate of toll fixed by government fiat No. 484/2006 Coll. for highways
y share of the fleet in the percentage
i dependence on vehicle emission standards EURO and the number of axles
a percentage of vehicle going by the highways from the total number of vehicles

Average rate for toll for 1th class road

$$S_{1T} = \sum_{i=1}^{n} (z_i \cdot y_i) b \,. \qquad (2)$$

S_{1T} average rate of toll for 1th class road
z the rate of toll fixed by government fiat No. 484/2006 Coll. for 1th class road
b percentage of vehicle going by 1th class road from the total number of vehicles

Overall rate of toll

$$S_C = S_{DR} + S_{1T} \,. \qquad (3)$$

S_C overall rate of toll

Tariff setting tolls for different distance and weight of the consignment

$$rate = \frac{S_C.l}{M}.m\ . \qquad (4)$$

l	distance
M	average traffic of vehicles
m	weight of the shipment

For accurate detection of the actual toll rate per distance of a particular and specific mass of the shipments are based on the total rate of tolls. Given that it is very difficult always to identify the necessary variables to determine this value, the value of using spreadsheets. Based on the distance to the division into five zones to the maximum distance 600 km.

Considering all the criteria to calculate the total rate in the amount of tolls S_C 3.87 CZK/km (0,138 € / km).

2.2. Example

What will be the amount of the toll charge for the shipment for the weight of 320 kg and for a distance of 340 km?

By such criteria are used attributable rate interval 301 to 400 kg weight of the shipment and 301 to 400 km distance transported. Therefore, the formula for calculating the toll rate (4) which will be charged as part of expenses, there will be used the value of 400 kg and 400 km. The calculated value of the tolls at the following established criteria is 77.4 Kč (2.76 €).

3. Tolling System - Germany

Germany introduced a electronic toll system from 1.1.2005. This system applies to all vehicles with a total weight of 12 ton in the approximately 13 000 km of motorways. To 31.12.2008 was segmentation of vehicle according to emission class into 3 groups.

Number of axles	Emission class		
	EURO5+4	EURO3+2	EURO1+0
To 3	9 C/km	11 C/km	13 C/km
4 and above	10 C/km	12 C/km	14 C/km

Tab. 3. Summary of toll rates according to emission class and the number of axles. [2]

The average toll rate is 12.4 euro per kilometer. Funds obtained by choosing the toll should be used for the reconstructions and the expansion of roads. From 1.1.2009 vehicles from 12 ton maximum permissible total weight have to pay much higher toll for the use of motorways than before. The reason for the decision is the fact that vehicles don´t cover cost of the roads by taxes and fees, which they caused. It was made the new toll rate adjustment. It has been made the new division of vehicles according to emission from the 3-groups to the 4 groups and in the same time to the vehicles belonging to the category of emission standards EURO 2 and 3 was offered an opportunity to enter into a higher toll category by adding the exhausts soot filter.

Number of axles	Emission class			
	EURO 6 + 5	EURO4+3with filter	EURO3+2with filter	EURO 2 + 1
To 3	14,1 C/km	16.9 C/km	19,0 C/km	27,4 C/km
4 and above	15.5 C/km	18,3	20,4 C/km	28,8 C/km

Tab. 4. New toll rates according to emission class and the number of axles from 1.1.2009. [2]

The average toll rate increased from 12.4 C / km to the value of 18.6 C / km. The method of calculation is just about the same as the method of calculation in the Czech Republic. The difference is that the rate corresponds to the middle of the interval of the both criterias and not to the maximum value of intervals.

Toll rates are dependent on the number of axes and emission class truck. Until 31.12.2008, the breakdown of vehicles used by the issue of class into 3 groups.

3.1. Example

What will be the amount of the toll charge for the shipment of the weight of 320 kg for a distance of 340 km?

On the basis of the input values of the weight of the consignment and the transmission distance, it is necessary to calculate the amount of the toll fee at intervals of 301 to 400 kg weight and 301 to 400 km distance. The rate is calculated for the middle value of the interval, in this case the value of 350 in both criteria. After the substitution values in (4), we get the result rate of € 2.85 in tolls.

4. Conclusion

From 1.1.2010, our country will introduce an electronic toll collections on highways and first class roads. For this reason, it will be necessary to develop a matrix system of the toll rates for piece shipments, which would be offset by costs. The aim of this article was to show how the toll of an appropriate amount attributable to the shipment.

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Prices On the Polish Postal Market

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Abstract. This article presents the situation on the polish market. The competitions grows up since 1996. The competition in the postal market as well as the emergence of new service substitutes force the postal operators to concentrate on the prices and quality of their services. The prices becomes the springboard for postal operators' efficient performance. A fundamental principle to follow while determining prices of postal services is that the prices should be based on the necessary costs of providing those services. On the one hand, this method guarantees neutralization of incentives that encourage bigger profits at the expense of lower quality and standard of customer service.

Key words: prices, postal operators

1. Introduction

A market of postal services is developed very intensive from many years. On the one hand it is result of progressive liberalization of a postal market. For postal companies it means that Polish Post will not already a privileged entity. On the other hand it may observe increase of clients requirements with respect to offered services. At present, clients expect a flexible offer of postal services, adapted for their needs. A price stop to be the most important determinant of logistic operator choice.

The Polish postal service market dynamic develops from many years and an increase according to a segment is from a few to between ten and twenty percents in a year. Analysis of number postal operators in years 2001-2008 points out that was over 4,5 times increase number of registered alternative operators. The biggest increase in relation to the previous year it was noticed in 2006 – about 44 operators.

Gradual opening of the postal market and limiting the reserved area makes it possible for more and more postal operators to operate in those market sectors that have been served only by Poczta Polska so far, especially in the sector of correspondence mail. Owing to a big amount of mail delivered annually, especially letters, it is a very attractive market sector.

Although postal operators other than the public operator do not have such complex infrastructure, and most of all such chains of outlets, it is highly probable that they can take over some of the customers that have used the services of the public postal operator in the past. It can happen especially when the existing legal regulations will allow operators to provide postal services in areas that are spatially limited (e.g. voivodeship, poviat, city). It must be emphasized, however, that even when the postal market is fully open, it will be essential to keep controlling it, especially to make sure that the former monopolist does not use its market power, which results from the infrastructure it possesses[1], in order to gain an unfair competitive advantage.

[1] R. Czaplewski, J. Buko, A. Drab-Kurowska, T. Sondej, Analiza cen usług operatorów alternatywnych w porównaniu z cenami usług operatora publicznego wraz z ewentualnymi

According to the provisions of the Treaty of Accession – from 1st January 2006 on, companies can transfer mail that weighs up to 50 grams but must charge no less than 2.5 of the fee for taking, transferring and delivering the mail that belongs to the lowest weight range of the fastest category specified in the price list for common postal services.[2]

2. Operators on the Polish postal market

The analysis of the postal market shows that despite a potentially large number of alternative operators that can provide common services3, these services are virtually provided by only a few companies. The following are the companies that have been analyzed with regard to price:

1. InPost

InPost is a postal operator present on the market since 2006. InPost operates all over Poland and has branch offices in 90 Polish towns.

2. PCD Polskie Centrum Doręczeniowe (Polish Delivery Center) Gorzów

PCD Gorzów operates in Gorzów Wielkopolski and its neighborhood. The company was set up in 2006.

3. PCD Polskie Centrum Doręczeniowe (Polish Delivery Center) Zielona Góra

PCD Zielona Góra started its activity in August 2006. It operates in Zielona Góra and the neighboring locations such as: Przylep, Racula, Zawada.

4. PAF – Polska Sieć Opłat (Polish Charges Network)

"PAF" postal operator was registered in 2004, but started providing postal services in 2006. PAF has its own network of over 200 post offices that serve individual and corporate clients all over the country through postmen and couriers. PAF's offices are located in 160 towns.

5. Service Post

"Service-Post" postal operator was registered and initiated its business activity in 2006 (on 1st July 2007 the activity was suspended). The operator conducted its activity in Śląskie voivodeship and in some parts of Małopolska region.

6. MPD - Miejskie Przesyłki Doręczeniowe (Mail Delivered in Cities)

"Miejskie Przesyłki Doręczeniowe" postal operator with its registered seat in Gdańsk has operated since May 2006. The operator conducts its business activity in Gdańsk, Gdynia and Sopot.

7. Polska Grupa Pocztowa S.A. (Polish Postal Group PLC)

Polska Grupa Pocztowa S.A. is an operator that has functioned on the Polish postal market since August 2006. It provides guaranteed time-limit services in the whole territory of Poland.

8. CRL Biznes Serwis

CRL Biznes Serwis operator initiated its business activity in February 1996. The operator concentrates mainly on services and trade. In 2007 the company started providing postal services. It has its branch offices in the whole of Poland together with qualified staff and logistics base.

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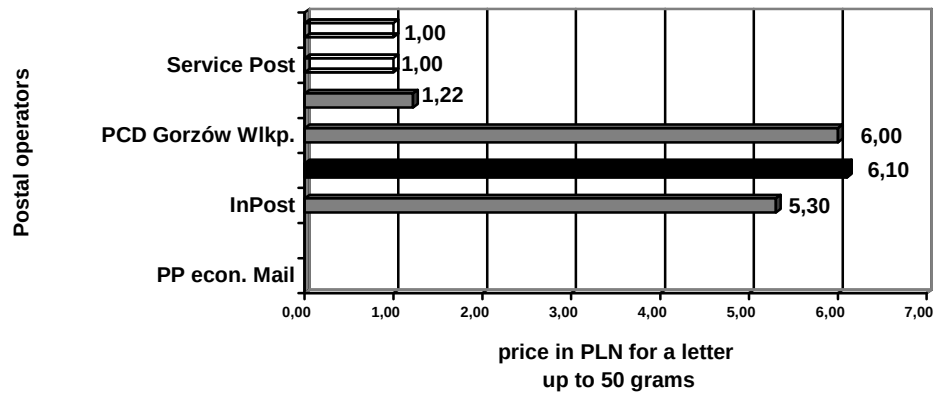
propozycjami zmian w zakresie regulacji cen. Opracowanie wykonane na zlecenie Instytutu Łączności w ramach Programu wieloletniego „Rozwój telekomunikacji i poczty w dobie społeczeństwa informacyjnego" na lata 2005 – 2008, maszynopis powielony (duplicated typescript), Szczecin 2007, p. 25.

[2] The charge equals 2.10 PLN x 2.5 = 5.25 for a letter up to 50 g.

[3] over 160 according to UKE (Office of Electronic Communications) register as of July 2007.

3. Prices of letters – analysis

The operators mentioned above provide postal services only in the territory of Poland. Table 1 presents prices of letters up to 50 grams offered by the operators examined.



Tab. 1. Prices charged by the postal operators examined for letters up to 50 grams in 2007

Source: the author's own work on the basis of information gathered from the survey conducted and from the operators' websites.

The prices analysis of letters up to 50 grams shows that Service Post and MPD Gdańsk have the lowest prices, i.e. 1.00 PLN. This means that the prices are incompatible with the Postal Law. The highest price in this weight range is offered by the operator PCD Zielona Góra. It must be pointed out that the analysis concerns the cheapest services in a given category which, with regard to a public operator, means economic mail – the other operators do not use the so called categorization.

In compliance with the regulations of the Postal Law, for letters up to 50 grams the postal operators PCD and InPost offer the public operator's prices multiplied by the required factor. At the same time, these operators use non-standard measures (ballasting mail with metal elements or cartons – officially stating that it provides additional protection for the mail) that, by increasing the weight of mail, make it possible to deliver mail for lower prices, bypassing limits established for reserved areas.

Table 2 presents prices charged by the operators examined for letters up to 100 grams.

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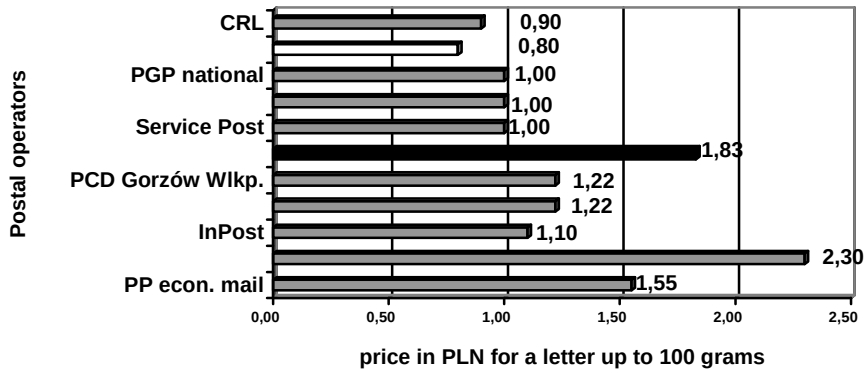


Tab. 2. Prices charged by the postal operators examined for letters up to 100 grams in 2007
Source: same as for table 1.

CRL Biznes Serwis and PGP have the lowest prices for letters up to 100 grams, whereas the highest price among alternative operators is offered by PAF. Table 3 presents prices charged by the postal operators examined for letters up to 350 grams.

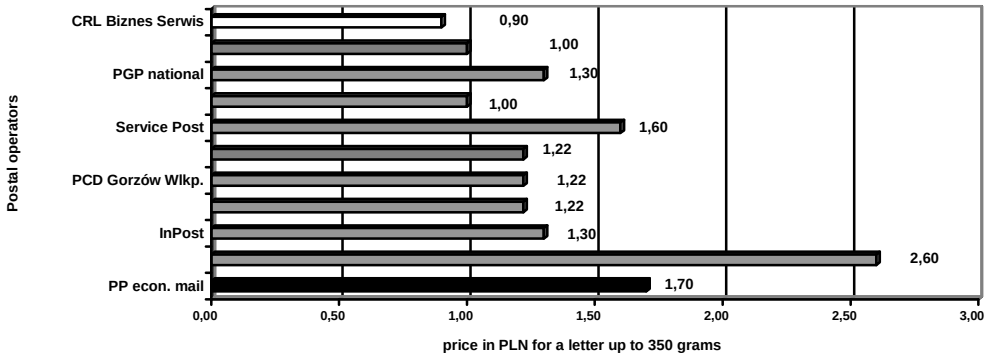
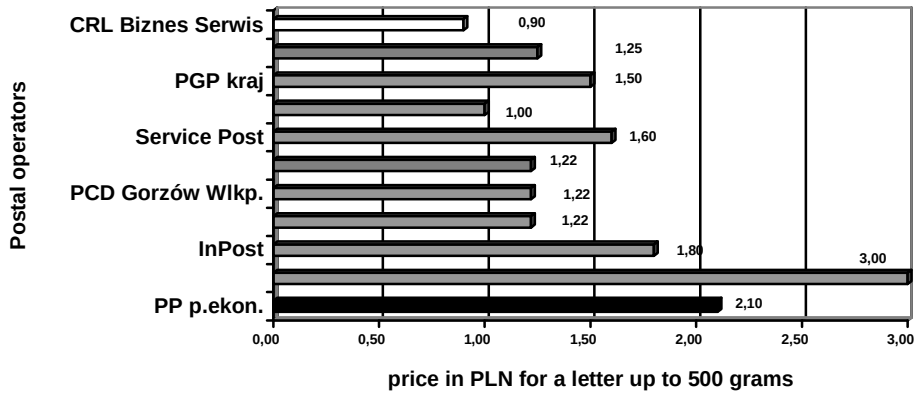


Table 3. Prices charged by the postal operators examined for letters up to 350 grams in 2007
Source: same as for Table 1.

Prices for letters up to 350 grams show that the operator CRL Biznes Serwis has the most affordable price for mail of this weight, whereas the highest price is offered to customers by the public operator Poczta Polska.

Table 4 presents prices charged by the postal operators examined for letters up to 500 grams.



Tab 4. Prices charged by the postal operators examined for letters up to 500 grams in 2007
Source: same as for table 1.

The same situation is with letters up to 500 grams. The operator CRL Biznes Serwis offers the lowest price in this weight range as well. The highest price – twice as much as CRL Biznes Serwis is offered by the operator InPost.

We can see from the above analysis of letter prices that alternative operators display a clear tendency to shape prices usually below the price level determined by the public operator. This situation is caused both by higher profitability of activity conducted without being required to ensure common availability of services and by the operators' striving to develop a stable position on the market, even at the cost of temporarily resigning from the expected profit levels. It should be simultaneously indicated that the public operator – previously isolated from the regime of competition, has not yet rationalized its costs, which is reflected in the operator's price levels. It can only be guessed (taking into account the progress in efficiency of operations achieved as a result of deregulation and privatization by public operators from other countries) how great the possibilities are to cut costs in this scope. It is also a problem that even the company itself is not aware of the real scale of reserves that are ready for use. To sum up, it is essential to arouse strong interest to rationalize costs in order to create a long-lasting basis for decreasing the public operator's service prices.

To supplement the prior discussion, prices of complementary services, such as registered letters, handling ordinary mail like registered mail and confirmation of mail receipt can also be analyzed.

Among extra charge for a registered letter, the lowest price for the service is charged by the operator CRL Biznes Serwis, i.e. 0.50 PLN. The postal operator PCD Zielona Góra charges the most – 1.83 PLN, a price similar to that charged by Poczta Polska.

6 alternative operators offering receipt confirmation were analyzed as far as the charge for this service is concerned.

Both the highest and the lowest price is charged by the operator PGP. This is because of a variable charge that ranges from 0.80 PLN up to do 2.50 PLN. This charge depends on the price of a standard letter, which can vary. 100% of the price is added to the price of a letter when it has return receipt confirmation.

3. Conclusion

While analyzing prices of mail, it is essential to point out the main targets according to which postal operators shape their price policies. These targets are the following:

- striving to cover own production costs, and
- striving to achieve or maximize profit.

The state's main aim with regard to shaping prices is to achieve the set political and economic goals.

In the situation of a monopoly, a postal operator interested in maximizing profits should recognize how individual submarkets are price-sensitive in order to vary prices appropriately and should understand how the market's regulators function. Recognition of price sensitivity makes it possible to examine price flexibility of demand for different types of services. Economic practice shows low flexibility with regard to variation of mail prices. Recognition of price sensitivity allows a company to apply prices that assure higher profit margins on less sensitive submarkets.

While determining prices of services on individual submarkets, a company must also take it into consideration that the surplus gained on some markets should not be used to cover potential deficit on the other submarkets.[4]

A fundamental principle to follow while determining prices of postal services is that the prices should be based on the necessary costs of providing those services. On the one hand, this method guarantees neutralization of incentives that encourage bigger profits at the expense of lower quality and standard of customer service. On the other hand, however, it has three serious disadvantages. Firstly, it does not create a mechanism that would bring about actions striving to lower costs. Secondly, it involves a regulator in current supervision over the public operator and causes danger of excessive interference in the decision-making process where decisions should be taken by the management of the company. Thirdly, this method of regulation is connected with high costs. They arise both with regard to the regulatory body and the public operator and are often connected with repeated procedures of approving charges on the basis of a detailed analysis of the operator's profits and costs.

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[4] R. Czaplewski, J. Buko, A. Drab-Kurowska, T. Sondej, Analiza cen usług …, op.cit., p. 26.

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The Definition of Correlations between Vehicle Work and Engine Start-Up Parameters Using Neural Networks Analysis

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Abstract. The engine start-up and the work of non-warm engine seem to be the most important functional states. The working conditions of the vehicle, which depend on the organization of its driving, influence on the engine start-up parameters. The paper presents the results of the statistical analysis of the maintenance research of the LUBLIN delivery truck and its engine 4CT90. The conducted analysis aimed at the estimation of the relations between the vehicle work organization conditions and the parameters of the engine start-up using neural network analysis.

Keywords: vehicle work, engine start-up, neural network analysis.

1. Introduction

The engine start-up and the work of non-warm engine seem to be the most important functional states. Due to unfavourable physical processes that take place during these states there is an increased emission of toxic compounds in exhaust gas and the wear of selected tribological engine units. We can also observe the high noise level and the overloads in the vehicle electric power system. The extent of such negative processes depends on the engine start-up parameters: the temperature and the time of the engine start-up, the value of current consumed by a starter etc.

The working conditions of the vehicle, which depend on the organization of its driving, influence on the engine start-up parameters. Thus, the knowledge of the influence of the vehicle work organization conditions on the engine start-up parameters has theoretical and practical meaning.

The paper presents the results of the statistical analysis of the maintenance research of the LUBLIN delivery truck and its engine 4CT90. The conducted analysis aimed at the estimation of the relations between the vehicle work organization conditions and the parameters of the engine start-up using neural network analysis.

2. Field tests

The field research was carried out using LUBLIN III delivery truck used by Polish Postal Service in Lublin. This truck has the 4CT90 combustion self-ignition engine. The engine was characterized by the following general data: the cubic capacity: 2,417 dm^3, max. power 63,5 kW at 4100 rpm and develops a maximum moment 195 Nm at 2500 rpm. The engine was fitted with an in-line fuel injection pump.

A special recorder constructed to register the selected parameters of LUBLIN III operation and activity of the 4CT90 engine was mounted. Gathered data were later processed off-line using the PC computer.

3. The neural networks analysis

The next analysis, connected with searching of relationships between the set of engine start-up parameters and the group of the parameters describing the vehicle work organization conditions, was a neural networks analysis. The authors carried out the neural networks analysis to estimate the connections between the two sets using STATISTICA program. The first set of variables is connected with the organization of the vehicle routes in the Polish Post Branch Lublin transport system and they characterize of the vehicle work conditions:

X_{tpra} – the time of the engine operation before its next starting [min], X_{tpos} – the time of the pause in a vehicle operation with the engine switched off before the start-up [min], $X_{ltł}$ – the distance covered by the piston before the engine start-up [km], X_{lpoj} – the distance covered by the vehicle before the engine start-up [km], $X_{Tpł}$ – the engine temperature (coolant temperature) at the engine start-up [°C], X_{Tol} – the oil engine temperature at the engine start-up [°C].

The second set of the variables represents the engine start-up parameters:

X_{Imax} – the maximum value of the intensity of the current consumed by the starter in a first step of the engine start-up [A], X_{Umax} – the voltage applied at the starter at the maximal current intensity [V], X_{Pmax} – the power consumed by the starter at the maximal current intensity [W], $X_{Iśr}$ – the mean current intensity, which occurs when the starter drives the engine crankshaft during the start-up [A], $X_{Uśr}$ – the mean voltage, which occurs when the starter drives the engine crankshaft during the start-up [V], $X_{Pśr}$ – the mean power, which occurs when the starter drives the engine crankshaft during the start-up [W], $X_{tprzył}$ – the time of applying the voltage at the starter [s], X_{troz} – the time of the engine start-up [s].

The neural network analysis was used to carry out the regression problems between distinguished set of the parameters. Basing on the results of this analysis we can state that the MLP 6:6-13-8:8 neural networks give the best solution to the regression problems. This multilayer perception is characterized by the 6 neurons in input layer, 13 neurons in hidden layer and 8 neurons in output layer. This neural network takes into account all input and output variables.

The engine temperature (coolant temperature) at the engine start-up $X_{Tpł}$ has the top rank in this network. The next are: the time of the pause in a vehicle operation with the engine switched off before the start-up X_{tpos}, the distance covered by the vehicle X_{lpoj}, the oil engine temperature at the engine start-up X_{Tol}, the time of the engine operation before its next starting X_{tpra}. The distance covered by the piston before the engine start-up $X_{ltł}$. has minimum rank. Unfortunately this neural network was characterized by the value of the errors for the test which equals 0.1192. The value of this error exceeds 90% level of the confidence.

It shows that this neural network with one hidden layer doesn't give the satisfactory solution to the regression problem between the parameters describing the vehicle work organization conditions and the engine start-up parameters. It's caused by the dimensionality, interdependency and redundancy of the variables in the analysis sets of the parameters. The neural network with one hidden layer cannot identify the any subregion in the error space either. This type of the network recognizes only the convex region and one coherent region which are limited by the hyperplanes.

To identify the incoherent and no convex regions of the error surface we can use the neural network with two hidden layers facilities. It enables the better match of the neural network to the analyzed data during solving the problem of the regression between input and output sets of the variables. In the MLP 6:6-13-12-8:8 (network with two hidden layers) the test terror is equal 0,0916. This error not exceeds the 90% level of confidence. The figure 1 presents the MLP 6:6-13-12-8:8 neural networks.

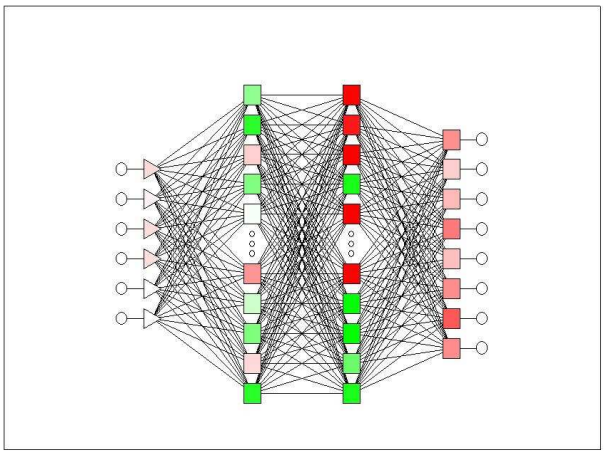

Fig. 1. The MLP 6:6-13-12-8:8 neural networks which give the best solution to the problem of the regression problem between the vehicle LUBLIN III work and 4CT90 engine start-up parameters.

For the neural network from figure 1 the variable connected with the engine temperature (coolant temperature) at the engine start-up $X_{Tpł}$ has the top rank. The next are: the oil engine temperature at the engine start-up X_{Tol}, the time of the pause in a vehicle operation with the engine switched off before the start-up X_{tpos}, the distance covered by the vehicle X_{lpoj}, the time of the engine operation before its next starting X_{tpra}. The distance covered by the piston before the engine start-up $X_{ltł}$. has minimum rank.

When we limit the number of the parameters which are interdependent in the distinguished sets we can state that the test error diminishes. For example the MLP 3:3-12-11-3:3 network has the test error equal 0,0823. This fall of the test error shows the dimensionality, interdependency and redundancy of the variables in the analysis sets of the parameters. The MLP 3:3-12-11-3:3 neural network is presented on the figure 2.

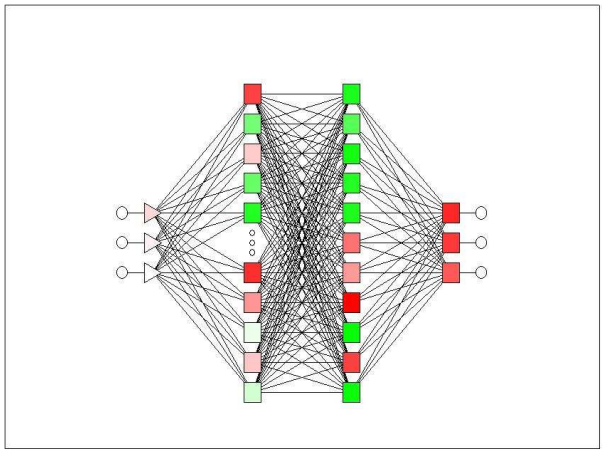

Fig. 2. The MLP 3:3-12-11-3:3 neural networks (3 input and 3 output, 12 neurons in the first hidden layer, 11 neurons in second).

The order of the rank of the parameters is: the time of the pause in a vehicle operation with the engine switched off before the start-up X_{tpos}, the time of the engine operation before its next starting X_{tpra}, the engine temperature (coolant temperature) at the engine start-up $X_{Tpł}$.

4. Conclusion

Basing on the results of the statistical analysis of the field research of the LUBIN III delivery truck and 4CT90 diesel engine using the network analysis we can state that the most important parameter influencing on the engine start-up conditions is the engine temperature (coolant temperature).

The results of the analysis using neural network show that the another analyzed parameters, connected with the work conditions parameters of the LUBLIN III delivery truck (the time of the engine operation and the time of the vehicle operation before the next engine start-up, the distance covered by the vehicle and the distance covered by the piston before the engine start-up), have not crucial influence on the engine start-up parameters.

The results of the carried out analysis show that the dimensionality, interdependency and redundancy of the variables in the tested sets of the parameters occur too.

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Public Transport Safety in Krakow

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Abstract. Nowadays safety and security problems in European transport sector becomes more important. Many programs to reduce number of fatal and serious injury accidents are implemented within the EU, very often with contribution of the EC funds. Strict objectives has been determined, like "vision zero" and all EU countries are trying to achieve them. Very important issue within that efforts should be a safety and security in public transport, due to it's key role in sustainable mobility management. Even very innovative, expensive and well disseminated achievements regarding to PT, which increase the attractiveness of the system will not work, if the passengers do not feel safe. This paper is a short description of some Krakow's PT safety problems and activities made under the European Project CARAVEL to solve them.

Keywords: safety, public transport, Krakow, sustainable mobility, public transport infrastructure

1. Introduction

Krakow is the second largest city in Poland with about 750 thousands of inhabitants and more than 120 thousand of students in addition. Total street length is 1263km (on more than 10km dedicated bus lanes are existing) and bicycle paths length is more than 70km.
Public transport system is basing on municipality buses (two operators), trams and private operators (more than 200 companies) which operate using small buses (up to 27 people) between the city and suburban area. Since December 2008 new line of the fast tram (partly in a tunnel) is operating. Total length of tramway lines in Krakow is 324km on which over 13,5 mln vehkm are made every year, and total number of bus lines is 1882km where operation work is over 35 mln vehkm annually.

In 2007 on the city streets there were 10084 incidents including 1409 accidents, where 1659 people were injured and 50 died. According to the largest public transport operator database, number of accidents where it's PT vehicles were involved is about 170 per year, with about 210 people injured (not only passengers, but also pedestrians or other vehicle passengers) and about 4 fatalities.

Several problems concerning safety of public transport system users can be defined, including for example:

- unsafe infrastructure, not only construct in past but also nowadays,
- inhabitants behaviour at streets,
- data availability,
- risk management

Two of four problems above are shortly described below.

2. Infrastructure Improvement

Infrastructure used by public transport (e.g. PT stops, tram tracks crossings, street crossings, tram tracks, dedicated bus lanes) in Krakow, in major part was planned before 1989, when permanent lack of funds determined implemented solutions. Unfortunately modernizations made during last twenty years very often didn't improve mistakes made in the past and what is really worrying, similar mistakes are repeated nowadays. Most of problems which are still not solved in Krakow, were already managed in EU15 countries.

One of the examples are tram stops in the inner city area where passengers have to cross the street lane to reach the vehicle.

Picture 1. Typical tram stop in the Krakow city centre

At these twenty tram stops, despite the uncomfortable boarding, a risk of knocking down passengers is high, what research made under the EU project CARAVEL has proved. A safety audit made at tram stops localized in the city centre showed relatively high share of "conflicts" between cars and passengers entering or getting out from the tram. "Conflict" means that tram passenger was forced by the car to slow down or to stop immediately, what hypothetically could be a collision or an accident.

At one case, where passengers have to cross two street lanes (!) to reach the vehicle, percent of conflicts was more than 70%, what taking into consideration level of passenger interchange (3050 p/h) means that more than 2000 of them per hour were disturbed by cars during the boarding.

Due to that results three tram stops were reconstructed under the CARAVEL project, to achieve improvement in the passengers safety. Two stops were rebuilt in "Vienna style" where car lane between PT platform and the tram tracks is raised to the level of platform. Moreover during the reconstruction of the street, it's geometry was changed that buses currently are able to ride on tram tracks, so both tram and bus passengers are boarding vehicles from the raised lanes

Picture 2. Krakow's tram stop reconstructed in a "Vienna style"

Third stop was reconstructed in a similar way as the "Andels" tram stop in Prague, what means that car lane was raised to the level of tram platform and a pavement.

Picture 3. Krakow's tram stop reconstructed in a "Andel's style"

Evaluation of that solution brought conclusions that it is not as safe as "Vienna style", especially when the surface of the car lane, and stop platform is not in diversified very well (e.g. by different colours) like in Krakow case. As a result of that, pedestrians waiting for the tram were often standing at a car lane. Unlike to the "Vienna style" implementation, where number of conflicts has decreased to 2%, it was not possible to reach the same level at the "Andel's style" case.

3. Data Availability

A real problem is a database content and available information about PT safety. In Krakow there are two databases containing information about PT traffic accidents, which include source data. First is the national Police Department Database (name: SEWIK) which cover all road accidents in PT in the city area (city buses and trams, regional buses, regional minibuses). Unfortunately there are major lacks in it's content which prevent proper analysis, like poor description of localization, no distinguish between city bus, regional bus and minibus or victims injury heaviness.

Second database (name: SILIKOM) is located in MPK (Public Transport Operator). It include very detailed information about accidents but only which happened in it's own fleet. Comparison of two source databases (SEWIK and SILIKOM) bring a conclusion that there are large differences between it's content. For example number of people injured in accidents where PT vehicles were involved is much more higher in SILKOM than in SEWIK.

	2001	2002	2003	2004	2005
SEWIK	132	115	115	122	108
SILIKOM	212	213	221	216	180

Tab 1. Number of people injured in PT accidents according to different databases

Main reason of such a difference is that very often passengers of the PT do not call the Police, when they are getting hurt inside of the vehicle (e.g. when driver slam on the brakes).

Among other activities made in the CARAVEL project, the Municipality together with the Krakow University of Technology has decided to improve data collection system by equipping policemen with PDA and increase the scope of registered information also by new indicators concerning public transport. (e.g.: under accident localization, to add "dedicated bus or tram lane", under accident type, to add "knock down of the pedestrian as a potential passenger on PT stop" and under vehicle type, to divide "city bus, regional bus and minibus"). Moreover it is planned to define a relative safety indicators for PT passengers and compare them with individual transport indicators.

4. Conclusion

It's not possible to describe at four pages all problems and successful activities taken to improve safety in Krakow's public transport. This paper include only examples, but should be treated as a teaser for further exchange of knowledge between different stakeholders, especially in the EU new member states, where PT safety problems are very often similar.

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Functional Reliability Calculation of Complex Pipe-Line Transport System

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Abstract. The work is devoted to the establishment of the functional reliability calculation method in complex pipe-line transport systems. The suggested method allows defining, in relative period of the time, to get an ultimate product for definite consumer of a distributed pipe-line transport system. The product depends on the structure of the pope-line network and the reliability of its separate segment.

Keywords: Functional reliability, pipe-line transport system, pipe-line network, weighted graph, consumer, zone of break-down and repair, stop valves.

1. Introduction

Reliability calculation methods of pipe-line transport systems (PTS) are connected with the determination of the time span problem for which a pipe-line network is in serviceable state. It is a state with one or more disconnected sectors. The given problem has been sufficiently studied in details. The calculation formulae for the values determination are well-known. Also there is an opportunity to calculate a relative time span of a sector finding with an arbitrary length in a disconnected state. Nevertheless, this information can not be considered relevant, as it allows defining the current functional reliability. The functional reliability of PTS comprises the system ability to satisfy its designation – to supply the ultimate product (UP) to a consumer with the qualitative and quantitative parameters, specified in bilateral agreements. The quantify index of the functional reliability is understood as the execution probability of a concrete functional task with the system during some definite time period T. A special interest to the problem of the functional reliability calculation is accented in the framework of complex transport systems, namely pipe-lines, where reliability underestimation can lead to the transport or ecological catastrophes.

2. Stage enumeration of the functional reliability calculation method

The outcome data for functional reliability calculation of PTS are:

- the topology network structure with a length definition of spatially extended elements (pipe-lines), location of stop valves, and the active elements (pump stations, compressors) and consumers;
- failure intensity of spatially extended network elements and the intensity of their restoration;
- free-failure operation probability of spatially non-extended elements of the network (active elements, stop valves, distributive places, etc.).

The functional reliability calculation method comprises 7 successive stages [1].

Stage 1. The mathematical model plotting of complex PTS in the way of a weighted graph. The mathematical model of distributive PTS in the form of an oriented weighted graph

$$\mathbf{G}\left[h, z, l, \lambda, \mu, \mathbf{p}\right] = \left(\mathbf{V},\mathbf{E};h,z,l,\lambda,\mu,\mathbf{p}\right), \tag{1}$$

where V – is a multitude or graph vertexes, corresponding to the water supply wells; E – is a multitude or graph arcs, corresponding to the real pipe-lines; h – is a weighted function on the 2 graph vertexes, defining the well height above the sea level; z, l□ □ p – weighted functions on the graph ribs, correspondingly defining the presence and location of valves, length, wear intensity and restoration intensity of pipe-lines, engineering reliability of stop valves.

Stage 2. Breaking-up of an outcome weighted graph of pipe-line network into subgraphs, each of which corresponds to one zone of break-down and repair (ZBR). The global problem solution of a graph division includes the solution of two quotient problems: localization problem of ZBR for an arbitrary chosen pipe-line, extraction problem of a number of essential stop valves out the sub-graph of ZBR. While solution of a global problem only essential stop valves influence the outcome result. A correct division of stop valves is realized automatically in the process of a quotient problem localization of ZBR automatically.

Stage 3. Engineering reliability calculation of ZBR. Engineering reliability of every ZBR is being calculated by one of the four methods:

– the analytic method with the help of the formula

$$P_{Z_k} = \left(\prod_{i-1}^{t_k} p_i\right) \cdot \left(\prod_{i-t+1}^{t_k+z_k} p_i\right) = \prod_{i-1}^{t_k+z_k} p_i\,, \tag{2}$$

where t_k – is a quantity of arcs in a graph of ZBR ; $\mathbf{Z}_k$; z_k – is a number of stop valves in the zone $\mathbf{Z}_{k;}$

– statistics and analytic methods of the mass service theory on the basis of the formula use

$$P_{\mathbf{Z}k} = 1 - \frac{P_{\bar{0}}\, l_k}{L}\,, \tag{3}$$

where $P_{\bar{0}}$ – is the probability of the whole network being in a defective state; $P_{\bar{0}} = 1 - P_0$

P_0 – is the probability of the whole network being in a serviceable state; l_k – is the added length of pipe-lines of k-zone; L – is the added length of all the pipe-lines in a network;

– statistics and analytic methods of the mass service theory on the basis of the equity

$$P_{\mathbf{Z}k} = P_{0k}\,, \qquad k \in \{1, z\}, \tag{4}$$

if we consider ZBR as an independent network.

Stage 4. Outcome weighted graph transformation of the network of a great dimension into a weighted graph of ZBR of a small dimension. According to the data, obtained in the previous stages, we can construct a weighted graph

$$\mathbf{Z}\left[p, p_a\right] = \left(\mathbf{Vz}, \mathbf{Ez}_Z; p, p_a\right), \tag{5}$$

where **Vz** – is a number of graph vertexes, corresponding to the source of the UP of ZBR, $\mathbf{V}_Z = \left\{v_k\right\}_0^z$; **Ez** – is a multitude of graph arcs, corresponding to the existing stop valves, unite the source of UP and ZBR into a common network,

$$\mathbf{Ez} = \left\{e_{ij} = \begin{pmatrix} v_i v_j \end{pmatrix} \mid i, j = \overline{0, z}, \quad i \neq j\right\};$$

z – is a multitude of ZBR in a network; p – is a weighted function on the graph vertexes, defining engineering reliability of the corresponding ZBR; pa – are weighted functions on the graph arcs, defining the engineering reliability of the corresponding stop valves.

Stage 5. Construction of function reliability calculation models concerning ZBR, which are not directly joined to a source of UP and their simplification. The outcome data, necessary for the calculation construction, that are contained in a weighted graph of ZBR $\mathbf{Z}_{\text{simpl}}\left[p, p_a\right]$ and the calculation models themselves represent weighted subgraphs $\mathbf{z}_{f_k}\left[p, p_a\right]$ $(k = \overline{1, z})$: $\mathbf{Z}_{f_k}\left[p, p_a\right] \subseteq \mathbf{Z}_{\text{simpl}}\left[p, p_a\right]$ As a result of a simplified graph stage completion of $\mathbf{Z}_{\text{simpl}}\left[p, p_a\right]$ is being transformed into the system of calculation models:

$$\mathbf{Z}_{\text{simpl}}\left[p, p_a\right] \Rightarrow \begin{cases} \mathbf{Z}_{f_1}\left[p, p_a\right]; \\ \mathbf{Z}_{f_2}\left[p, p_a\right]; \\ \cdots \\ \mathbf{Z}_{f_z}\left[p, p_a\right]. \end{cases} \tag{6}$$

Stage 6. The calculation model analysis with the purpose of ZBR revealing and removal of non-existent relations out of them between ZBR and the zones themselves, which do not influence the function reliability. As a result of the given stage execution the system of calculation models (6) is transformed into the new system of calculation models:

$$\begin{matrix} \mathbf{Z}_{f_1}\left[p, p_a\right]; \\ \mathbf{Z}_{f_2}\left[p, p_a\right]; \\ \cdots \\ \mathbf{Z}_{f_z}\left[p, p_a\right], \end{matrix} \Rightarrow \begin{cases} \mathbf{Z}'_{f_1}\left[p, p_a\right]; \\ \mathbf{Z}'_{f_2}\left[p, p_a\right]; \\ \cdots \\ \mathbf{Z}'_{f_z}\left[p, p_a\right], \end{cases} \tag{7}$$

where $\mathbf{Z}'_{f_k}\left[p, p_a\right] \subseteq \mathbf{Z}_{f_k}\left[p, p_a\right], \quad k = \overline{1, z}$.

Stage 7. The functional reliability calculation of the network concerning one and the same zone with the help of classical methods of engineering system reliability calculation. The functional reliability calculation of the network, concerning *k* of ZBR $P^{f}_{\mathbf{Z}k}$ for every calculation model $\mathbf{z}'_{f_k}{}^{[p,\,p_a]}$ is done by means of engineering systems reliability calculation technique with a mixed combination of elements. As the last stage we obtain a desired index of the functional reliability of PTS

$$P^{f}_{\mathbf{Z}_k} = \begin{cases} P_{\mathbf{Z}_k} \cdot \prod_{i=1}^{card\,\mathbf{W}_k} p_{ki}, & k = \overline{1, z_c}; \\ P^{f}_{k}, & k = \overline{z_c + 1, z}. \end{cases} \qquad (8)$$

3. Conclusion

The developed method of functional reliability calculation of PTS allows to get a probability of UP to a particular consumer concerning network structure and reliability functioning of separate network elements.

Acknowledgement

The method is oriented to the pipe-line networks, which in complexity of their structure are commensurable to the complexity of PTS, functioning in different fields of national economy. The calculated value corresponds in its reliability to the accepted state standards [2].

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The Using of the Gravity Model for Evaluation of the Transport Network in Žilina

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Abstract. The traffic impact on the transport network has a various reasons that are perceived in negative sense. This contribution presents the application of transport modeling with the help of gravity model. The gravity model can answer to the question why some areas in the city are congested and some not. The answer consists in land-use parameters that indicate the how can urban activity brings the positive but also negative effect in city.

Keywords: gravity model, transport modeling, transport network.

1. Introduction

The current situation in city of Zilina is characterized by the increasing traffic volume trend in transport network. Due this fact, it is necessary to understand the origins of this problem. The traffic increasing is related to the changes in citizens behavior caused by location of the points of interests (POI) and the attraction function of the city area. For this reason the city is divided into basic zones which represent the parameters of citizens, land – use, etc. To put into close relationship the traffic or transport relationship and the citizens travel behavior, the gravity model approach has been applied [1].

1.1. The gravity model

The gravity model [2] reflects to the traffic zonal interaction and it is organized in an origin-destination table, so called OD matrix. The origins and destination are represented by zones that produce and attract the trips of citizens or industry. The input data are collected from travel survey, statistics and direction surveys. In the case of citizens, it is important to know their socio- economical status. Therefore the zonal data of citizens are divided into following groups:

- Employed
- Children
- Pupils
- Students
- Unemployed
- Pensioners

We know that citizens travel to other zones because they commute to work or schools, etc. Therefore, it is necessary to analyze each zone from point of attraction. The attractions represent:

- Number of jobs

- Number of places for children, pupils, students in educational institutions
- Number of houses, flats
- Number of shopping places,
- Number of cultural, sports, relax places

If we know who is the traveler and where is he/she travel and also for which purpose, we need to know what kind of means of transport is he/she using. For city of Žilina the following means of transport are considered:

- Car driver
- Car passenger
- Bus
- Trolleybus
- Train
- Bicycle
- Walk

Very important issue is related to the skim matrices creation. The skim matrices represent the cost functions (i.e. distances, travel time, travel monetary cost, etc.) which helps in the process of assignment the travel volume at the transport network. Based on skim matrices we can analyze the current status, forecast future or evaluate the alternatives.

1.2. The modeling approach

The modeling approach consists of calculation the production and attraction for each zone. Then the skim matrices are created. The citizens are divided into subgroups and they are assigning on the network based on time demand and also based on transport means that is used. To take into account the difference among travel groups and transport means, the simultaneous gravity model is used. In comparison with common gravity model, the simultaneous model distinguishes between user groups can be built more specifically by making this classification for either the Productions or Attractions. If a classification according to ownership is made at the Attractions, the model uses the formulas (1-3):

$$T_{ijvg} = \rho * Q_i * X_{j*} F_{(zijvg)} \quad (1)$$

$$\sum_g \sum_v \sum_i T_{ijvg} = A_j \quad (2)$$

$$\sum_v \sum_j T_{ijvg} = V_{ig} \quad (3)$$

where:

ρ = the scaling factor

$T_{i,j,v,g}$= the number of trips from zone *i* to zone *j* by mode *v* for group *g*

A -the number of attractions at zone *j*

V- is the number of productions for zone *i* for group *g*

Q- row balancing factors

X- column balancing factors

F(z) = the distribution function, describing the extent to which people are *willing* to make a trip with a particular impedance *z* . The distribution function is specified for each mode/user combination.

Z_{ijv} - the cost impedance between zone *i* and zone *j* for mode *v*

From this, it is easy to deduce the formulas needed to make a classification into groups based on Productions. The general condition for gravity model states that the number of trips from origin equals to number of trips between origin and destination. Based on this condition, the iteration in multiple steps is run. The gravity model has been applied into existing ZTM.

2. The outputs and findings

The transport model in general has to provide useful information for not only for transportation engineers or planners, but it should provide the clear information also for local transport authorities and decision makers who have influence on transport policy making. The outputs from transport modeling using the gravity model are divided into two basic groups. First group refers the current status in Zilina transport network as demonstrates the Fig.1.

Fig. 1. The Žilina transport network assignment.

The transport infrastructure has the significant problems [3] with volume and capacity. The problems are caused by various types of road which were built for other function as they are serving. The modeling provided the information about analysis of LOS that represents the important parameters of roads service evaluation. The analysis provided the information that on roads specially in centre or close to centre the LOS responds to the levels D,E,F according

the methodology [4]. That means the roads doesn't serve with their function for city of Žilina. Another problem is the highway that ends in the western part of city. The high volume of traffic passes around the city and also through the city as traffic corridor which substitutes the function of highway which is planned build in future. This caused the heavy condition for common traffic in city especially for all day. Moreover the locations of jobs for citizen have changed and in present time are spread out within city what force to citizen to travel more.

The current status of traffic is caused also by not-respecting the principles of the urban planning. The former representatives and authority of Žilina didn't respect the urban master plan, location of areas which were suitable for future development, etc. This status allowed to the developers to build the commercial and residents complexes without analyzing and evaluation the traffic impact on the city network. So now in city of Zilina are situated new complexes, some still under construction that will worse the traffic situation in the city. The gravity modeling found also answer to problem with car parking. In recent years, the parking in the city of Zilina represents a big problem which is related to the basic problem of car space using. The city and special its centre represents the area which attracted a big amount of trip. In current situation where the biggest share of modal split is related to the cars and the citizens use the individual car motoring within city, the city create the conditions that allow to park in the central zones. It is cause also by the status of legislation, mainly the Act of road traffic.

3. Conclusion

The results of transport modeling with gravity model approach pointed on some outputs which are related to the current status, the origins of problems. The heavy traffic condition will be still present until the municipality agrees new principles of urban and transport planning and also new rules for developers. For citizen will be important to promote the new mobility concepts which could shift from car usage to the alternative means of transport as public transport, cycling, etc.

Acknowledgement

The author is lecturer and works in area of transport engineering, demand forecast and transport modeling.

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Innovativess as the Key Element of Shaping Competitiveness of a Region and Regional Passenger Transport

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Abstract. Today innovation represents one of the key elements of shaping the economic policy of countries. Implementation of the planned changes will enable to create in Polish realities the economy based on knowledge, in which high innovativeness will be the strength of entrepreneurs on competitive markets. Created by the public authorities of RP programming documents define the institutional framework of the innovation policy, and undertaken as their result actions shape changes in the sphere of organization and management and in operation of enterprises, including the regional passenger transport – a significant link of Regional Innovation System. The paper considerations focus on identification of basic directions of changes designed in the perspective 2007-2013 in the sphere of innovativeness and their influence on competitiveness of a region and the regional passenger transport.

Keywords: Innovations, innovation policy, regional transport, Regional Innovation System, region

1. Introduction

Innovativeness of economy is indicated as one of essential factors shaping the international competitiveness of the economy, and long-term economic development. Innovativeness is now not only a fashionable definition of technical and scientific progress. For several years it has become one of the key elements of modern enterprise. A region plays an important role in pro-innovative actions. Supporting innovativeness of a region - a new attribute of the socio-economic space of the Community is shaping its innovative potential within Regional Innovation Systems (RIS)[1]. The Regional Innovation System is a system in which different cooperative unions in branches of regional economies are created, and its important component is the regional passenger transport. Hence, competitiveness and development of the regional passenger transport should be considered in the context of programmed by the public state and regional authorities of Poland innovative activities and policies of the European Union in this scope

In the Lisbon Strategy - the basic programming document of the European Union, the issues of innovation have been reflected. The priorities of the European Union as well as directions and prospects for changes serve realization of the superior and at the same time strategic objective of the Union which is: '... creation of based on knowledge, and at the same time the most competitive and dynamic economy in the world, capable of sustained economic

[1] Regional Innovative System (RIS)– is a specific forum of cooperation of different organizations and institutions operating in a region, whose purpose is to develop enterprise and innovativeness. Elements of RIS are: enterprises, a public sphere of research and development and intermediary institutions, that is: non-commercial centres of innovation and transfer of technology, and other subjects connected with business providing services included in the market infrastructure. cohesion

growth, providing a greater number of work places in conditions of greater social cohesion [2] Innovativeness is an important factor of competitiveness. Competitiveness of a country can be described as such development of institutional and macro-economic conditions, and conditions of competition and efficiency of market mechanism, which build economic bases for dynamic development of enterprises in the conditions of the changing environment.'[3] In building competitiveness an important role is played by the adaptability of economy as a whole, and subjects acting in it, including subjects of the regional passenger transport, to changing environmental conditions. It enables to maintain or improve the position on the market in global conditions.[4] Conditions of competitiveness development depend on the internal conditions of economy functioning and on the conditions of influence of its international environment[5] on it. Competitiveness has also a regional dimension because the factors of shaping economic advantages, formulated by M.E. Porter, can be referred to regions. Determinants of competitive advantages create an environment in which the subjects of regional economy operate. This environment can favour or hinder regional entities to obtain or maintain a competitive advantage, and thus affect the competitiveness of the region - as a whole. An important role in shaping competitiveness of a region and components of its economy – in this the regional passengers transport, innovative policy created by state and regional public authorities plays.

2. Shaping Competitiveness of the Regional Passenger Transport in Aninnovative System of a Region

A source of innovativeness in a region is wise and fair management of its own resources, including human resources and taking care of innovative culture both within the regional economy and in the surrounding of a region. In realization of the innovative policy of the state a significant role is fulfilled by an innovative region - understood as a system of innovations closed with three circles, that is: the core, which is made by the potential innovativeness of firms created in their cooperation through alliances and work in the network; an environment of supporting innovativeness (law, administrative regulations, a structure of economic and social support); defining rules of the field in a region. Factors affecting the innovative system of a region can be conventionally divided into: institutional, the state policy, and the innovative activity of components of regional economy.[6] The regional passenger transport, as a part of an innovative region, has a major role to fulfill in creating economic, social and ecological development of regions in Poland. It is indicated as an essential determinant of creating competitiveness of a region and an important component of the Regional Innovation System. Among the factors influencing competitiveness of the Regional Innovation System

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and the regional passenger transportthere is regionalization of transport. In the process of transport regionalization one candistinguish three groups of actions relating, on the one hand, transport services being public services, on the other hand, services not having such a status. Regionalization of transport comprises activities connected with creating a system of passenger transport services in a region, serviced by public collective transport. Regionalization creates a sphere of services in the public regional transport, technical infrastructure used in the public regional transport, organization of regional transport serviced by public collective transport.

By isolating in each of the categories of services their defined sort structure, and then establishing a system of payment for these services and accepting solutions in the scope of financing transport services in a region, a modern shape of the sphere of services in the system of regional passenger transport is obtained. A new rule in this group of activities should be the abandonment of the branch character of public services in the regional transport for the good of public services serving the needs of particular groups of local communities in the region, in this, coordination of services provided by different branches of transport: car transport and railway transport.

Practical implementation of solutions of regionalization of public passenger transport comprising, among others: improvement of the quality of functioning the regional public transport, reducing travel time in relations in the region, improvement of traffic safety, including, first of all, the safety of car traffic, improvement of the accessibility of different areas of a region resulting in its increased attractiveness for business, tourist and living (housing) undertakings, etc. Regionalization of transport, and creating in the process a modern system of public transport networks in the region, also requires solutions in the field of transport infrastructure. Regional transport infrastructure should promote social and economic development, because it creates competitiveness of the Regional Innovation Systems, and thus the competitiveness of individual regions. An important factor here is also improving the conditions of the environment. As a part of the Regional Innovation Systems improvement of the natural environment should take place as a result of activities creating conditions for development of rail transport, reducing the rate of growth of pollution caused by automobile traffic, improvement of aesthetics of the landscape. An optimally shaped spatially, technically advanced and reasonably exploited network of regional transport roads will enable to use new, innovative technologies in passenger transport in the future. An essential element of regionalization is also made by organization and management of passenger transport in a region, including public transport and the issues connected with defining tasks and competences of regional self-government authorities in such a way that, being responsible for this sphere of public services, they can create the subjects responsible for organization of transport in a region.

Polish organizational-managerial solutions connected with regionalization of transport should be consistent with trends observed in practice in the European Union. So, they should take into account undertakings liberalizing the regional passenger transport market serviced by public transport and promote integration of transport.

Activities liberalizing the market and integrating transport are not mutually exclusive. Strengthening the regulated system of transport, with a simultaneous diversification of the scope of regulations, market segmentation into two essential elements, that is transport executed within the framework of public services and the other transport services identify future development directions of an organization system of passenger services in a region.

3. Conclusions

The regional passenger transport is a part of the Regional Innovation System, which is a consistent part of the National Innovation System (NSI). The National Innovation System is an aggregate team of linkages between particular institutions creating innovations on the domestic market. It is a dynamic system having the character of an open system. It is defined as a network of cooperating with one another institutions of a public and private sector, which results in import, modifications and diffusion of new technologies.[8] An innovative region is a part of so understood NSI. Due to the horizontal nature of the innovation policy and a variety of subjects at a national and regional level involved in activities in the sphere of innovations, it is necessary to create appropriate mechanisms of coordination. So far specific mechanisms coordinating innovative activities, realized at a regional and central level, have not been developed, which is a significant barrier to ensuring the growth of an innovative level of the economy.

The regional transport system is one of the most important elements of an economic system in the region. It characterizes with its own features and links. It is created by subsystems, among which the main subsystems are: regional transport infrastructure, means of transport of different branches of transport, regardless the form of property, human resources, legal and organizational regulations, etc. The innovative policy of public authorities, both the state and regional, shapes competitiveness, functioning and development of the regional passenger transport - an important component of an innovative region.

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Logistics and Limiting Factors of the Environment

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Abstract. Limiting factors of the environment, their awareness and acceptance, would help in the effective utilization of existing logistics centres, and in expanding their services. The Slovak economy, despite the direct or secondary negative impact of the current crisis on acquisitions in the market for industrial property gives hope, despite the various recessions for further development in this field.

Keywords: logistic, environment, logistics centres, planning documentation, environmental logistics.

1. Introduction

Central Europe is one of the most interesting sites for the development of industrial and logistics parks. Confirming the evidence is also Slovakia, which to its territory attracted series of domestic and foreign investors engaged in logistics.

Majority has focused on storage and partially on completing components for the automotive and electrical industry, there are also distribution centres, specializing in consumer and high-turn commodities. To date, were built more than 50 such logistics centres.

2. Environmentally orientated logistics

Environmental aspects of logistics can be divided into basic groups:

1. **The conditions for the selection of suitable sites**
   (nature protection, territorial planning, the occupation of agricultural land, etc.)

2. **The conditions required by law in relation to the particular elements of the environment**
   (water - its inlet and waste water discharges, the handling with substances contaminating water, air pollution, waste, obligations under the law on packaging, etc..)

3. **Added environmental value**
   (voluntary environmental activities beyond the basic obligations of the legislation).

The first two aspects determine the limiting factors for the environmentally-oriented logistics. The third aspect is an added environmental value, which brings not only real increase of the protection of environment, but also increased competitive advantage for the operator decided to go this way.

Most of the logistics centres undertook a process of assessment of their expected impact on the environment. This is provided by act no. 24/2006 Law Digest, the assessment of the

impact on the environment, and about changing and amending certain laws (hereinafter "EIA Law").

3. Logistic centres

Important role of SR in assessing the attractiveness of the sites selected for the logistic centres in conjunction with the summary confirms, that the current placement of logistics centres have been very appropriate also in terms of possible negative impact on the environment.

Logistic centres are placed:

- In accordance with applicable documentation of area-planning
- Out from the interests of nature and landscape protection, including protected areas
- With minimal necessity of other variants
- Without the need to continue in the process of assessing their possible impacts on the environment
- Exclusively on the land of the agricultural land fund

For the negative impact of logistics centres on the environment we consider the following:

- Permanent or temporary occupation of the agricultural land
- Change the landscape structure, which is usually compensated by measures (change in the height of the objects, appropriate plantation adjustments)

3.1. Logistic centres and area-planning documentation

- Logistic centre located on the areas determined for it in the area-planning documentation. This is an area known as for example territorial and spatial area of a reserve for building industrial parks, industrial zone. Prior to issuing the decision of land, it is necessary to assess the proposal for the logistics centre under the EIA Law.
- Logistic centre placed in the locality, which is not intended for such activities under the area-planning documentation seems appropriate to change or amend area-planning documentation. Change or amendment of the area-planning documentation may be subject to the assessment process under the EIA Law.
- Logistics centre, situated in the territory for which is processed area-planning documentation is possible to place a logistics centre in the territorial proceedings. Then the basis for issue the decision of land is area-planning documentation (urban studies, regional forecast or area-technical documentation). Prior to the issuance the decision of land, should be assessed the proposal for the logistics centre under the EIA Law.

3.2. Logistics centres and protected areas

Requirements for protection of these territories and the ensuing restrictions on the performance of various activities, including development activities, are quite clearly laid down

in Act No. 543/2002 Law Digest, about the nature and landscape protection, as amended according to the various degrees of protection. By overlapping of different areas with different degrees of protection of nature, which is arising from the restrictions that complicate the orientation of investors in the processing of plans for development activities, not only in protected areas, but virtually on the entire territory of Slovak Republic. It is necessary to add to the protection in the various categories of protected areas (territorial protection) includes also the protection of protected species of plants, animals, minerals and fossils, as well as tree growing outside forests.

After the accession of Slovakia to the EU, it made protected more areas that are part of a European network of protected areas, called NATURA 2000. For these areas there is special regime of protection, bringing some additional restrictions.

In these areas it is not strictly prohibited placement of buildings, even if for the realization is necessary more permits, due to which can be construction more expensive (e.g., financial compensation for damages or destruction of biotopes at the European or national importance), or even stop it.

3.3. Logistics centres and the protection of agricultural land

Act 219/2008, which amends Act 220/2004 Law Digest on the protection and use of agricultural land and about the change of the Act No. 245/2003 Law Digest on integrated prevention and control of the environmental pollution and amending and supplementing certain laws as amended by Act No. 359/2007 Law Digest, which came into force on 1 January 2009, returns into the Slovak legal system the payment of levies for permanent or temporary withdrawal of agricultural land. Method of payment and the amount of contributions provides regulation of the Government of Slovak Republic No. 376/2008 Law Digest, establishing the amount and method of payment of levy for the withdrawal of agricultural land. Although the above mentioned law allows giving exception from payment of levies on some buildings (e.g., constructions in the urban areas of the agricultural and industrial enterprises), there is no doubt that the payment of levies will increase the cost of construction of logistics centres, which might create an effort that their placement will be for now on disused areas and may be a limiting factor in the protection of nature and landscape, or in old industrial areas (the so-called Brownfield),also may be a limiting factor the existence of old environmental burdens.

4. Development of Environmental Logistics

- Perform a categorization of the territories under environmental conditions for the selection of new and suitable localities for logistics centres
- Create an overview of secure disposal of waste associated with the operation of the logistics centre (packaging, storage of goods, etc.)
- Make an outline of possible activities for the creation of added environmental value - the conditions of engagement in the EMAS system, by orientating to environmentally friendly products, usage of renewable energy sources, support the third sector activities in the environmental protection and so on

5. Conclusion

For the near term, the question remains, whether Slovakia has enough of the other appropriate localities for the placement of logistics centres, or whether there is a need for additional centres in respect of the number of existing and constructing centres. It is assumed that the placement of additional logistics centres will be limited by the economic factors, but also by the environmental aspects. Limiting factors of the environment, their awareness and acceptance, would help in the effective utilization of existing logistics centres, and in expanding their services.

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Comparison of Calculated Braking Distance and Simulated in CarSim Application

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Abstract. this paper introduces CarSim application as a simulator of dynamic behavior of vehicles. It compares calculated values of braking distances and simulated in this application.

Keywords: braking distance, CarSim application, vehicle, time

1. Description of CarSim Application

CarSim simulates the dynamic behavior of racecars, passenger cars, light trucks, and utility vehicles. CarSim animates simulated tests and outputs over 700 calculated variables to plot and analyze, or export to other software such as MATLAB, Excel, and optimization tools.

The three main control inputs involve steering, braking, and speed. CarSim has options for open-loop and closed-loop inputs for steering, braking, throttle, and gear shifting. There are also options for building complex control sequences as a series of "events," where a new control can be triggered by any output variable reaching a specified value [1].

The equations of motion in the CarSim math models are valid for full nonlinear 3D motions of rigid bodies. The major kinematics and compliance effects of the suspensions and steering systems are specified with properties that can be measured directly. Details of the linkages and gears in the suspensions and steering systems are not needed, reducing the amount of information needed to obtain accurate predictions. Many of the components that have the greatest effect on handling, braking, and acceleration are represented with nonlinear tables of measurable data. For example, CarSim uses detailed nonlinear kinematical relationships, nonlinear spring models, and other nonlinear component models.

Main interface to CarSim is the simulation graphical user interface (SGUI), which contains an extensive database of vehicle and component properties that are displayed in a graphical content in about 160 screens. The virtual vehicle is assembled from datasets, similar in concept to the way a physical vehicle is assembled from parts and subsystems. CarSim is provided with example datasets that cover over 15 representative vehicles, ranging from an A-class hatchback, to an F-class, sedan, along with SUVs, pickups, and an F3 racecar.

2. Calculation of Braking Distance

In connection with braking of vehicle it possible to simulate braking mechanics in CarSim application or checking of braking system function. Simulations were done for vehicle marked in this program as „Sedan Big“ with fluid double-circuit braking system to measure braking distances from speed of 60 km/h on road surface with different friction coefficients.

Objective was:

1. determine braking distance for vehicle on dry road surface with friction coefficient 0,85 and speed 60 km/h,
2. determine braking distance for vehicle on wet road surface with friction coefficient 0,3 and speed 60 km/h.

In calculating the stopping distance will be based on facts that braking procedure consists of the reaction time of driver SR , time of onset of full developed deceleration SN (consisting of time delay onset of braking efficiency tO and from the time of onset of fully braking efficiency tN) and time of braking SB . Than it is possible to determinate appertaining trajectories for single times in braking procedure [2].

2.1. Vehicle Braking Distance for 60 km/h Speed on Dry Surface

Total braking distance is:

$$S_Z = S_R + S_N + S_B \quad [\text{m}]. \tag{1}$$

During vehicle braking inertia force acts in the vehicle centre of gravity, whose size is

$$F_S = m.b \quad [\text{N}] \tag{2}$$

m – vehicle weight [kg]
b – braking deceleration [ms^{-2}]

This force acts at the center of gravity in the direction of the vehicle driving with opposite direction as the braking force F_B in place of wheel contact with the ground [4]. For braking force stands:

$$F_B = \mu_X . F_Z \quad [\text{N}] \tag{3}$$

μ_x – longitudinal adhesion coefficient [-]
F_Z – radial load of wheel [N]

As the balance of power, the braking deceleration *b* can be expressed as:

$$\begin{aligned} F_S &= F_{B1} + F_{B2} \\ m.b &= \mu_X . F_{Z1} + \mu_X . F_{Z2} \\ m.b &= \mu_X . (F_{Z1} + F_{Z2}) \\ m.b &= \mu_X . G \\ m.b &= \mu_X . m.g \;/ : m \\ b &= \mu_X . g \quad [ms^{-2}] \end{aligned} \tag{4}$$

F_{B1} – braking force on front axis [N]
F_{B2} – braking force on rear axis [N]
G – vehicle gravity [N]
g – acceleration of gravity [ms^{-2}]

For mentioned example the value of the braking deceleration according to relation (4) will be:

$$b = 0{,}85.9{,}81 = 8{,}3385 ms^{-2}$$

The value of driver reaction time is considered t_R = 1s. Than the trajectory S_R will be:

$$S_R = t_R.v_0 = 1.\frac{60}{3,6} = 16,67m$$

For time delay onset of braking efficiency for braking system with liquid transmission is considered value t_O = 0,05 s and for time of onset of full braking efficiency is considered value t_N = 0,15s [3]. These two times can be merged into time t_1. Then for braking distance S_N on which the full braking effect was evident after the time t_1 can be written:

$$S_N = t_1.v_0 - \frac{bt_N^2}{2} = 0,2.\left(\frac{60}{3,6}\right) - \frac{8,3385.0,15^2}{2} = 3,24m$$

Vehicle was decelerating already during the onset of full braking effect. The speed by which the full braking effect was evident is:

$$v_B = v_O - \frac{b}{2}.t_N = \frac{60}{3,6} - \frac{8,3385}{2}.0,15 = 16,04ms^{-1}$$

Than the time which vehicle needs to stop is:

$$t_B = \frac{v_B}{b} = \frac{16,04}{8,3385} = 1,9s$$

For braking distance of vehicle braking from speed v with braking deceleration b to zero speed can be written:

$$s_B = \frac{v^2}{2b} \quad [\text{m}] \qquad (5)$$

Than for S_B according to (5) stands:

$$s_B = \frac{16,04^2}{2.8,3385} = 15,43m$$

Total braking distance according to (1) for speed 60 km/h is:

$$S_Z = 16,67 + 3,24 + 15,43 = 35,34m\,.$$

2.2. Vehicle braking distance for 60 km/h speed on wet surface

Braking distance can be estimated analogically with the previous example. The value of the braking deceleration on wet surface with friction coefficient 0,3 according to relation (4) will be:

$$b = 0,3.9,81 = 2,943ms^{-2}\,.$$

Trajectory corresponding to the driver reaction time remains unchanged. Braking distance S_N for time t_1 is:

$$S_N = t_1.v_O - \frac{bt_N^2}{2} = 0,2.\left(\frac{60}{3,6}\right) - \frac{2,943.0,15^2}{2} = 3,3m\,.$$

Full braking effect is evident at a speed of:

$$v_B = v_O - \frac{b}{2}.t_N = \frac{60}{3,6} - \frac{2,943}{2}.0,15 = 16,45 ms^{-1}$$

.

Time t_B is:

$$t_B = \frac{v_B}{b} = \frac{16,45}{2,943} = 5,6s$$

Than for S_B according to (5) stands:

$$s_B = \frac{16,45^2}{2.2,943} = 45,97m$$

Total braking distance according to (1) for speed 60 km/h on wet road surface is:

$$S_Z = 16,67 + 3,3 + 45,97 = 65,94m\,.$$

3. Simulation of Braking Distance in CarSim Application

To perform simulation of braking in CarSim application on road surface with different friction coefficients is needed to create a new data file with friction coefficient $\mu_X = 0,3$ in part of program *„3D Road: Friction coefficient“* . Predefined dry road surface has defined friction coefficient $\mu_X = 0,85$. As an output from plotter has been selected *„Longitudinal speed vehicle Total“* and for finding the vehicle braking distance has been selected coordinates of its movement *„XY coordinate“*. This table shows calculated and simulated values for braking distance and time to stop and their differences.

		Calculated values	Simulation results	Difference
$\mu_X = 0,85$	Braking distance	18,67 m	19,4 m	0,73 m
$V_0 = 60$ km/h	Time to stop	1,9 s	2,3 s	0,4 s
$\mu_X = 0,3$	Braking distance	49,27 m	50,7 m	1,43 m
$V_0 = 60$ km/h	Time to stop	5,6 s	6,1 s	0,5 s

Tab. 1. Comparison of calculated and simulated values.

Braking distance in table is shown without trajectory S_R because CarSim application does not calculate with driver reaction time. Simulation was run so that in fifth second of driving the full braking effect came into action in 0,15 seconds.

4. Conclusion

As is shown in table above values of braking distance and time to stop for simulation are little bit lower than calculated values. It is due to fact that CarSim takes into consideration other input values current axle load other dynamic parameters. Other reason is that friction coefficient is not constant value and it is changing in time during braking.

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Parametric Models of Real System and the Validation Tools

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Abstract. The existing tunnel system was identifying using methods for system identification. Since each tunnel is unique, the design must be realized for the particular road tunnel – in this case for the Prague's road tunnel. Data measured in the control centre of the tunnel are used to create basic types of stochastic parametric models in the programme environment MATLAB. By model validation methods we can determine the accuracy of created model.

Keywords: model, identification, road tunnel, validation.

1. Introduction

For identification it is interesting to describe the process using input-output relations [1]. The general procedure for estimation of the process model consists of several steps: determination of the model structure, estimation of parameters and verification of the model. In stochastic models existence of the stochastic component $\xi(t)$ was assumed. Most often we considered ξ to be a white noise; however more complex cases are possible too. The stochastic models mentioned in this work are in discrete area all [1].

The aim of this work is not only identify the road tunnel system as a parts of whole but also verify these models. Data characterizing the existing ventilation system can be used to analyze and identify the system and create its stochastic model. Inputs values are traffic rate and output values are CO concentration and opacity inside the tunnel [2]. Measured data come from tunnel Mrázovka in Prague

2. Modeling the Dynamic System Having Stochastic Characters

Mathematical models are mathematical expressions of essential characteristics of an existing or designed system that describe knowledge about the system in a usable form.

Turbulence inside the tunnel, variety of traffic and atmospherics make the system stochastic. To make the models we use parametric identification. The input data are traffic rate.

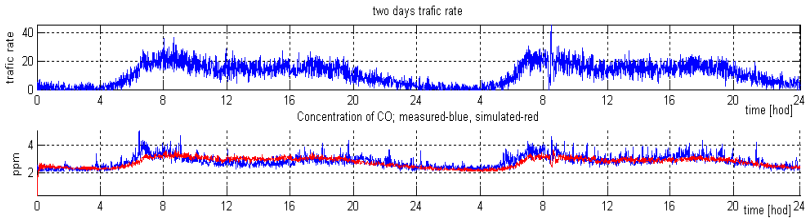

Fig. 1. Input and output data.

The main models are ARX (auto-regressive moving average), ARMAX (auto-regressive moving average exogenous), and OE (output error) [3]. We set the number of each parameter for these models according to Fig. 2.

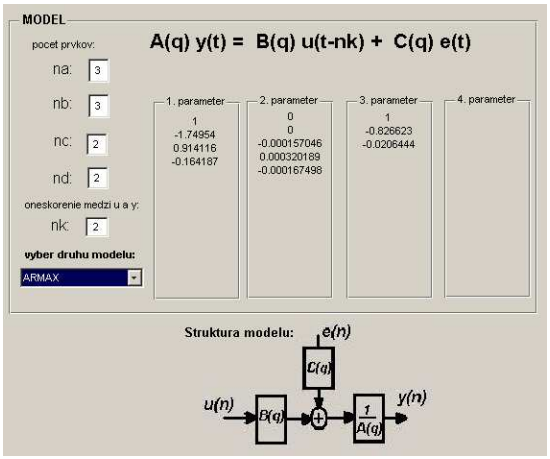

Fig. 2. Model estimate.

We have possibility to choose one of above mentioned models. The model structure is shown automatically.

2.1. Model order

It is necessary to distinguish between the lack of fit between model and data due to random processes, and that due to lack of model complexity. Model order tests are relevant for all identification of parametrized models.

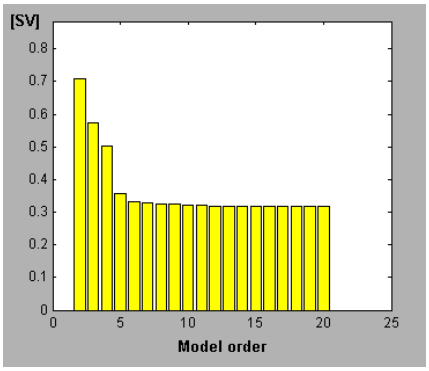

Fig.3. Model singular values vs order.

The horizontal axis corresponds to the model order. The vertical axis, called Log of Singular values, shows the singular values of a covariance matrix constructed from the observed data. We can use this plot to decide which states provide a significant relative contribution to the input-output behavior, and which states provide the smallest contribution. Based on this plot, we select the rectangle that represents the cutoff for the states on the left that provide a significant contribution to the input-output behavior. The recommended choice is the last significant change.

3. Model Validation

The purpose of model validation is to verify that identified model fulfills the modeling requirements according to subjective and objective criteria of good model approximation.

3.1. Residual Analysis

Residuals are differences between the one-step-predicted output from the model and the measured output from the validation data set. Thus, residuals represent the portion of the validation data not explained by the model. Residual analysis consists of two tests: the whiteness test and the independence test. According to the whiteness test criteria, a good model has the residual autocorrelation function inside the confidence interval of the corresponding estimates, indicating that the residuals are uncorrelated. According to the independence test criteria, a good model has residuals uncorrelated with past inputs. Evidence of correlation indicates that the model does not describe how part of the output relates to the corresponding input. For example, a peak outside the confidence interval means that the output $y(t)$ that originates from the input $u(t-k)$ is not properly described by the model. In Fig. 4 we can see the residual autocorrelation for some model with 95% confidence interval limits for noncorrelated residuals and cross-correlation function between input and residuals from output.

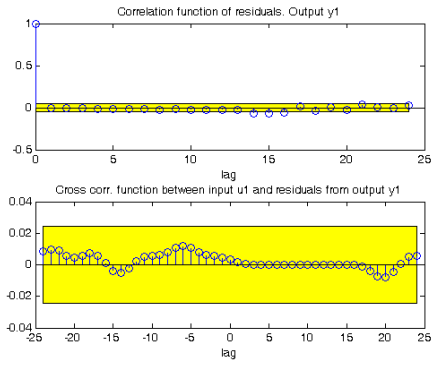

Fig. 4. Autocorrelation and cross-correlation test.

3.2. Akaike Final Prediction Error (FPE) for estimated model

The average prediction error is expected to decrease as the number of estimated parameters increase. One reason for this behavior is that the prediction errors are computed for the data set that was used for parameter estimation. It is now relevant to ask what prediction performance can be expected when the estimated parameters are applied to another data set. This test shows the flexibility of the model structure. We are looking for minimum value of FPE coefficient.

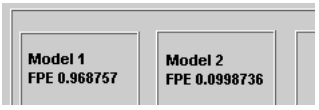

Fig. 5. FPE comparison.

3.3. Model and Parameter Accuracy

In this method we compare the model performance and behavior with real data. A deterministic simulation can be used, where real data are compared with the model response to the recorded input signal used in the identification. This test should ascertain whether the model response is comparable to real data in magnitude and response delay [1].

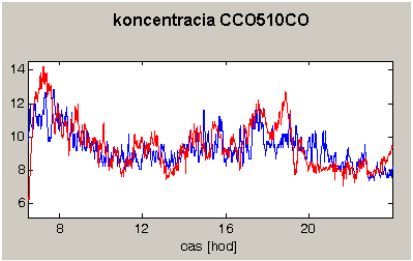

Fig. 6. Deterministic simulation – red/silver line.

This method showed graphically accuracy between simulated values and measured values. Although the simulated and measured data not fit precisely, this result is sufficient for most stochastic system like pollution inside the road tunnel. All mentioned validations are implemented in our developed software calls VTTas, made in MATLAB graphical interface.

The next work will include finding out the other factors causing to CO concentration inside the tunnel system. We can express the square of the correlation coefficient. This value represents the fraction of the variation in one variable that may be explained by the other factors. In our study we got the result, that traffic rate cause about 60 to 90 percent to final values of concentration inside the tunnel. We want determinate how affect the atmospherics and velocity to pollution and make connection between these models.

4. Conclusion

The paper presents a methodology that has been used for design parametric models of road tunnel system. We needs identification of system based on data obtained from the real ventilation system. Model from one week data has been created and verified in MATLAB environment. This part is the ground for best design of ventilation control system. Presented results point out that created model by identification method should be validate by several method.

Acknowledgement

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Slovakian Railways Transport as a Part of European Railway Network

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Abstract. This paper deals about the current situation of the railway infrastructure in Slovak republic, plans of its progress and implementation to the European railway network as well as the investment expenditures in transport infrastructure between particular transport modes. The paper includes also the distribution of the railway tracks in Slovakia by the AGC, AGTC and TEN.

Keywords: railway infrastructure, corridors, investment, transport modes

1. Introduction

Slovak Republic as a small country in the middle of the Europe, with the population density about 110 persons per km^2, has 3 658 km of railway lines. 3 509 km of this length is standard gauge (1435 mm), 50 km is narrow gauge and 99 km is large gauge. There are 2 491 km of single-track lines and 1 019 km of double-track lines in operation. 1 577 km of this railway lines are electrified, that represent 43,11 % of total length of railway lines.

Railway network density	74,609 km/ths.km^2	0,678 km/ths.inhabitant
Inland Waterways network density	5,116 km/ths.km^2	0,047 km/ths.inhabitant
Number inhabitants per 1 road vehicle	3,263	
Number inhabitants per 1 car	4,044	
Passenger transport per capita	7 582,326 pkm/cap	
Freight transport per Gross domestic product	20,067 tonnes.km/thous SKK	

Tab. 1. Basic data of transport in Slovak Republic.

2. Transport infrastructure in Slovak republic

In Slovakia the European Railway Network includes:

- 863,9 km of railway lines according to AGC,
- 1 023,9 km of railway lines according to AGTC,
- 1 415,0 km of railway lines included in the Network of Trans-European Multimodal Corridors.

Transport infrastructure of combined transport consists of transport network, terminals and warehouses. It is based on railway lines integrated in the network according to AGTC Agreement. Slovak area is operated by 7 terminals for combined transport, of which one is used for water-road-rail combined transport and others are used for road-rail combined

transport.

Background and implementation of development of SR transport infrastructure emerges from Principal Development Documents of SR Government and Ministry of Transport, Posts and Telecommunications of the Slovak Republic. Principal objectives and their achievements are aimed at:

- construction and modernization of the road infrastructure in routes of multimodal corridors No. IV, V and VI with priority construction of motorways and express highways that are part of international transport network TEM and TEN-T,
- modernization of railway infrastructure included in the network of Trans-European Multimodal Corridors,
- modernization o fair transport infrastructure according to Standards and Recommendations of ICAO,
- modernization of artery waterway – Danube (E80) and waterway Váh (E81) according to AGN Agreement and modernization of public ports,
- development of international combined transport terminals and supplementary terminals and transshipment centers,
- providing conditions for implementation of transport infrastructure development projects within structural funds.

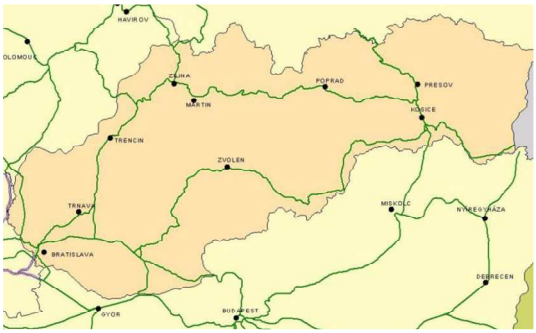

Fig. 1. Trans-European Rail Transport outline (2010 horizont).

3. Investment expenditures

Investment expenditures in transport infrastructure (excluding expenditures in urban roads) amounted to 1,46% of GDP in 2006, and distribution of investment expenditures between particular transport modes is in the table 2.

Infrastructure type	2003	2004	2005	2006
Railway	3 761 (124,8)	3 629 (120,4)	6 169 (204,7)	8 392 (278,5)
Road	8 724 (289,5)	9 611 (319,0)	13 895 (461,2)	14 439 (479,2)
Inland waterways	33 (1,1)	50 (1,6)	36 (1,2)	47 (1,6)
Air	230 (7,6)	455 (15,1)	1 243 (41,2)	503 (16,6)
Urban public transport	209 (6,9)	162 (5,4)	118 (3,9)	512 (17,0)
Total	**12 957 (430)**	**13 907 (461,6)**	**21 462 (712,4)**	**23 892 (793,0)**

Tab. 2. . Total investment expenditures in transport infrastructure (current prices) in mil. SKK (mil. EUR)

Road infrastructure	14 439 mill. SKK (479,2 mill EUR)	0,882% of GDP
Railway infrastructure (including in development of combined transport)	8 392 mill. SKK (278,5 mill. EUR)	0,513% of GDP
Waterway infrastructure	47 mill. SKK (1,56 mill. EUR)	0,003% of GDP
Air infrastructure	503 mill. SKK (16,6 mill. EUR)	0,031% of GDP
Urban public transport	512 mill. SKK (17,0 mill. EUR)	0,031% of GDP

Tab. 3. . Distribution of investment expenditures between particular transport modes in 2006.

4. Trend of transport performance

In the trend of goods transport are recorded declines mostly in all modes of transport in the reporting years. There was reported increase in the volume of goods carried in tones in compared to 2005, while volume of goods transported by road transport was increasing. In the structure of goods carried by modes road transport was predominant in the period of 1995-2006.

Year	1995	2004	2005	2006
Road transport (mil. tonnes-km)	26536	18517	22550	22124
Railway transport (mil. tonnes-km)	13674	9702	9374	10061
Inland waterway transport (mil. tonnes-km)	1468	721	740	649
Air transport (mil. tonnes-km)	1,8	0,6	0,8	0,8

Tab. 4. Freight transport performance.

In the trend of passenger transport are reported declines in all modes of public transport (except air transport) in the reporting years within continually growth of individual passenger road transport, however, there is slower decline in public modes of transport after 1995.

Year	1995	2004	2005	2006
pass. car transport (millions pass-km)	17977	25332	25824	26342
road public pass. transport (millions pass-km)	11191	7882	7525	7625
urban public trans. (millions pass-km)	3688	1330	1399	1403
rail public trans. (millions pass-km)	4202	2228	2182	2205
inland waterway transport (millions pass-km)	7	5	4	4
air transport (millions pass-km)	186	1569	2465	3107

Tab. 5. Passenger transport performance.

5. Railways corridors in Slovak republic

There are four main Europe international railway lines in Slovakia E-40, E-52, E-61 and E-63. The total length of them is 863,9 km.

E-railway line	track
E-40	(Ostrava ČD) - Žilina – Poprad Tatry – Košice – Čierna nad Tisou – (Čop UŽ)
E-52	Bratislava – Galanta – Nové Zámky – Štúrovo – (Szob MÁV)
E-61	(Břeclav ČD) – Kúty – Bratislava – Komárno – (Komárom MÁV)
E-63	Žilina – Leopoldov/Galanta - Bratislava

Tab. 6. AGC Railway Lines in Slovakia.

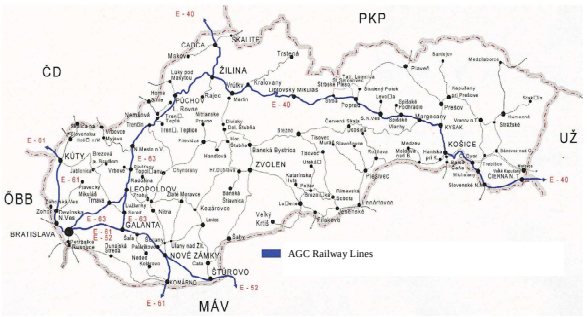

Fig. 2. AGC railway lines in Slovakia.

There are five main Europe international multimodal railway lines in Slovakia C-E 61, C-E 63, C-E 40, C-E 52 and C-30/1. The total length of them is 1 023,9 km.

C-E railway line	track	
C-E 40	(Mosty u Jablunkova ČD) – Čadca -	- Žilina – Poprad Tatry – Košice – Čierna nad Tisou – (Čop UŽ)
	(Horní Lideč ČD) – Lúky pod Makytou – Púchov -	
C-E 52	(Marchegg ÖBB) – Devínska Nová Ves – Bratislava – Galanta – Nové Zámky – Štúrovo – (Szob MÁV)	
C-E 61	(Lanžhot ČD) – Kúty – Bratislava -	- Komárno – (Komárom MÁV)
		- Rusovce – (Hegyeshalom MÁV)
C-E 63	Žilina – Leopoldov – Bratislava – (Kitsse ÖBB)	
C-30/1	(Muszyna PKP) – Plaveč – Prešov – Kysak – Košice – Čaňa – (Hidasnemeti MÁV)	

Tab. 7. AGTC Railway Lines in Slovakia.

Fig. 3. AGTC railway lines in Slovakia.

The total length of TEN-T railway lines is 1411 km in Slovakia. Network of TEN railway lines in Slovakia is at the figure 4.

Fig. 4. TEN-T railway lines in Slovakia.

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Quality in Railway Transport in the Relation to Transport Infrastructure

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Abstract. This paper is engaged in the influence of transport infrastructure over quality in transport. It is also one of the bases for the author's thesis with the title Delay from traffic and transport quality. The quality of transportation is heavily influenced by infrastructure quite. The main focus of this paper is only on the situation in railway transport thanks to the huge size of this problem. The railway transport has been chosen due to its problematic adaptability to acceptation of quality management. The main intent of this paper is on the time element in quality evaluation which has been detailed depictured in it.

Keywords: Quality railway transport, transport infrastructure, time standpoint.

1. Introduction

The view of quality in transport has been developing in time as well as the view of the general quality. The transport quality assessment has begun approximately since the fifties when the general quality assessment was in the fifth period of quality development. The biggest development of the transport quality assessment has taken place in recent years. This fact is thanks to competition among sort of transports. The endeavour of quality secure on corresponding level has become one of company goal.

The quality and the quality management in railway transport were against the background for a long time. This situation caused the unitary of railway companies. Europe has started fainting against this situation with acceptance of the First Railway Package in 2001. The transition to providing high quality services has been going slowly due to big size of original companies.

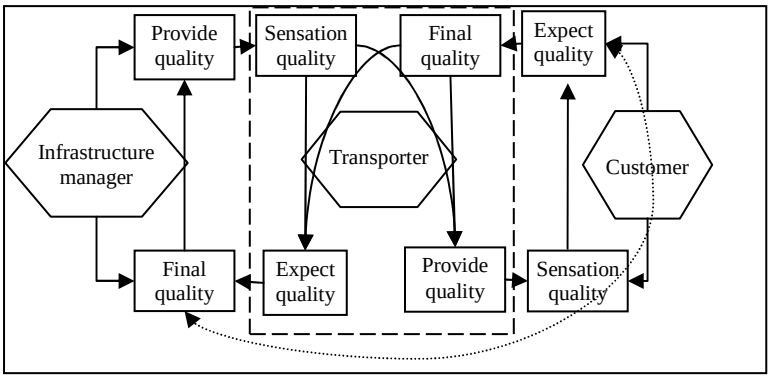
The quality of transport services in railway transport in the Czech Republic is abided by the standard ČSN EN 13816:2003 and the Passenger's Charter which have extended the IS0 9001:2001 standard for transport. The road carriers have been accredited with the certificate in recent years. Over 150 transport companies have been accredited till 3rd March 2009, but only one company of them is from railway sector [1].

The final customer observes these items during the quality evaluation [2]:

1) availability
2) accessibility
3) information
4) time
5) care of customers
6) comfort
7) safeness
8) ecological impact

2. Relation between Quality in Transport and Infrastructure

The quality in transport is necessary to observe from the customer view. An infrastructure manager ensures quality infrastructure. The infrastructure manager seeks to provide quality on the quality level which corresponds with the expected carrier's quality. The transporter doesn't ask only quality level for his needs, but he seeks to get such quality level as customer (passenger, carrier) look forward in his services – it means the expected quality (2).



Pict. 1. Relations in transport quality

The customers are searched a final service quality which they compare with the sensation quality. The selection of carriage's way is based on this confrontation (the customer's satisfaction grade). Therefore the infrastructure manager should also observe carrier's potential customer focuses.

The infrastructure can be the cause of divert from quality in the items availability, accessibility, time, comfort, safeness and ecological impact. This diversion is caused with infrastructure imperfections. The infrastructure is only one of items which influence the final quality of transportation, on the other side the quality of transportation is heavily influenced by infrastructure quite.

2.1. Availability

The availability is influenced with many factors. The traffic net density along with the stops distant from customer's places of interest is decisive for choosing from modes of transport. The passenger usually includes also the time for getting from and to station in the transportation time (1).

$$T_T^C = \sum_{i=1}^{n} \left(t_{ch}^{i;i+1} + t_{odb/w}^{i;i+1} + t_j^i \right) \cdot \qquad (1)$$

Where T_T^C is whole time for transportation between places A and B,

n is number of means of transport which were used,

t_{ch} is time which is necessary for walking (place A – stop, the platform of the first mean of transport – the platform of the second mean of transport, platform of the *n-th* mean of transport – place B),

$t_{odb/w}^{i;i+1}$ is time for check-in or waiting for the *i+1-th* mean of transport,

t_j^i is travelling time in the *i-th* mean of transport.

2.2. Accessibility

Stops and stations status and their facilities include high of platform and access on them.

The accent is setting on a barrier-free access at least in station building and some platforms.

2.3. Time

Infrastructure influences the time item in number of levels. Expect the availability; the length of travelling by mean of transport is depended on speed restrictions due to bad infrastructure status. Another relevant problem is a capacity of yards and routes. The lack of capacity has been manifesting recently especially thanks to an integrated tact timetable. The restrictive factors are number of track, track's length, lay-out of points, kind of interlocking, lay-out of platforms and access on platforms.

The failures of infrastructure have caused delays which passengers don't like. The Czech Railway's statistics [3] have said that 25 % of trains were late due to infrastructure difficulties in January 2009. It is possible to divide in more detailed parts. Tracks failures caused 18 %, interlocking caused 5 % and traction mains 2 %. In 2008 were 48 % of long-distance trains late for infrastructure difficulties. According to the author's monitoring can the delay's duration be from 5 to tens minutes in relation to a delay's reason. The delay dilemma increase according to the lack of capacity. This fact is manifested in delay transfers among trains.

The lay-out of infrastructure heavily affects technological times: turnaround of classic a train set (2) and general operations times.

$$T_{TR} = t_{uc} + t_{sh} + t_c \tag{2}$$

where t_{uc} is time which is necessary for powered vehicle uncoupling,
t_c is time of powered vehicle coupling,
t_{sh} is time for shouting.

With regard to scope of the paper the shouting time will be describe. The shouting time can be interpreted:

$$t_{sh} = t_r^{t-s.} + t_r^{s-p} + t_r^{p-p} + t_r^{s-t} + \sum_{i=1}^{3} (t_i^{ssr} + t_i^{usr}) + \sum t_{wfa} + \sum_{j=1}^{j} t_C \tag{3}$$

Where $t_r^{t\text{-}s}$ is ride from the train set to a signal,
$t_r^{s\text{-}p}$ is ride from the signal to the given point,
$t_r^{p\text{-}p}$ is ride on the other side of the station,
$t_r^{s\text{-}t}$ is ride from the signal (point) to the train set,
t_i^{usr} is time necessary for setting up the *i-th* shunt route,
t_i^{usr} is time necessary for upsetting of the *i-th* shunt route,
t_{wfa} is waiting time for fulfilment of next operation caused by infrastructure's unit occupancy with another operation,
t_C is time necessary for engine cab changing.

It is possible to make some simplification in the equation. The times t_i^{usr} and t_i^{usr} will be zero if we expect that the shunt route can be set up during powered vehicle uncoupling and ride. On the other hand the $t_r^{p\text{-}p}$ time can be divided in several parts if we expected that the shunt rout for powered vehicle is set up on the track which is already occupied by another train. In this case is necessary to wait for departure of that train and insetting of train route.

The situation is more complicated in stations, where is level access to platforms. The safety of passengers must be taken to account. If there are route signals in a station, is possible to use platform times which should avoid train driving in passengers of another train [4]. The increasing of the time of turnover has caused acquisition of new train set, or extension of interval between two trains.

The succession of train is realized with using arriving and departing betweentimes in junctions, this situation is based on using of the integrated tact timetable. This traffic organization has caused easy delays transfer between different trains. The additional times to travelling times and waiting times have been instrumental to delay's erasure. The standard UIC 451-1 has recommended addition of 3 minutes at the most to every big junction. Thinking about capacity in the CD D24 standard is going to be insufficient.

2.4. Comfort

The infrastructure has been manifested especially with its surface. It means geometric position, construction of long-welded rails and points with elevating frog in railway infrastructure. Adjustment of the infrastructure should be pointed at elimination of not necessary slow speed zones, because passengers don't want to be disturbed with frequent breaking.

2.5. Safeness

The safeness has been ensured by interlocking with elimination of human factor's influence or just his controlling. The construction of fly-over crossing has faced to higher passengers safety.

2.6. Ecological Impact

Steps in the infrastructure are aimed at lowering of noise level (anti noise screens, increase of curves radius) and at a protection of subsoil water.

3. Conclusion

To be able to involve all influences of the infrastructure's adjustment, it is necessary to use software for modelling processes in railway transport. Dynamic models are able to involve a traffic situation better than static models.

It is impossible to think that the infrastructure improvement ensures transport in high quality. Interaction between all quality's items can only ensures that provided or more precisely a sensation quality level gets near to an expected quality level.

The transport like service will have as quality as each of its items has. But locking of serviceable infrastructure is the basic presumption for successful traffic realization.

Acknowledgement

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New Load Securing Standard in Europe in 2009 as an Implementation of the Theory into Practice

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Abstract. As members of CEN/TC 168/WG 6 working group Load Restraint Assemblies we have prepared the new revision of the standard EN 12195-1 Load restraining on road vehicles. Safety. Calculation of Securing forces which shall be the new standard to design cargo securing arrangements for road transport in Europe. Which impacts the standard brings to the daily praxis are the topic of this paper with an explanation of the theoretical background for the frictional lashing against sliding as the most used lashing method in daily practice of load securing.

Keywords: cargo securing, frictional lashing.

1. Introduction

prEN 12195-1, that is a new version of the existing standard EN 12195-1 will be sent out for final vote and hopefully adopted by the end of this year. The new version of the standard is more in line with the **IMO/ILO/UN ECE[1] Guidelines for cargo transport units** (further as CTU[2] guidelines) and **IMO model course 3.18 Safe packing of cargo transport units** than what the existing EN 12915-1 is. The CTU guidelines are world-wide accepted for surface and water transport and also for intermodal carriage.

Among others, the CTU guidelines incorporate best practice procedures for visual inspections prior to packing, securing and packing cargo, additional advice on the packing and securing of dangerous cargoes, advice on the receipt of CTU's, basic principles for the safe handling and securing of CTU's.

CTU guidelines as an Annex to the IMDG[3] Code are obligatory requirements for safe packing of CTU's within the carriage of dangerous goods at sea. However, the IMO Model course 3.18 provides to the user load securing tables for different lashing and blocking methods based on certain calculation principle. When we compare this calculation principle with the principles in current EN 12195-1 the big disproportions are clear.

[1] IMO – International Maritime Organization, ILO – International Labour Organization, UNECE – United Nations Economic Commission for Europe
[2] CTU – Cargo Transport Unit
[3] IMDG Code – International Maritime Dangerous Goods Code

2. Difference among Calculation Principle

The following table gives basic design parameters according to the CTU Guidelines, the existing standard EN 12195-1 and the new version of the standard prEN 12195-1.

Parameter	CTU Guidelines IMO Model course 3.18	Existing standard EN 12195-1	New version of the standard prEN 12195-1
Acceleration coefficients			
Road transport – forwards - c_x	1 g	0.8 g	0.8 g
Road transport tilting sideways - c_y	0.5 g	0.7 g	0.6 g
Friction for frictional lashing method			
friction parameter– μ	static - μ_S	dynamic - μ_D	$0.925 \cdot \mu_S$
Friction for direct lashing methods			
$\mu \cdot f_\mu$	$f_\mu = 0.7$	$f_\mu = 0.7$	$f_\mu = 0.75$
k – factor for frictional lashing with 1 tensioner only			
k-factor	2	1.5	2
Safety factor for frictional lashing - f_S			
f_S	0	0	1.1 1.25 only road transport forwards
Static inclination tests and dynamic driving tests as an equal measure for cargo securing arrangements as theoretical calculations based on load and transport types			
	YES–stat. ; NO–dyn.	NO	YES
Frictional lashing against sideways tilting[4]			
Equations calculate with following parameters	$c_y = 0.5$ $F_T = S_{TF}$	$c_y = 0.7$ $F_T = S_{TF}$	MAXIMUM FROM $c_y = 0.5$; $F_T = S_{TF}$ OR $c_y = 0.6$; $F_T = ½$ LC
Frictional lashing against sideways tilting for rows of identical units			
Equations	YES - tables	NO the same equation as for one unit	YES
Equations for loop lashings and spring lashing			
Equations	YES - tables	NO – the same equation as for slope and diagonal lashings	YES
Defined measurement procedures to obtain static and dynamic friction coefficients			
	YES - static	YES – static NO - dynamic	YES
Friction value for sawn wood – fabric base laminate/plywood			
μ	$\mu_S = 0.5$; $\mu_D = 0.35$	$\mu_S = 0.5$; $\mu_D = 0.35$	$\mu = 0.45$

Tab. 1. Basic parameters to design cargo securing arrangements.

[4] F_T…tension force in the lashing line, S_{TF} = standard tension force based on measurement procedure, LC…lashing capacity

Following example describes the different number of top-over lashings to secure 24 tons of load on semi-trailer against sliding forward, sideways and backward with the headboard certified according to the EN 12642-L (blocking capacity 5000 daN) or EN 12642-XL (blocking capacity 13500 daN). The load is to be secured by lashing straps with $F_T = S_{TF} =$ 400 daN and angle between the lashing and the platform $\alpha = 80°$ for road transport for different friction value (μ_S ; 0.7 x μ_S ; 0.925 x μ_S). The number of lashing to prevent sliding is as follows:

$$n = \frac{m \cdot g \cdot \left(c_{x,y} - c_z \cdot \mu\right)}{k \cdot F_T \cdot \mu \cdot \sin\alpha} \cdot f_S \cdot \qquad (1)$$

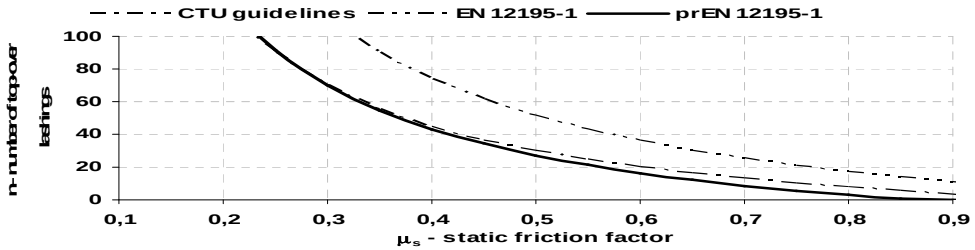

Fig. 1. Number of lashings to prevent sliding forwards for unblocked load

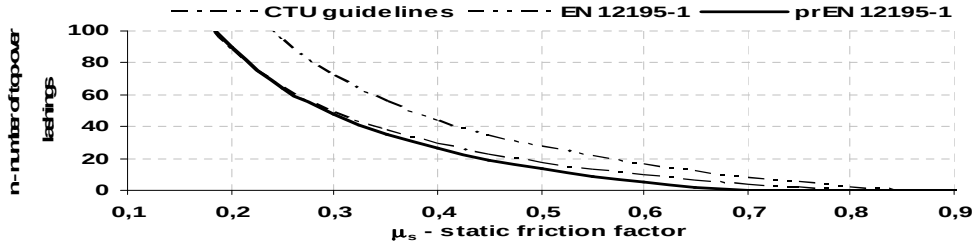

Fig. 2. Number of lashings to prevent sliding forwards for load blocked by the headboard EN 12642-L

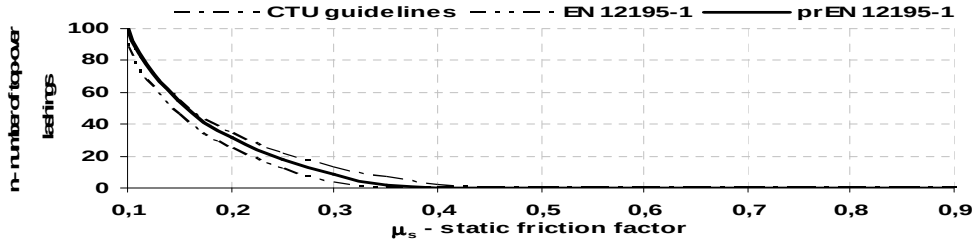

Fig. 3. Number of lashings to prevent sliding forward for load blocked by the headboard EN 12642-XL

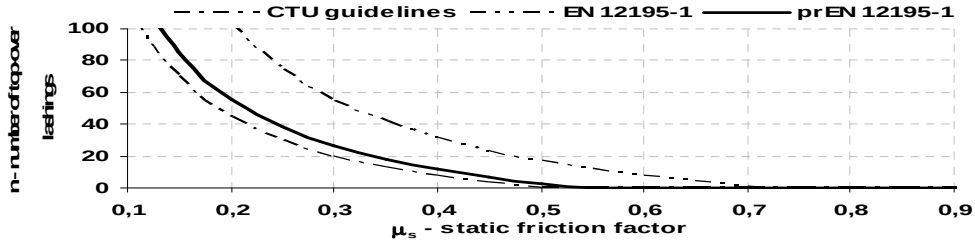

Fig. 4. Number of lashings to prevent sliding sideways and backward

For frictional lashing the standard prEN12195-1 is close to the CTU Guidelines. So we can say that our aim to get the new standard more in line with CTU guidelines has been fulfilled. This example shows the results for road transport only. Of course, the results for rail transport and sea transport are different.

3. Conclusion

The new standard prEN 12195-1 is more in line with CTU Guidelines and gives sufficient safety level. Calculation principles, static and dynamic friction tests, static inclination tests and dynamic driving tests shall be a standard tool to design load securing arrangements for road transport and intermodal transport road-rail-sea to achieve safe transport of load.

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Robust Planning Using the Computer Simulation

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Abstract. The paper discusses the methods of robust plans construction in railway transport using computer simulation. A strategy for creating the robust plan is presented and explained in detail. This strategy combines known methods for planning with computer simulation and allows creation of an executable robust plan.

Keywords: planning, scheduling, uncertainty, simulation, robustness.

1. Introduction

With the development of information technologies, planning and scheduling became an object of research for many scientists and also firms, trying to secure minimisation of their costs. There are many approaches to solve the problem of finding an optimal plan and later localisation of sources for its execution. Standard approaches are aimed especially at the mathematical description and solution of the problem by various numerical methods. The resulting plan obtained with such methods has a lot of limitations due to the stochastic character of many phenomena in the real world and its execution (carrying in the effect) is bound with a considerable risk of failure. More advanced methods are based on the continuously growing computing performance and the development of simulation software. Utilisation of artificial intelligence and simulation methods is frequent ([5]). To obtain the optimal plan is not the only goal anymore, instead we try to get a plan that will be robust enough ([2], [6]). Such a plan should be executable even under continuously changing conditions found in the real world.

Various simulation tools, mostly specialized for specific needs, are used for verifying the correctness of the plan. Without the simulation, the creation of more complex plans with random phenomena seems to be almost impossible. The possibility of verifying the rightness of already existed plans allowed creation new improved methods for planning stochastic systems.

2. Planning in Stochastic Medium

Planning is a method of creating a plan, where a plan is sequence of actions. These actions should be applied so, that the planned system gets from initial state to its goal state. The problem of planning in stochastic medium is more complicated, than in medium without uncertainties. If stochastic phenomena occur in the plan, then it is necessary to verify its enforceability. Enforceable plan is the plan, where all conditions during execution are fulfilled and it will not fail. The enforceability of the plan is an important quality, which is its necessary requirement during its creation. The enforceability of an optimal plan can be in a

real medium almost near to zero. It is important to verify the plan and its adaptation to current conditions.

The robustness is used for the comparison of plans regarding their resistance to changed conditions. Determining the robustness of the plan is an important part of planning in transport. Robust plan is a plan, whose quality and performance is not reduced during real execution due to already known uncertainties. The requirements on plan robustness are usually set already by the creation of the plan; however the need for robustness can be later increased. The problem of increasing the robustness of a plan lies in the necessity to measure robustness of the plan and also in the need for a method to integrate techniques for obtaining a robust plan into known process. It's necessary to notice that more flexible plan does not have to be more robust. For example, suppose that plan S1 is more flexible than S2; if S1 will have two critical paths and S2 only one, the chance of plan S1 failure is bigger than that of plan S2 – so the plan S2 is more robust. An investigation of the sensitivity and parametrical optimisation are part of the verification of plan's correctness.

3. Construction of the Plan of Transport System

Except many standard methods for solution the planning process, we know a lot of other methods that can be used in stochastic phenomena. It is necessary to describe mathematically the whole transport system, if we use the most standard methods. It often causes significant reduction of the problem and the plan can be inexact or non-executable. That is why the possibilities of computer simulation are nowadays used for creating more complex plans. The creation of complete seven days plan for the service of marshalling yard is without mathematical description almost impossible. This model would be computationally too complicated. It is necessary to create the initial plan by people with adequate knowledge about the transport system. Another possibility is to use methods that take into account the stochastic character of duration of individual activities. Then it is possible to test the robustness of the plan, or to use computer simulation for its improvement.

It is very suitable to use simulation for verifying the acceptation of the plan. The simulation enables to create a lot of optimizations and testing of the plan. During the creation of the plan it is also possible to use human experience. A user can on-line affect the simulation run. It is necessary to use the simulation for creating initial plan in the real conditions, since it is not possible to use standard planning process. The problem is to found out and describe solving problem and all relations between activities and sources.

According to knowledge about planning in a stochastic medium I developed the complex procedure of creation and optimization of the transport system plan. This method is demonstrated on the fig. 1.

The initial plan can be created by expert people with knowledge about the stochastic system. It is very suitable to use revision techniques that allow interactively changing the decision during the simulation run. With this method it is possible to solve problem parts in the plan until the plan is in time when a decision is needed to make. Using of this technique supposes the animation of simulation run. In case of existing systems the knowledge about actual working may be used.

Other possibilities how to get the initial plan is to use proactive techniques. In this technique it is needed to know which probability it is and which parameters it has. Information about probability distribution is not always available, so this technique cannot be used. It is a predictive method. All decisions in the planning process are made by taking into account the worst scenario that can happen during execution. It's clear, that this solution uses a lot of sources and time of the project will be too long.

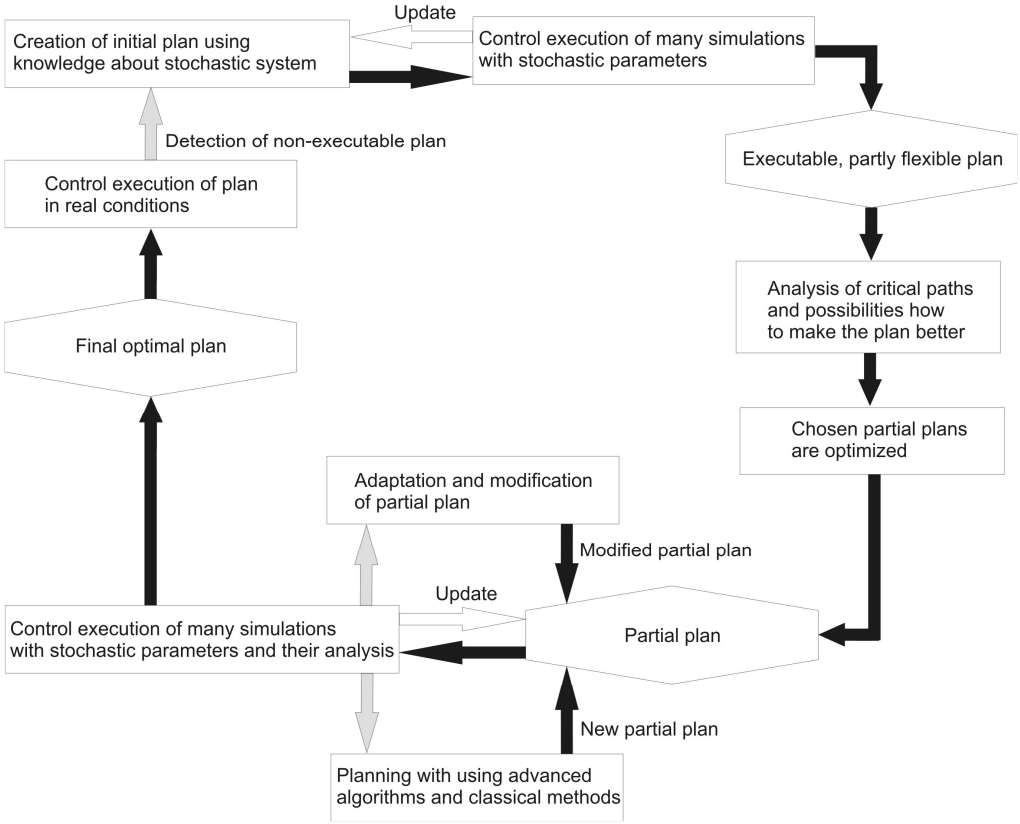

Fig. 1. Process of creating the plan of transportation system in stochastic medium using computer simulation

Instead of using the worst scenario it is possible to choose prolongations of activity duration at the beginning of the optimization. For the sake of simplicity, let us assume that only two types of variables exist in the project. The first is the vector of random variables "the duration of an activity" $C = (C_1, ..., C_n)$, where n is the number of activities. The second is vector of deterministic prolongations of activities duration $R = (r_1, \ldots, r_n)$.

Our prepared initial plan is probably very robust and therefore it has to be further formed in the following step. The plan analyser will be used, which executes Monte Carlo experiments on the plan. Sufficient number of replications is executed - each replication is an analysis of the plan (especially of its execution) with one realisation of vector R.

The measure of plan robustness is obtained as the result of this experiment. We can also obtain a lot of useful information about the real utilisation of reserves and so on. New plan is made by using values $(c_1 + r_1, ..., c_n + r_n)$. Based on gained information about the simulation runs with vector R we decrease some values of vector R and we run the simulation again. Decreasing of the values can be made by a human, automatically by the analyser or both together.

The task is to produce a robust plan with selected significance level α (e.g. $\alpha = 0.7$). It means that for vector R the plan can be executed with the probability α. Of course, in such plan time reserves must be present. Decreasing of the robustness of the plan causes higher utilisation of resources, which leads to decreasing in the amount of resources and compress of project duration. The process will be finished, when the measure of robustness approaches to chosen significance level α.

After finishing the initial phase of the plan creation is the plan executable, partly flexible and it has required robustness. This plan is based on the initial plan and for that reason it is suboptimal plan. Now we can analyze critical paths and possibilities how to make the plan better. The whole plan is suitable to optimize using progressive techniques.

The idea behind progressive techniques is to interleave planning/scheduling and execution, by solving the whole problem piece by piece. The plan is divided to some partial goals, which are planned separately. Partial plans are computed using revision and proactive techniques. Consequently they are verified and the partial goal is defined. Main advantage of this method is less memory consumption and decreased computing time. This process is very suitable by many uncertainties, where is a problem to get the whole executable plan. In this technique it is important to set the time horizon. After the horizon is reached the new goal state will be set.

According to the analysis of simulation runs of partial plans we can change some parts of the plan. On the short time section can be used classical planning or optimization methods. In case of specific requirements it is suitable to develop an ad hoc algorithm and use it for the partial plan. Another possibility is to modify the partial plan only, this can be made by a human or automatically by the analyzer.

The result of all processes is an optimized plan that fulfils requirements. The last phase is verification in the real praxis. This can be realized with complex computer simulation. In case the plan is non-executable, the depth analysis of causes is needed. This situation is mostly caused by wrong information about stochastic phenomena. Planning process can continue from the initial plan or from the modified plan.

4. Conclusion

Mainly due to the complexity and stochastic character, planning of transport systems is a challenging task. The method of construction and optimisation of the robust plan described here represents only one of the possibilities, how to create required plan, that will be usable under real conditions. Creation of a robust plan becomes more frequent requirement especially in the railway transport, where the delay of one train can cause delays of other trains. It is necessary to improve methods of planning, measuring the robustness of plans and especially methods to increase the robustness. The described method connects many advanced methods and allows to create an executable robust plan.

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Environmental Impacts of Air Traffic Operation

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Abstract. This paper describes how does Air traffic influences on environment and what should be in the total environmental footprint included. Less known traffic influences are mentioned and described. Expression Total Live Cycle Emissions model is slightly described and applied in Total Environmental Footprint of Air traffic. Purpose of this document is to provide general information about all ecological aspects of air traffic operation and to show possible way how to make the quantification of concrete impacts.

Keywords: Environmental Footprint, Total Live Cycle Emissions, Air Traffic Operation, Emissions, Indirect Environmental Impacts.

1. Introduction

Today's world needs huge volumes of the transportation. That is a fact. But there are many problems connected with it witch are solved by new technologies, better materials and many kinds of researches and case studies. The Environmental impact of traffic is one of the most discussed problems. Current situation can be described like a fight between economical and environmental interests with many of the compromises. These are often inconvenient right for ecological approach. Many experts warn us that the price of correcting current situation is high but price of eliminating damage caused by abidance in environment ruining is even much higher.

That is probably the main reason why many organizations and institutions are looking for the better – ecological friendly ways how to solve increasing volumes of the traffic and other aspects connected with it. There are often used some quantifications and comparisons of the environmental footprint and the total environmental footprint for various kinds of the transportation systems. Focusing only on the vehicle operation and considering only direct influences are the most common mistakes found in those studies.

Information what could be included in the total environmental footprint of air traffic, how to make the quantifications of the particular influences and explanation of some less known environmental impacts can be found in this labor.

In the second chapter of this article influences of the air traffic infrastructures are described. Indirect influences and influences connected with building infrastructures and their live cycle represents majority part of all ecological impacts of the air traffic infrastructures.

The aircraft operation environmental impacts are object of the third part of this paper. In compare with the infrastructures impacts indirect influences of the aircrafts operation seems to be lower than impacts caused directly by operating aircrafts.

2. Impacts of Air Traffic Infrastructures

The air traffic infrastructures direct influence is not so serious like in case of aircrafts. The most important part of their ecological impacts represents indirect influences and Total Live Cycle Emissions (TLC Emissions). These should be included in total environmental footprint.

The indirect influences are impact mostly caused during infrastructures building, maintenance and liquidation. For the quantification of these impact TLC Emissions model can be used. The TLC Emissions model uses mentioned three main ages of infrastructure live cycle. They are infrastructures building, infrastructures operation and liquidation of the infrastructures. Each transportation system is designed to operate for concrete amount of time. After this time reconstruction or liquidation of this system is required. TLC Emissions model counts all environmental impacts caused during all this three live cycles of transportation system and divides them for each year of transportation system operation equal. Some of the other important indirect influences are not included in TLC Emission model.

2.1. Air Transport Infrastructures Construction Environmental Impacts

Air transport Infrastructure composes of Airports, Air Navigation Aids and Air Navigation Services Provider's facilities. This labor is focused mostly on airports and air navigation aids.

First influence of this environmental impacts category is The Energy Consumption. During infrastructures construction huge amount of energy is consumed. Electricity and Fossil Fuels represents main part of consumed energy. During manufacturing energy and energy consumption a lot of pollutants are released in environment. Most relevant of them are CO_2 and NO_X Emissions.

Next category of impacts is closely connected with previous one and can be presented like its subcategory. It is CO_2 and NO_X emissions produced during construction vehicles activity. This influence can be counted more easily then total energy consumption. One of the ways how to make quantification of amount CO_2 and NO_X emissions is based on number of mechanisms used on infrastructure construction, their hourly rate fuel consumption and time of their usage.

Third important indirect influence of transportation infrastructures is environment pollution caused during producing materials used on infrastructure building. Main part of pollution represents energy consumption and chemical and mechanical reaction in material manufacturing processes. Another group of this category influences is connected with engineering plants existence. During their operation energy consumption is done and that means pollution production. Also engineering plants takes large areas of arable land. This type of impact is called Land Take.

There is also a waste production in transportation infrastructure construction processes. This waste must be recycled or placed somewhere usually in to the ground and that is again pollution. In addition during waste elaboration energy is used.

Natural biotope change is another of this influences category. Many impacts belong here. For example it is land take, water absorption change, land bioproduktivity change, local temperature increase and others. These influences description can be presented in detail study.

2.2. Air Transport Infrastructures Operation Environmental Impacts

In compare with infrastructures construction influences this category of impacts represents smaller environment pollution. Infrastructure operation influence ratio depends

mostly on technical perfection of the infrastructure what affects all partial environmental impacts occurred in this influences category.

The most important environmental impact coming under infrastructures operation influences is again energy consumption. Each technical device needs to consume some volume of energy for its correct function. Energy consumption of Air transport infrastructures compose mostly of electricity and fossil fuel consumption. This energy is used to power airport buildings, airport light systems, air navigation aids, technological systems of airports (fuel feeding, compressed air generating and distribution etc.), aircraft maintenance, communication systems, control and checking systems and many others. Energy consumption will be counted as CO_2 and NO_X emissions like in case of infrastructure construction.

Second group of infrastructure operation influences is represented by maintenance and repairs infrastructures. Most important components of this influences category are maintenance and repairs of Runways (RWY), Taxiways (TWY), Aprons (APN), visual navigation equipment and monitoring systems, airport periphery arrangement, general maintenance and seasonal maintenance. To this actions can be done energy and materials supplies are necessary. Also some volume of waste is produced.

3. Impacts of Air Traffic Vehicles - Aircrafts

This influences category will be divided into two main parts like for infrastructures influences (production and operation). TLC Emission model will be used as well. In this case impact of aircraft operation will be more relevant.

3.1. Aircrafts Production Environmental Impacts

Many of the aircraft production environmental impacts are similar with infrastructures construction impacts. Only character and quantities of pollution are slightly different. Live cycle of the aircraft compose again from next three phases: production, operation and liquidation. TLC emission principle is the same like in case of infrastructures live cycle.

First category is again represented by energy consumption. Compared to infrastructure construction energy consumption in this case electricity is used mainly. CO_2 and NO_X emissions represent environment pollution over again.

In aircrafts production processes many various wastes are produced and must be recycled or putted somewhere. It is the same situation like in infrastructures construction with just one difference. These wastes are more disparate and composed of more toxic components. This is why the costs of activities connected with this type of waste are higher.

Materials used in aircraft production are more involved. It means more mechanical and chemical pollution and energy consumption in material productions processes.

Aircrafts has large dimensions so they need to be fabricated in large halls. These buildings represent another of indirect aircrafts production influences. Constructing building only to produce transport vehicles is standard practice (KIA Motors Slovakia, Peugeot – Citroen Slovakia, etc.). These impacts are the same like in infrastructure construction case.

3.2. Aircrafts Operation Environmental Impacts

First and most important category of aircrafts operation environmental impacts is the energy consumption as always. Current situation represents fossil fuels usage like energy source for all commercial aircraft. Calculate fossil fuel consumption like CO_2 and NO_X emissions is the best way how to figure this environmental pollution. There is one significant problem with aircraft CO_2 and NO_X emissions. Aircrafts operate in high altitude so emissions are released into the ambient air far from the Earth surface. Degradation of CO_2 and NO_X

emissions in here is much more complicated than close to surface and that means more extensive environment damage.

One of the most relevant impacts is a noise. All large airports must solve this problem. The fact is that much more people are annoyed by road traffic noise than noise produced by aircrafts. This topic is well known and often discussed so detail description in this article is not necessary.

There are many other environmental influences connected with aircrafts operation. Most relevant of them will be just listed in this part of the labor. They are Vibrations, Additional Materials and Components Usage (spare parts, oil, water, etc.), Aircrafts Maintenance and Repairs, Wastes Production (wearied out components, discarded vehicles, etc.), Animals Killing (bird strikes, on runway collisions, etc.) and Accident Damages (as first live losses and injuries but also toxic materials emissions, wastes production – damaged vehicles or parts of them).

4. Conclusion

People need transportation like was mentioned at the beginning of this article. It is just about us to care to this necessity do not cases damaging our planet. It is about us to look for ways how to protect environment. It is about us to find better solutions and apply them to a real live. To we can do that we need to know laws of nature we need to know how we affect them we need to know what do we wrong and what can be done better.

This paper shows us what unwanted effects of traffic are. This paper describes total environmental footprint of air traffic. Total live cycle emission model principle is described. Also indirect negative influences of traffic are mentioned and described.

This article can be used like a guide or recipe for more exact traffic environmental impact study.

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European Transport Policy and Road Accidents in 2008

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Abstract. The Development of road transport is also connected with negative effects. The most significant negative effects include increased accident frequency, environmental damage, the increasing number of casualties and heavily injured, huge physical damage as well as environmental damage. The aim of national plan for road transport better safety till 2010 is very ambitious; i.e. to decrease the number of casualties by 50% compared to 2002.

Keywords: traffic accidents, European transport policy, national plan for increasing the road safety, casualties.

1. Introduction

The issues of road transport and the consequences of traffic accidents represent a serious social problem affecting all the spheres of human activities. Therefore, the solution of such issues requires a complex and rational approach.

The Slovak Republic executes many activities to improve road safety. The Council of Slovak Government for traffic safety continues to realize the recommendations to improve traffic safety and to implement the recommendations into practice with respect to all the participants to traffic.

2. European Transport Policy

The European Commission urges the member countries of the European Union to increase road safety. Traffic safety is declared in the White Paper dated 2001 – the European Transport Policy till 2010 – Time to Decide as well as in the European Action Program for Traffic Safety.

The basic goal is represented by efforts to decrease casualties till 2010 by 50%, and the starting point is the year 2002. The European Commission does not leave traffic safety to chance, and within the framework of medium-term review of the European action program for traffic safety dated 10.02.2006 concludes that "generally, safety on roads of the European Union is improving. In past, progress was faster, but there is still some space for improvement. Constructive actions were taken in all the relevant spheres as infrastructure, behaviour and vehicles. The European Union and member countries as well as all the other countries should, within the framework of "joint liability", act to a larger extent and in a better manner in order the ambitious common target might be achieved. Therefore, the European Commission will study further measures within the framework of medium-term revision of the White Book on transport."

As many as 40 000 people die in Europe due to traffic accidents per year. According to the provisions of the European Charter, the number of casualties in the Slovak Republic

should decrease to 300. Unfortunately, Charter No. 1 indicates that current development is different.

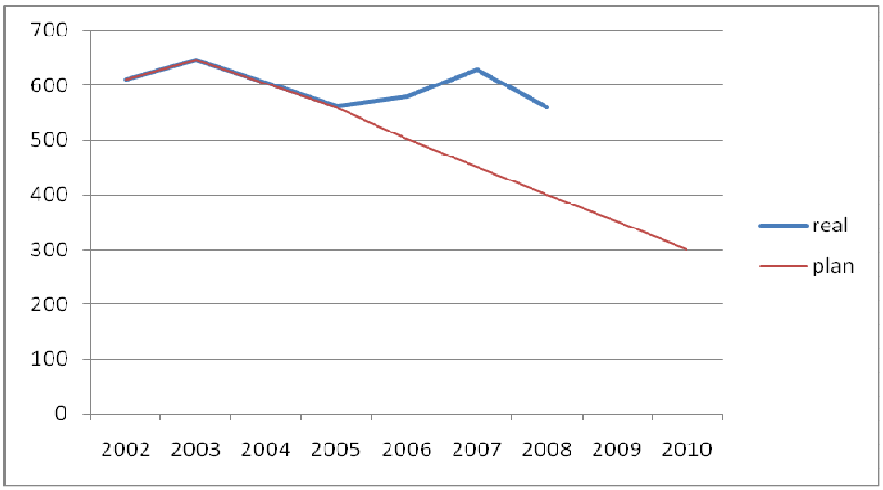

Fig. 1. Accident chart

2.1. National Plan on Improving Traffic Safety

The Slovak Republic executes activities to improve traffic safety. The Slovak Ministry of Transport, Post and Telecommunication is a guarantor of these activities, and in 2005, the **National Plan on Improving Traffic Safety** was prepared up to 2010.

The national plan BECEP is based on the detailed analysis of previous development with respect to traffic accidents as well as on experience resulting from the implementation of measures for individual relevant government departments.

The proposal of measures is structured according to the following spheres:

A. Safety of vehicles,
B. Safety of ground communications,
C. Transport and public education,
D. Health education and transport psychology,
E. Traffic safety legislation,
F. Supervision of traffic safety and continuity,
G. Promotion by mass media,
H. National coordination,
I. International cooperation.

The execution of proposed measures requires the coordination of all the involved authorities and institutions, including the determination of concrete responsibilities with the purpose to achieve a complex and integrated target.

3. Accident Frequency in the Slovak Republic

Accident frequency is also significantly influenced by the number of vehicles in traffic. With respect to the large number of vehicles participating in traffic and their continuous

increase, it can be concluded that the consequences of accidents do not show a steep increase. Unfortunately, accident frequency does not reach the target as it was determined.

Year	Casualties	Number of vehicles	thereof: passenger cars	Physical damage in SKK million
2002	610	1 833 818	1 326 891	3 263.66
2003	645	1 879 854	1 356 185	3 815.72
2004	603	1 945 809	1 397 692	4 023.38
2005	560	1 801 117	1 277 795	3 999.87
2006	579	1 841 275	1 333 749	4 232.71
2007	627	1 989 824	1 433 926	4 515.71
2008	559	2 158 181	1 544 888	4 500

Tab. 1. The statistical review of accident frequency, casualties and the number of registered vehicles

With respect to statistical indicators, the number of casualties in 2002 - which was 610 on Slovak roads - represents the basic indicator for the evaluation of the development of traffic casualties according to the criteria of the EU .

Statistics of accident frequency in the Slovak Republic (comparison between 2008 -2007)		
Accident frequency in the Slovak Republic	Year 2008	Difference compared to 2007
Total of traffic accidents	58 996	-2075
Casualties	558	-69
Seriously injured	1 974	- 242
Slightly injured	9 194	-80
Accidents caused by motor vehicle drivers	51 843	-1 887
Accidents caused by drivers of other than motor vehicles; thereof children	546 117	-185 -40
Accidents caused by pedestrians; thereof children	926 267	-31 -31
Alcohol	3124	+14

Tab. 2. Statistics of accident frequency in the Slovak Republic in 2008.

The main causes of traffic accidents in 2008:

- Violation of basic obligations 20 529x
- Inappropriate driving 18 069
- Excessive speed 7 582
- Wrong traffic priority 4 616
- Incorrect overtaking 1 019
- Technical defect 28

The most frequent types of accidents can be characterised for the following cases:

- Collision with a going non-rail vehicle,
- Collision with a parked vehicle,
- Collision with a fixed barrier,
- Others,
- Accident of vehicle itself ,
- Collision with a pedestrian.

The most frequent accidents with respect to communication network:

- Roads of class I.
- Roads of class II.
- Roads of class III.
- Motorways,
- Monitored, unmonitored and other communications.

Act No. 8/2009 Coll. on traffic operation and seq. valid since 01.02.2009 should also contribute to the decrease in traffic accidents as well as the increased penalties for drivers who will not follow this law.

4. Conclusion

Safety on roads relates to all of us and is represents a tool for ensuring the sustainable development of society. The goal to decrease casualties on roads is an ambitious challenge. The European Commission, in its last report, calls for more radical initiative and progress, being aware that the target is ambitious.

During the existence of the first half of European program for traffic safety, Slovakia succeeded to reduce its annual number of casualties on roads by 9%, contrary to other countries that exceeded 25% during the same period of time. However, Slovakia shows better results in comparison with the countries of Visegrad Four.

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The Risks in Connection with Road Transport of Dangerous Goods

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Abstract. The aim of the contribution is to highlight the emergency of potential risks in handling and transportation of dangerous goods by road. The contribution offers also statistics of traffic accidents of vehicles transporting dangerous goods. Paper describes the use of the system DINS as one of the options of eliminating the consequences.

Keywords: risk, dangerous goods, traffic accident, rescue system

1. Introduction

Road transport has observed after the Second World War, almost in all countries the sharp development. At present, it is because of the availability of effective and irreplaceable and comprehensive transport system. Even in the Slovak Republic dramatically increases its importance in connection with the development of the economic base and increasing living standards.

However, with the increasing intensity and volume of road traffic is steadily stronger impact of negative accompanying characters, the problems that combines the creation and functioning of the executive transport system.

Taking into consideration the transport of dangerous goods, serious accidents involving toxicity, flammability, explosiveness, radioactivity or other characteristic of dangerous goods, can be extremely costly in terms of loss of human lives, environmental degradation, the cancellation of transport, etc. On the other hand, the total ban of dangerous goods transport by road is unthinkable. [2] Problems and the issue of dangerous goods, safety during transportation and procedures for traffic accidents, they are currently devoted considerable attention to the right.

2. The Legislative Framework for the Road Transport of Dangerous Goods

The issue of chemical substances and preparations and protection against its adverse effects in the Slovak Republic, begun to address comprehensively and in accordance with the chemical legislation. The transport of dangerous goods is governed by the two basic agreements: [1]

a) The Basel Convention.
b) European agreement concerning the international carriage of dangerous goods by road – ADR.

a) The Basel Convention. No.60/1995 Coll. on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

The Basel Convention was drafted under the auspices of UNEP (The United Nations Environment Program) and adopted in 1989 in Basel. Entered into force on 5th May 1992. The adoption of the Basel Convention in international life, introduced a control mechanism for cross-border shipment of hazardous wastes, in which incorrect handling may have a negative impact on the environment and human health. The Basel Convention was ratified by more than 160 Contracting Parties. The main objectives of the Basel Convention are:

- reduction of cross-border shipment of hazardous wastes and other wastes defined by the Basel Convention with minimal consequences for the environment,
- the destruction incurred by hazardous wastes and other wastes, and as close to their place of occurrence,
- ensure strict control over the movement of hazardous wastes and the prevention of illegal shipments,
- prohibit shipments of hazardous wastes to countries that have inadequate legal, administrative and technical capacities for the management and disposal of these wastes in an environment, etc.

b) ADR Agreement

ADR agreement (accord europeen relatif transport international des marchandises dangereuses par route) was concluded in Geneva on 30.9.1957 at the UN Headquarters. Annex A of ADR include provisions on dangerous substances and articles. Annex B of the ADR contains provisions on means of transport and shipment. On 17.5.1996 the SR approved the Law on Road Traffic No. 168/1996 Coll as amended (Act no. 58/1997 Coll), which governs the national transport of dangerous goods according to the ADR. In practice, the control of road operated by the Contracting Parties to ADR and failure of its provisions may result in the imposition of sanctions by national authorities under their national laws. ADR Agreement itself does not sanction.

3. Risks Arising from the Handling of Hazardous Items

The dangerous goods are substances which have one or more hazardous chemical properties. In connection with the release of DG for handling may lead to serious damage to health, property and environment. [2]

3.1. The Risks in the Handling of Dangerous Goods

When handling operations, which can include loading, unloading and transhipment, dangerous situations can occur, which may result in leakage of DG:

a) defect in the handling and the subsequent escape of DG
b) exceeding the total weight of the vehicle and its axle loads permitted,
c) using of improper packaging,
d) a breach of fundamental obligations for the handling of dangerous goods, etc.

3.2. The Risks for the Transportation of Dangerous Goods

In the carriage of dangerous goods may be a risk of a leak, not only the influence of improper placement or attachment of cargo, but the risk of leakage in road accidents. Road accidents of vehicles carrying DG pose a big problem, because the leakage of transported DG and may cause permanent damage to health, property or the environment.[2]

a) Traffic accidents, caused by the vehicle or the driver of the vehicle transporting DG:

These accidents occur to a less extent in comparison with all the traffic accidents. Accidents are usually caused by:

- Changes in the driver skills.
- Non-safety regulations.
- Low quality training for ADR.
- Speed, etc.

b) Traffic accidents, not caused by the vehicle or the driver of the vehicle transporting NV

These accidents are caused by the driver of another vehicle eventually other road users. In these cases it is primarily a violation of the law č.8/2009 Coll. Traffic on the roads. Therefore, the elimination of such accidents should be the drivers and other road users to be more respectful and follow:

- A safe distance and spacing.
- Ensure the required speed.
- To comply with other rules of the road.

4. Accident Statistics

The traffic accidents are the negative phenomena of transport from the beginning of its existence. In Table No. 1, you can see the number of traffic accidents in 2008 compared with the number of traffic accidents in 2007. [3]

Number of traffic accident / year	**2008**	**2007**
total	58996	61075
persons killed	558	627
severely injured persons	1794	2036
slightly injured persons	9194	9274

Tab. 1. Statistic of traffic accidents 2007 - 2008

In Table No. 2 you can see the number of accidents of vehicles carrying dangerous goods in 2008 compared to the year 2007. [3]

number / year	**2008**	**2007**
total	213	200
persons killed	1	4
severely injured persons	8	9
slightly injured persons	27	34
total material damage [€]	751 340	867725

Tab. 2. Statistic of accidents of vehicles carrying dangerous goods.

From the above survey, it is clear that the number of road accidents of vehicles carrying dangerous things on the road is around 190 to 220 accidents per year. On the number of road accidents is the most represented a breach of fundamental obligations and driving the wrong way. The most common culprit of road accidents in the Republic of Slovakia as drivers of motor vehicles, following the accident the fault of forest game or domestic animals are also to pedestrians, drivers of non-vehicle, and not least the technical problem of vehicles or other undetected fault. [see Illustration No.1]

4.1. Transport and Hazard Information System

In 1990 The CEFIC (European Chemical Industry Council) introduced program ICE (International Chemical Environment) which aims to coordinate, at the international level, existing national system of voluntary aid vehicles in accidents with dangerous goods. Therefore the Association of the Chemical and Pharmaceutical Industry (ZCHFP) of the Slovak Republic has created a voluntary system to minimize the consequences of accidents of vehicles carrying DG. Transport Hazard and Information System (DINS) began the practice after signing the Agreement between ZCHFP SR and the Ministry of the Interior - Bureau HaZZ[1] in August 2001. Its aim is to provide accurate information, advice and further assistance in case of accidents. The base of the system is a network of centrals and one coordinating center (CKS), which provide assistance within its means to transport accidents involving dangerous goods. The system is built on a voluntary basis and provides free assistance HaZZ units in three stages:

1) Provision of information:

If there is an accident in the transport of DG and paramedics have a lack of information for the hazardous substance, the CKS will look in its database some expert. The role of the expert is only consultative.

2) Qualified board at the place of accident

If the intervention unit does not have enough practical experience with the chemicals, they can request via DINS the professional technician. Experts involved in the elimination of consequences of accidents on the spot of accident.

3) Technical assistance on-site accident

If the response units of HaZZ are not able with its technical means to limit the consequences of an accident, call the CKS request for technical assistance.

5. Conclusion

Transport of dangerous goods in the transport market occupies a special position. Economic and industrial development makes explosive, toxic, corrosive or otherwise dangerous substances and articles in an increasing extent transported by road. This is the risk to which such transport is linked to the environment, as well as carriers increasingly. To eliminate risk is to be treated individually but rather to address practical issues relating to the adequate equipment of vehicles and drivers, design of safe transportation routes, ensure quality parks and emergency stopping lane for the driver, etc. Generally it can be said that with increased shipments of dangerous goods by road transport is increasing the potential risk. Although this is governed by the legislation (the ADR), or we can not guarantee zero traffic accidents and accidents with this particular shipment.

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[1] HaZZ - Fire and rescue brigade

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Theoretical Analysis of the Vehicle Crash Compatibility Using Classic Mechanics

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Abstract: The article deals with crash compatibility between vehicles with different masses. To understand basic relations between vehicle mass, velocity change, deceleration and deformation distance the fundamental laws of classic mechanics are used – law of conservation of energy and law of conservation of momentum.

Keywords: crash compatibility, crashtest, passive safety, deceleration, deformation distance

1. Introduction

Research in the area of passive safety of road vehicles was in the past focused on the protection of own passengers. The vehicle and its means of passive safety are constructed in the way to prevent marginal and supramarginal load of the occupant body. However, this fact puts essential question in the air: if we create vehicle that will protect its own occupant what is the influence of the vehicle to the occupant in other vehicle?

2. Crash Compatibility of Colliding Vehicles

The issue can be explained with the help of classic mechanics. Both vehicles have certain value of kinetic energy (because they are on the move) that is directly proportional to their mass and square of their velocity:

$$E_{k1} = \frac{m_1.v_1^2}{2} \qquad E_{k2} = \frac{m_2.v_2^2}{2} \tag{1}$$

According the law of conservation of energy is the sum of kinetic energies before (crash) impact equal to the sum of kinetic energies after impact and deformation work that was done on both vehicles (the vehicles are not absolutely rigid bodies). This sentence can be arranged in following form:

$$\frac{m_1.v_1^2}{2} + \frac{m_2.v_2^2}{2} = \frac{(m_1 + m_2).\ u^2}{2} + F.(\Delta s_1 + \Delta s_2) \tag{2}$$

v_1 and v_2 are impact speeds of vehicles
u is common speed after the impact
F is deformation work
Δs_1 and Δs_2 are deformation distances on the vehicles.

Likewise, according the law of conservation of momentum it is valid that sum of momentum of both vehicles before impact is equal to the sum of momentum of vehicles after impact:

$$m_1.v_1 + m_2.v_2 = (m_1 + m_2).u \tag{3}$$

From that it results for common speed after impact:

$$u = \frac{m_1.v_1 + m_2.v_2}{m_1 + m_2} \tag{4}$$

For the relative speed of both vehicles before impact it is valid:

$$v_r = v_1 - v_2 \tag{5}$$

and for the change of speed it is obvious that:

$$\Delta v_1 = v_1 - u = (v_1 - v_2).\frac{m_2}{m_1 + m_2} = v_r.\frac{m_2}{m_1 + m_2} \tag{6}$$

$$\Delta v_2 = v_2 - u = (v_2 - v_1).\frac{m_1}{m_1 + m_2} = v_r.\frac{m_1}{m_1 + m_2} \tag{7}$$

From last two equations results an interesting information: the change of vehicle speed in the collision with other vehicle depends only on their relative speed and their masses. If the masses of both vehicles are equal thus both vehicles are exposed to the equal change of speed. But if one vehicle is heavier than the other the problem is on the way. If two vehicles collide and one is two times heavier than the other the changes of speed are as follows:

$$\Delta v_1 = \frac{2}{3}.v_r \text{ (light vehicle)} \tag{8}$$

$$\Delta v_2 = \frac{1}{3}.v_r \text{ (heavy vehicle)} \tag{9}$$

If each vehicle travels with speed 50 km.h^{-1} thus their relative speed is v_r = 100 km.h^{-1}. The speed change of light vehicle is 66 km.h^{-1} and speed change of heavy vehicle is 33 km.h^{-1} – striking disadvantage of light vehicle is obvious.

Vehicles that are introduced to the traffic must fulfil certain mandatory requirements. Part of the requirements concerns vehicle ability to ensure certain surviving chance for an occupant in a case of traffic accident – thus some level of passive safety. Vehicles are tested by means of crashtests and the level of passive safety of a vehicle can be further evaluated by consumer tests like EuroNCAP.

Let's consider crashtest of the aforementioned vehicles. Assume that achievable magnitude of deformation distances is in both vehicles equal, e.g. 0.8 m. The initial parameters are simplified for better understanding: crashtest to the rigid barrier, plastic deformation, impact speed of 50 km.h^{-1}, deceleration of passenger compartment is 30 g ≈ 300 m.s^{-2} and masses of vehicles are m_1 = 1000 kg and $m_2 = 2.m_1$ = 2000 kg. Characteristic of ideal force – deformation distance dependency shows figure 1. It is obvious that to achieve biomechanical tolerable value of passenger compartment deceleration (30 g) the heavy vehicle must be stiffer (c - stiffness of front part of the vehicle, F = c.Δx, where F is deformation force and Δx is deformation distance).

In case of frontal collision of these vehicles a deformation happens on both vehicles thus certain part of kinetic energy transforms to deformation work:

$$W_1 = \int F dx_1 = \int c_1 x_1 dx_1 = \frac{1}{2}.c_1.x_1^2 \tag{10}$$

$$W_2 = \int F dx_2 = \int c_2 x_2 dx_2 = \frac{1}{2}.c_2.x_2^2 \tag{11}$$

By comparing the deformation work performed on both vehicles:

$$\frac{W_1}{W_2} = \frac{c_1.x_1^2}{c_2.x_2^2} = \frac{F.x_1}{F.x_2} = \frac{x_1}{x_2} = \frac{c_2}{c_1} \tag{12}$$

we find out that the amount of "dissipated" energy in crash (by means of the deformation work) is in inverse proportion to the stiffness of the deformed part. Thus, a stiffer vehicle is deformed much less than vehicle with low stiffness.

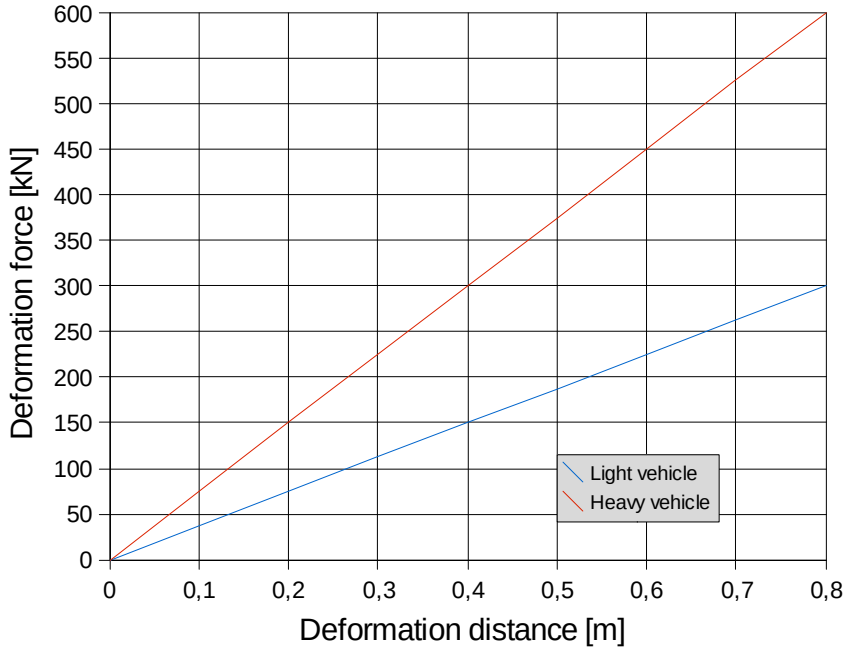

Fig. 1 Ideal force – deformation distance characteristic

From the analysis it is obvious that heavy vehicle is more "aggressive" in collision with light vehicle thus a collision creates bigger velocity change in lighter vehicle. The result from this velocity change is bigger value of deceleration and subsequently bigger value of force load that acts on occupant. In addition, as both vehicles are optimized in crashtests in manner to protect its own occupant so their stiffness differs and subsequently the redistribution of deformation work between vehicles is uneven. This fact creates an excessive deformation of lighter vehicle what can lead to passenger compartment violation. This is the worst case scenario – the functionality of passive safety systems can be nullified. If the safety belt system (safety belt, belt pretensioner, load limiter) is optimized to hold the deceleration in biomechanical tolerable value through certain distance (e.g. 0.35 m) thus by passenger compartment interruption can be this distance shorten to the distance of 0.20 m. The occupant body hits rigid obstacle (displaced steering wheel, dashboard, etc.) and the function of the system is cancelled.

3. Conclusion

Ensuring vehicle crash compatibility is not a simple matter considering a heterogeneous vehicle park that is in operation in traffic. A basic scope should be lower stiffness of the deformation zones of the heavier vehicles to ensure bigger deformation of such vehicle in collision with lighter one. A reduction in heavy vehicles stiffness should be compensated (to ensure sufficient protection of its own passenger) by bigger length of its deformation zone. This simplest theoretical principle is not always achievable because of practical reasons and therefore the deformation zones must be optimized to possess different stiffness characteristics in various parts of these zones. This construction can ensure protection of own occupant as well as protection of human being in other vehicle.

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A Contribution to the Traffic State Estimation by Means of Image Processing

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Abstract. The success of traffic simulations depends largely on the simulation model validity and on accuracy of input data. For input data acquisition, video cameras are used to survey the traffic at junctions or at other places along the road to collect video data. The velocity, distance between the vehicles, acceleration and other relevant parameters can be extracted from the collected data. The estimated values are used for calibration of the simulation model. The data, that has to be collected for calibration or validation of the simulation systems, differ from country to country. For that reason, the data must be collected and the simulation model calibrated, each time when modeling a different traffic area. The more accurate the obtained parameters, the more accurate the traffic simulation would be. The image processing methods and the expected accuracy of traffic state estimation, such as vehicle position, speed and acceleration, is discussed in the paper..

Keywords: microscopic systems, transportation simulation, error estimation, image processing

1. Introduction

There are many areas of traffic applications, where the estimation of the traffic states is necessary. A variety of methods can be applied, depending on the environment, i.e. the objects in the scene and many other factors. This paper concentrates on the estimation of traffic states necessary for calibration of the traffic simulation models. Furthermore, the traffic states of interest are position of the vehicle, its velocity and acceleration. Also in this subfield, there are many possibilities, how to obtain the mentioned traffic state values. The important characteristic of the estimated traffic states is the acquired data precision. There are not many known results on defining the methodology, which investigates all possible error sources during the process of traffic state evaluation. The main goal of this paper is to contribute to the methodology for the error estimation. The traffic applications that can profit from this work are the traffic simulation systems, which have to be calibrated and its calibration has to be validated.

The chapter 2 describes the car following model. This model is used in many the traffic simulation models and will be also considered in this work. The third chapter describes the common framework structure for vision surveillance systems. The error sources are identified and the proposal how to estimate them. The final chapter 4 is the conclusion and the outline of the future work.

2. Car Following Models

Microscopic traffic flow models simulate the behavior of single traffic participants. The dynamic variables of the model for the simulated vehicles are the position and the velocity of the single vehicle. There are many models used in traffic simulation, which basically belong to two major groups: car-following models and cellular automation models. For this work the model of interest was the car-following model.

Car following models are also known as time-continuous models, since the transportation flow is modeled as a continuous process not a discrete one.

The car following process is depicted in Figure 1, [1]. The vehicles are considered inertial systems. All vehicles are modeled with the same average characteristics: the average length L_V, the average speed v and the average distance L from the previous vehicle. The parameter L_S is the minimum safety distance between the vehicles.

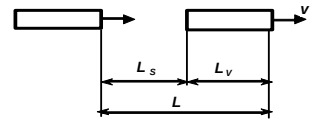

Figure 1. The Car Following Process

The basic characteristics of the transportation flow are:

v – Speed [m/s] or [km/h],

K – Density [veh/m] or [veh/km],

Q – Traffic volume (intensity) [veh/s] or [veh/h].

(Alternative units *km* and *h* are ofen used in transport as an alternative to the standard ones.)

The density stands for an average number of vehicles on a unit road length. It can be estimated as

$$K = \frac{1}{L} \tag{1}$$

The traffic volume is defined as an average number of vehicles that pass a certain point on a road during a unit time interval. The following equation defines the basic relation among characteristics of a steady flow

$$Q = K * v \tag{2}$$

The calibration of the microscopic models is a challenging task. The simulation system must be accurate in order to be applicable for solving the transportation problems.

After the calibration parameters are chosen, the simulation model must be validated for its accuracy. The formal representation of how the model corresponds to reality is as follows:

$$\Pr\left[\left|reality - simulation\_prediction\right| < \delta\right] > \alpha \tag{3}$$

The symbol δ in the formula represents the difference between the simulation model and reality, α is the probability that the acceptable difference δ is respected, [3].

The inputs for the simulators are of various forms and origin. Geometric inputs, like lane width, junctions etc, are available through documented map sources. Others are obtained by calibrating the system, i.e. using the field data. The field data can be classified in the following categories.

- Parameters that can be directly estimated from field data (vehicle mix, arrival rates, turning percentages)
- Parameters not directly measurable (drivers aggressiveness)
- Tuning parameters that are not measured in the real traffic but are required in the model (free flow speed, lost time)

The traffic states can be determined by the statistical analysis of traffic flow data observed from surveillance videos. The vehicle characteristics include vehicle length, maximum speed, and maximum acceleration and deceleration rates.

3. Vision Surveillance Framework

This chapter explains the framework of such a system and shows the layer where this work aims to search for the error sources.

Nearly every visual surveillance system starts with motion detection. Motion detection aims at segmenting regions corresponding to moving objects from the rest of an image. Subsequent processes such as tracking and behavior recognition are greatly dependent on it. The process of motion detection usually involves environment modeling, motion segmentation, and object classification, which intersect each other during processing.

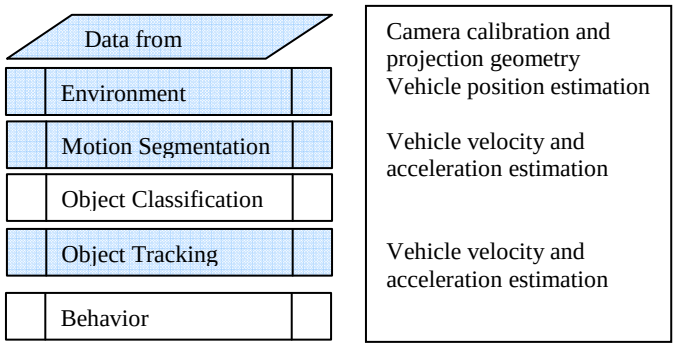

Fig.2 Vision Surveillance Framework

After motion detection, surveillance systems generally track moving objects from one frame to another in an image sequence. The tracking algorithms usually have considerable overlapping with motion detection during processing. Tracking over time typically involves matching objects in consecutive frames using features such as points, lines or blobs. Tracking methods are divided into four major categories: region-based tracking, active-contour-based tracking, feature based tracking, and model-based tracking.

Behavior understanding involves the analysis and recognition of motion patterns, and the production of high-level description of actions and interactions.

The described framework shows the sequence of steps used for the traffic surveillance. For each step there is a possibility to choose between different methods, depending on the application of interest. Each chosen method in each framework step is an error source. For estimating traffic states in this work, the following steps depicted in *Fig.2* will be considered:

- Data from Camera
- Environment Modeling
- Motion Segmentation

- Object Tracking

The possible errors when collecting data from camera are related to the camera calibration and projection geometry. Errors due to environment modeling relate to the precise estimation of the vehicle position. The possible errors during motion segmentation and object tracking are related to the estimation of velocity and acceleration. The problems to solve are how to estimate the real dimensions from a video picture, depending on the camera position and the road position in the video image. It is possible to use the GPS to measure the position of the chosen landmarks. The accuracy of GPS measurements is in the range of 0.01m to 15m.

The second error source is the quantization both in time and in space. The traffic states are derived from the sequence of video images. The position of the vehicle is evaluated in each video frame. These values give information about the velocity and acceleration. The video sequence is discrete in time, since it consists of individual frames, and in space, since the image consists of individual pixels. The filtering that can be used is important as well as the influence of the sampling frequency on the accuracy of results.

The frequency of frames is an important parameter for the calculation of velocity and acceleration. The frequency has the influence on the velocity and acceleration error. There is a minimum frame frequency necessary for evaluation of vehicle velocity and acceleration, depending on the range of the observed traffic states. It is possible to determine, through the theoretical analysis, what frequency rates, depending on the measured velocity, are sufficient, so that the increase of frame frequency above this value results in no significant decrease in error.

4. Conclusion

The further work will concentrate on the implementation steps. The implementation of the image processing methods as a software program should enable the practical validation of the proposed method improvements. The video data collected with the cameras should be processed. The calculated traffic states are going to be used as the calibration parameters of the simulation model. The simulation model at the University of Žilina will be soon available and will be used for the further work. The model should be calibrated with the gained traffic states from the previous step. The simulation will deliver the simulated traffic sequences, which can be used to verify the results. Based on these results, the final evaluation of results and conclusion will be made. The statistical evaluation of the results will be also performed.

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The Correlations between Vehicle Operation Conditions and its Start-Up Engine Parameters

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Abstract. The knowledge of the correlation between the operation conditions of the truck and its engine is very important. This paper presents the canonical statistics analysis which is the result of the field research of the LUBLIN III delivery truck owned by the Polish Postal Service. This analyze allowed to define the relations between the chosen vehicle operation conditions and its engine start–up parameters.

Keywords: engine start-up, vehicle operation, canonical analysis.

1. Introduction

The knowledge of the correlation between the operation conditions of the truck and its engine is very important. For example this correlation can help the car and its engine design which should be oriented towards the future operation. Also the investigations of this relationship can help to determine the influence of the trucking organisation on the emission of the toxic compounds of the exhaust gases from the engine. For these reasons we should carry out estimate the correlation between vehicle operation condition and its engine start-up parameters.

This paper presents the canonical statistics analysis which is the result of the operational research of the LUBLIN III delivery truck owned by the Polish Postal Service. This analyze allowed to define the relations between the chosen vehicle operation conditions and its engine start–up parameters.

2. Field Tests

The field research was carried out using LUBLIN III delivery truck (maximum authorized total weight < 3,5 t) used by Polish Postal Service in Lublin. This truck has the 4CT90 combustion self-ignition engine produced by a Diesel Engines Factory „ANDORIA S.A." in Andrychów. The engine was characterized by the following general data: the cubic capacity: 2,417 dm^3, max. power 63,5 kW at 4100 rpm and develops a maximum moment 195 Nm at 2500 rpm. The engine was fitted with an in-line fuel injection pump.

A special recorder constructed to register the selected parameters of LUBLIN III operation and activity of the 4CT90 engine was mounted. Gathered data were later processed off-line using the PC computer. The data were analysed by a computer programme STATISTICA.

3. The Canonical Statistic Analysis of Chosen Parameters

The authors carried out the canonical analysis to estimate the connections between the two sets. The first set of variables is connected with the organization of the vehicle routes in the Polish Post Branch Lublin transport system and they are the characteristic of the vehicle work conditions:

X_{tpra} – the time of the engine operation before its next starting [min], X_{tpos} – the time of the pause in a vehicle operation with the engine switched off before the start-up [min], $X_{ltł}$ – the distance covered by the piston before the engine start-up [km], X_{lpoj} – the distance covered by the vehicle before the engine start-up [km], $X_{Tpł}$ – the engine temperature (coolant temperature) at the engine start-up [°C], X_{Tol} – the oil engine temperature at the engine start-up [°C].

The second set of the variables represents the engine start-up parameters:

X_{Imax} – the maximum value of the intensity of the current consumed by the starter in a first step of the engine start-up [A], X_{Umax} – the voltage applied at the starter at the maximal current intensity [V], X_{Pmax} – the power consumed by the starter at the maximal current intensity [W], $X_{Iśr}$ – the mean current intensity, which occurs when the starter drives the engine crankshaft during the start-up [A], $X_{Uśr}$ – the mean voltage, which occurs when the starter drives the engine crankshaft during the start-up [V], $X_{Pśr}$ – the mean power, which occurs when the starter drives the engine crankshaft during the start-up [W], $X_{tprzył}$ – the time of applying the voltage at the starter [s], X_{troz} – the time of the engine start-up [s].

The system of the canonical variables for these sets assumes:

$$\begin{cases} U_i = a \cdot \dot{X}_{tpra} + b \cdot \dot{X}_{tpos} + c \cdot \dot{X}_{ltł} + d \cdot \dot{X}_{lpoj} + e \cdot \dot{X}_{Tpł} + f \cdot \dot{X}_{Tol} \\ V_i = k \cdot \dot{X}_{I\max} + l \cdot \dot{X}_{U\max} + m \cdot \dot{X}_{P\max} + n \cdot \dot{X}_{Isr} + o \cdot \dot{X}_{Usr} + p \cdot \dot{X}_{Psr} + r \cdot \dot{X}_{tprzył} + s \cdot \dot{X}_{troz} \end{cases} \quad (1)$$

where: U_i – the canonical variable, which represents the group of the vehicle work parameters, V_i – the canonical variable, which represents the group of the start-up engine parameters, $\dot{X}_i$ – the following standardized variable for the analyzed parameters.

For the results of the operational researches we can state (on 95% level of the confidence) that only the first four canonical roots (from six possible ones) the system of the canonical variables has the canonical correlation significantly different from zero. The value of the coefficient canonical of the correlation is shown in table 1. We can see that the first distinguished canonical element describes very good the canonical dependence between to analyses sets of the parameters.

Number of the canonical root	The coefficient of the canonical correlation		
	The value of the coefficient	Value χ^2	Value p
1	0,8253	1763,58	0,001
2	0,4623	374,620	0,001
3	0,1859	81,726	0,001
4	0,1500	38,950	0,002

Tab. 1. The coefficients of the canonical correlation.

Basing on the analysis of the coefficients of the first system of the canonical variables occurring in table 2, we can state that the oil engine temperature at the engine start-up X_{Tol} provides the decisive contribution to the canonical variable $\boldsymbol{U_1}$, which represents the group of the vehicle work. The parameters in this group have the following order: the distance covered by the piston before the engine start-up $X_{ltł,}$ the distance covered by the vehicle before the

engine start-up X_{lpoj}. For the canonical variable $\boldsymbol{V_2}$, which represents the group of the parameters of the engine start-up decisive contribution have: the mean power, which occurs when the starter drives the engine crankshaft during the start-up $X_{Pśr}$, the mean voltage $X_{Uśr}$ and the mean voltage $X_{Iśr}$.

The parameters of the coefficients of the first system of the canonical variables				The parameters of the coefficients of the second system of the canonical variables				The parameters of the coefficients of the third system of the canonical variables				The parameters of the coefficients of the fourth system of the canonical variables			
Parameter				Parameter				Parameter				Parameter			
a	-0,0969	*k*	-0,0287	*a*	1,2160	*k*	1,1210	*a*	1,6640	*k*	-2,6558	*a*	2,3770	*k*	-2,2481
b	0,0683	*l*	0,0185	*b*	0,3833	*l*	0,6216	*b*	0,9330	*l*	-1,9386	*b*	-0,5102	*l*	-1,9825
c	0,2466	*m*	-0,0357	*c*	-2,6842	*m*	-1,5397	*c*	-3,1158	*m*	2,9940	*c*	-5,6876	*m*	1,8170
d	-0,2055	*n*	-2,0211	*d*	1,4055	*n*	-6,0806	*d*	1,2301	*n*	3,2957	*d*	2,7551	*n*	7,7625
e	0,0785	*o*	-2,4268	*e*	-1,1345	*o*	-9,5008	*e*	1,1710	*o*	6,7019	*e*	-0,2621	*o*	13,319
f	0,9771	*p*	2,7110	*f*	0,9756	*p*	9,3660	*f*	-0,5603	*p*	-6,3115	*f*	0,1235	*p*	-12,939
		r	-0,4683			*r*	0,7518			*r*	0,3896			*r*	-0,2373
		s	-0,0852			*s*	-0,3780			*s*	0,3218			*s*	-0,4613

Tab. 2. The value of the coefficients of the systems of canonical variables.

Basing on the analysis of the coefficients of the second system of the canonical variables occurring in table 2, we can state that the distance covered by the piston before the engine start-up $X_{lłł}$ provides the decisive contribution to the canonical variable $\boldsymbol{U_2}$. The parameters in this group have following order: the distance covered by the vehicle before the engine start-up X_{lpoj}, the time of the engine operation before its next starting X_{tpra} and the engine temperature (coolant temperature) at the engine start-up $X_{Tpł}$. For the canonical variable $\boldsymbol{V_2}$ the order of the decisive contribution is the same as in the first system of the canonical variables.

The variant isolated for the first canonical root in the first sets of the parameters, which represents the group of the vehicle work, is equal 100%. It provides that this root explains the whole internal variability in this group. The integral redundancy for the first group of the parameters, which explains how many internal variability is explained the second group of the parameters, is equal 23,57%. For the first canonical root in the first set of the parameters, which represents the group of the start-up engine parameters the isolated variant is equal 90,30%. It means that the selection of the parameters for the groups is good. The integral redundancy for the second group of the parameters, which explains how many internal variability is accounted by the first group of the parameters, is equal 26,69%.

Value of the parameter					Value of the parameter					Value of the parameter				
a	—	*k*	-0,7562	Coefficient of the canonical correlation	*a*	—	*k*	—	Coefficient of the canonical correlation	*a*	—	*k*	-0,0444	Coefficient of the canonical correlation
b	-0,0309	*l*	-0,4548	0,6834	*b*	-0,1809	*l*	—	0,6834	*b*	-0,0908	*l*	—	0,6834
c	—	*m*	0,8690	The isolated variant of the set U_i	*c*	—	*m*	0,2292	The isolated variant of the set U_i	*c*	—	*m*	—	The isolated variant of the set U_i
d	-0,1008	*n*	0,9370	100%	*d*	-0,0518	*n*	—	100%	*d*	-0,1282	*n*	-0,3626	100%
e	1,0086	*o*	2,2623	The isolated variant of the set V_i	*e*	0,9105	*o*	—	The isolated variant of the set V_i	*e*	0,9806	*o*	—	The isolated variant of the set V_i
f	—	*p*	-1,9182	56,36%	*f*	—	*p*	0,0418	56,36%	*f*	—	*p*	—	56,36%
		r	-0,7107	The integral redundancy of the set U_i			*r*	-0,8698	The integral redundancy of the set U_i			*r*	-0,9134	The integral redundancy of the set U_i
		s	0,0791	22,30%			*s*	—	22,30%			*s*	—	22,30%
				The integral redundancy of the set V_i					The integral redundancy of the set V_i					The integral redundancy of the set V_{if}
				16,74%					16,74%					16,74%

Tab. 3. Values of the coefficient of the canonical variables, the canonical correlation, isolated variant and integral redundancy in the groups which have not strong correlation between parameters.

When we exclude from the canonical analysis the parameters which strongly correlate between each other we can notice the relationship between the groups of the parameters either.

It is confirmed by the results of the third group of the parameters which is presented in table 3. The level of statistically significance for the calculation of the coefficients of the canonical correlation is equal p=0,001.

When we exclude from the canonical analysis the parameters which are strongly correlated, we can state that the value of the canonical correlation reduces about 20%. These results show that the distinguished parameters are not explain enough to the engine start-up and the internal complexity of this process.

4. Conclusion

The canonical analysis of the chosen vehicle and its engine work parameters showed that four crucial statistical canonical roots exist. First of them is the best to describe the correlation among the analyzed parameters. In this root the oil engine temperature at the engine start-up X_{Tol} provides the decisive contribution into parameters which represent the group of the vehicle work parameters. In the first root the mean power is the most decisive in the group of the start-up engine parameters. The values of the canonical analysis show that the start-up process is internal complicated either.

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Inputs for the Model ´System for Passenger Attendance in a Urban Public Transport´

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Abstract. This paper presents the approach for founding well-function system of passengers attendance in cities or bigger regions. It can be also used for little towns or regions. There are described the first step for model. It is collecting, analysing, and sorting of data. Data are separated in some logical groups. Each data must be explained in some metric unit or by some special coefficient. Outgoing data is tariff which can be used for solution. Then it could be again analysed according to other criteries. All relations, entering and outgoing data are described on figure.

Keywords: passenger attendance, model, data, parameter, tariff

1. Introduction

The passenger attendance in a public transport makes one part of integrated system of mass urban transport in the cities. The creation of a well functioning system is not easy. It is necessary that this system would be effective for the city carrier in terms of economy, public, technology and ecology, too. For the passenger, there is important travelling time and economical point of view. There are proposed some groups of data entering into the model of system for passenger attendance.

2. Entering Data for the Model

Entering data for the model to define a suitable tariff system for a city or wide region can be divided into some logical groups. Each group of data contains some other entering data. Each entering datum (parameter) must be measurable and define a specific unit. For example, the length of road in kilometres, number of passengers in seconds, break time in seconds. For data, which could not be exactly specified, must be defined a coefficient expressing its statement.

2.1. Technological Data About Line

The first group of data are technological data about the line. This group contains these data:

- number of lines (number) which have to be operated within existing area,
- number of connections (number) on each line during 24 hours (day and night schedule),
- pick-up point distances (m) and number of stop points (number) on each line,
- lenght of the line (km),
- travel time (min) on each line,
- pic-up point time (s).

Number of lines: We can assume, that we know the number of lines.

Number of connections: Number of connections and theirs distribution during the day and night schedules have to satisfy transport claims of passengers.

Pick-up points distance and number of pick-up points: In mass urban transport is usual that the distance between two pick-up points in central parts of city is aroud 300 – 400 m. In suburban areas it can be around 400 – 600 m [2].

Length of the line: Length of the line is a distance which is measured according to the transport route on which the public transport line is operated from the first to the last pick-up point [2].

Travel time: Travel time is the time which the vehicle of public transport needs to move between two points by driving on transport road with suitable technical speed [2].

Pick-up point time: Pick-up point time is the remaining time of vehicle, which stopped on the pick-up point.

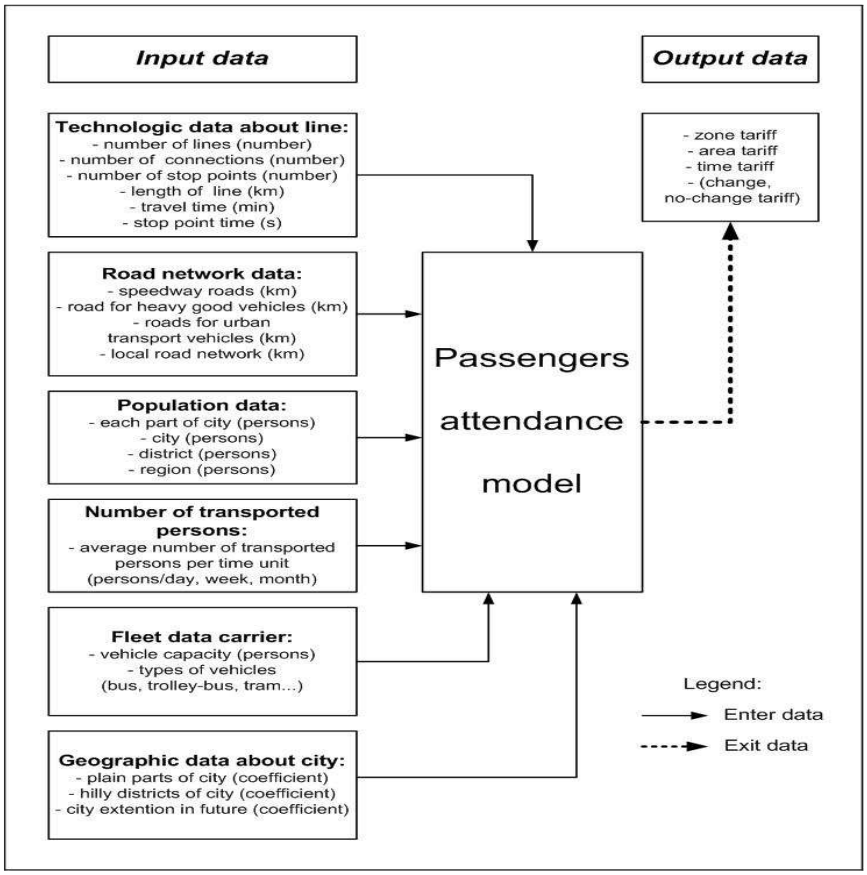

Fig. 1. Passengers attendance model

2.2. Road Network Data

The second group of data entering to the model are data about the road network. This group contains following data.

- speedway roads (km),
- roads only for heavy vehicles (km),
- roads for urban transport vehicles (km)
- local road networks (km).

At the beginning have to be realized the first analysis of all road networks for the solved area. Speedway and roads only for heavy vehicles are not suitable for the installation of urban transport lines. On this roads, there should be a special bus lane, which would be used only by urban transport vehicles. The final solution of this analysis is that for the installation of urban transport are suitable some roads in the city and selected local roads in some length. It is also important that on each end of the line have to be created a rest place for vehicles.

2.3. Population Data

Next group of data is about population in each part of the city. It is important to know which part of the city or neighbourhood is the most populated. If this part is in the centre or on suburban area. Thus some geographic deployment of population. This issue is closely connected with the population movement. The movement of inhabitants is influenced by demographic and sociological actors, such as age, gender, employment rate, icomes, lifestyle, work offer, civic amenities, transport operation, degree of automobilism, weather and seasons [2].

2.4. Average Number of Transported Persons

Another very important fact is an average number of transported persons in a time unit (persons/month). Time interval can be represented by day, week, month or year. It is important to know the source road and destination of each passenger, thought his direction. It is possible to get this fact from a carrier. Concerning the model, it will be necessary to define one number for each city district telling us about the overall number of population, who move from one city district to another in a time unit, usually one month. The objective is to define the size of each transport connection between the two city districts for the source roads as well as the final ones [1]. This datum can be defined as the addistion of all the got in or got out passengers on all the pick-up points in a concrete city district. There would be considered the average number for one month. This number, or the demand of passenger for the transport, would a basis for the lines proposal and their alingment in individual city districts.

2.5. Fleet Data

Another important group of data entering in the model of passenger attendance are fleet data including:

- Vehicle capacity (persons),
- Number of individual types of the vehicles (number) within the fleet (bus, trolley, tramway, ...).

Normal capacity: Normal capacity is limited by the transport quality requirements and comes from the following facts:

- 0.2 up to 0.25 m^2 of a useful area for one place aimed to the standing – it means 5-4 persons per m^2
- 0.315 m^2 of a useful area for one place aimed to the sitting [2].

Maximal capacity: - is counted from a useful weight using an average passenger´s weight. Maximal capacity comes from the following facts:

- 0.125 m^2 of a useful area for one place aimed to the standing, which is 8 people per 1 m^2
- 0.315 m^2 of a useful area for one place aimed to the sitting.

For the needs of the model would be considered the capacity of 80% from the maximal capacity. It would be possible to change the above mentioned fact according to the carrier´s requirement (higher value in %) or higher passengers´ comfort (lower value in %).

It will be necessary to ddefine the vehicles used in the mass passenger transport according to the types purchased by a carrier. It involves buses, trolleys, or tramways. The input for the model will be a coeficient from the interval 1 up to 2 (1,1 1,2 ...2). Coeficient can serve to define the comfort rate of a concrete vehicle, vehicle´s equipment, ecological factor, etc.

2.6. Geographical Facts

The last group of facts represents a geographical character of the city or region. Plain parts of the city will possess coeficient 1. City districts located in the hills will possess coeficient from the interval 1,1 up to 2. Koeficient can also identify the extention of the city construction in the future.

3. Conclusion

Another part of the work will be to look for a suitable model for passenger attendance. The output of the model should be a design of a suitable tariff system for a concrete city (zonal, area, time tariff). A suitable passenger attendance system would be chosen according to the tariff. It would be possible to use the model for the choice of the suitable passenger attendance system for already existing city or for prognosis. I would like to use for the model multicriterial system for decision about each data entering into the model. I will to observe how will entering data influece another after entering data into the model.

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Alternative Possibilities of Financing of Personal Public Transportation

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Abstract. Important characteristic of services provided by personal public transportation is fact that state and local government should periodically participate in high level to financing and operation. Guarantee of personal transportation by bus, or by train involving ever more of financial sources. More over this fact, requirement of maintenance aged systems and are increasing it is become fact of detach centres of working and accommodation, which is presenting the progress of differences between cost of operation and incomes to transportation enterprises.
Necessity of additional financing is in contradiction to present trend of reductionist public financial supports to general services and therefore we can say that public sources reserved by government to transportation are always unsure.
Financial support is in present cover by fiscal incomes. Capable offices collect allocated part of incomes of various taxations, which hereafter are used to financing support of public transport of persons.
Therefore is necessary to look for a possibilities of additional financing sources, it is possible to take as example many countries, where it is used to financing untraditional categories of taxations, charges and deliveries.

Keywords: financing, person public transportation, taxations, tax, untraditional system of financing, source of financing

1. Complementarily sources of financing of person public transportation in the world

There is wide range of implemented and projected systems, which is possible to separate to following categories [1]:

- taxations of employers and employees,
- property taxations,
- developing deliveries,
- parking fees and penalizations,
- fees for using of communications,
- locally taxations of motor conveyance,
- excise taxations,
- financing by cross-utility,
- additional untraditional charges.

In connection with said is necessary to think with, that each of follow complementarily source of financing means supplementary burden to users of transport, possibly to taxpayers.

Majority of untraditional systems of financing is implemented as source of financial funds in consequence of shortage of accessible public finances. It is possible to say, that

everyone systems have indirect connection to environmental problems, because public transport is from environmental attitude considered to more acceptable as individual transport. Nearly all systems create an important source of financing, what is very frequent first primary reason of theirs acceptance.

2. Evaluation results of untraditional systems of financing of person public transportation

Outputs deduced of various identified evaluation untraditional systems of financing are presented in table 1:

Category	Main results
Taxations of employer/employee	- elementary and practical mechanism with low costs, which can be very effective provided for certain and great financial resources - acceptability at first time problematic, but where is traffic system considered to problematic, may firms intensively help to deal with this problem
Property taxations	- elementary and practical mechanism with low costs, which can be very effective provided for certain and great financial resources - charges of recipients - in North America is subject to ratification by voters
Developing deliveries	- convertible system, which is practically changeable in each identify examples - usually small extent of implementation, but high acceptability
Parking fees and penalizations	- elementary and practical mechanism with low costs, which can be very effective by provide for certain and great financial resources - acceptable and convertible system - connected with both transport policy, and also with environment policy
Fees for using of communications	- flexible and transparent system with great potential to support of public transport - acceptability is problematic - connected with both transport policy, and also with environment policy
Locally taxations of motor conveyance	- great source of incomes, dependent on travelling models - convertibility is dependent on fiscal structure - in routine practice acceptable as taxation of fuels, in North America is demanded ratification by voters - connected with both transport policy, and also with environment policy
Excise taxations	- have predisposition to be received, as is necessary ratification by voters , but must be fill meaning of sociable comprehension - important source of incomes, even though impacted by external factors
Academic surcharge and airport fee	- effective, if open up specific service, which in otherwise isn´t be offered

Tab. 1. Main evaluation results of untraditional systems of financing [1]

It is possible to say, that the most of innovative financing methods and technologies have potential to create great and relative stable source of income. It is important to remark that each spoken case of untraditional way of financing public personal transportation is specific and its utilization and possible success depends on regional conditions, for example tax structure, acceptability of institutional, legislative, public and etc. [1]

3. Alternative sources of financing public person transportation in Slovak Republic

In condition of Slovak republic VÚC (superior territorial area or district) should utilize from shown possibilities as a source of financing:

- tax of motor vehicles 100%,
- tax of realty,
- tax of entrance into historical part of town,
- tax of utilizing of public area,
- consumable taxes,
- fee of road utilizing.

Utilizing of these financial sources should be important, but it will be necessary legally registered them.

The following table shown expensive for transportation – ordinary and investment of VÚC budget, grant for SAD companies (Slovak bus transportation companies), but also the value of financial sources obtaining from taxes of motor cars should be utilized as a new possibility of obtaining finance.

VÚC	Ordinary expenses	From that donation for SAD	Rest	Investment expenses	Tax of motor vehicles
Bratislava	188 700	85 700	103 000	49 441	540 404
Trnava	312 600	152 000	160 600	23 550	320 500
Trenčín	546 276	236 684	309 592	65 491	288 855
Nitra	631 050	241 476	389 574	25 538	393 750
Žilina	386 000	146 805	239 195	10 000	300 000
B. Bystrica	579 000	210 000	369 000	41 758	285 000
Prešov	610 000	195 000	415 000	30 000	260 000
Košice	564 593	313 370	251 223		310 000
Sum	**3 818 219**	**1 581 035**	**2 237 184**	**245 778**	**2 698 509**

Tab. 2. VÚC expenses for transportation in year 2006 and possibility to cover them (in thousand Sk (currency – Slovak crowns)) [2]

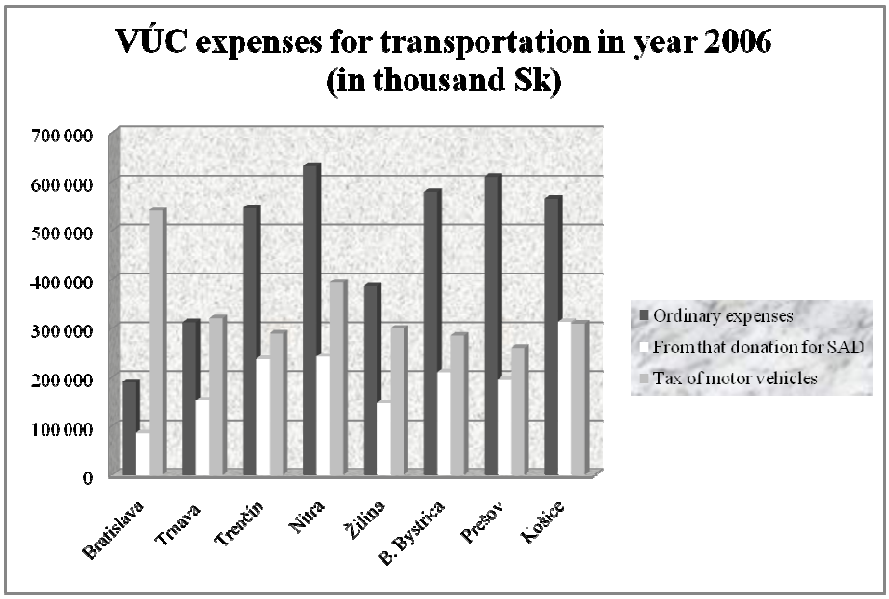

Fig. 1. VÚC expenses for transportation in year 2006 [2]

From the table 2 above and the graphical presentation on the picture 1 it is shown that if the value of finance sources obtain from taxes of motor car utilized as a donation, perhaps as a payment of estimated loss for SAD companies offering performances in public interest, should be by VÚC possible (instead of VÚC Košice, where the value of financial sources lower than the necessary of value of donation) to pay these finances, because of value of sources from the taxes of motor vehicles is enough.

Also in practice of integrated transport systems is possible to obtain financial sources, like in Czech Republic, where the municipality are deals in the form of part of financing per resident to IDS (integrated transport system). If we can speak about the price of 100 Sk (currency - Slovak crowns) per resident, in the aim of Žilina region it should be possible to obtain 15 740 700 Sk. In case of the price of 100 Kč (currency – Czech crowns) will be recalculated on base of NBS (National bank of Slovak republic) exchange rate to the date 25. 4. 2007, it means in exchange rate of 1,2 Sk/1 Kč, then the fee will be 120 Sk per resident. In this way it is possible to obtain the fee of 18 888 840 Sk. In the case that VÚC determine the fee of 150 Sk per resident, it could be obtain the sources of 23 611 050 Sk. These finance sources should be utilized for estimated loss compensation, for financing of vehicle park renewal and etc.

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Workload Balancing and Idletime Minimalization on Two Identical Machines in Series

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Abstract. Article is dealing with the workload balancing and idletime minimalization problem on two identical machines in series with finite number of jobs. Appearance of real world applications that have alike properities as this environment, is motive of searching for the solutions of this scheduling problem. There are shown irregularity measure and idletime measure that are used as objective functions for schedule balancing and the idletime minimalization. A matematical model is presented and simple heuristic is developed that is based on optimal schedule attributes.

Keywords: Identical machines in series, Idletime minimalization, Irregularity measure, Idletime measure, Workload balancing.

1. Notation and Framework

Let $M = \{1, 2\}$ be a given set of positive integers of subscripts of machines and $N = \{1, 2, \ldots, n\}$ be a given set of positive integers of subscripts of jobs. The number of jobs is denoted by n and the number of machines by m. In our case, n is finite and $m = 2$. Every job J_i consits of two operations, $J_i = \{o_{i1}, o_{i2}\}$. Let p_{ij} be the processing time of operation o_{ij}. We used ordered n-tuple $\psi = (\psi_1, \psi_2, \ldots, \psi_n)$ of permutations of the set M for assigning the processing order of operations throught machine environment. We used permutation π of the set N for assigning of processing sequence of jobs to the system. The completion time of the operation o_{ij} is denoted in *final schedule* as C_{lk}, where $l = \pi[i]$ (we will write $l = [i]$) and $k = \psi_l[j]$. An operation o_{ij} of job i from the given scheduling problem is mapped by the permutation π and ψ to the machine environment in *processing sequence* as l^{th} operation that will be processed on machine k.

2. Two Identical Machines in Series

We have 2 identical machines in series and n jobs; Each job consists of 2 operations and each operation requires a different machine; n jobs have to be processed in *arbitrarily sequence* on 2 machines; Processing time of an operation o_{ij} of job i is given by p_{ij}. After the job completions on one machine a job joins the queue at the next machine. All queues are assumed to operate under the FIFO discipline, that is, a job cannot "'pass"' another while waiting in a queue.

Main assumptions are:

1. Every job has to be processed on all machines in the *arbitrarily order*;
2. Every machine processes only one job at a time;

3. Every job is processed on one machine at a time;
4. Operations are not preemptive;
5. Schedule is non delay.

We need to know how much is schedule unbalanced (irregular) and how much time units are machines idle. For this we need to define the irregularity measure and the idletime measure.

3. Irregularity Measure

An irregularity measure is a real function $f(x, y)$ on the set of real two-tuples (x, y) with following properties [3]: $f(x, y) \geq 0$, and $f(x, y) = 0$ iff $x = y$; f is a symmetric function; $f(x + d, y + d) = f(x, y)$ for any real number d; if $|\widetilde{x} - \widetilde{y}| \geq |x - y|$ and $x + y = \widetilde{x} + \widetilde{y}$ then $f(\widetilde{x}, \widetilde{y}) \geq f(x, y)$. Examples of irregularity measures:

$$\begin{aligned} f_{dif}(x, y) &= max\{x, y\} - min\{x, y\}, \\ f_{sqrt}(x, y) &= (x - z/2)^2 + (y - z/2)^2, \end{aligned} \tag{1}$$

where $z = x + y$.

4. Idletime Measure

The idletime on machine M_k exists between operations if completion time of the operation $l + 1$ minus her processing time is greater than completion time of the operation l, e.i., when $C_{l+1,k} - p_{l+1,k} > C_{l,k}$, where $l \in N - \{n\}$, $k \in M$. And therefore, the idletime measure I_k on the machine M_k is denoted as:

$$I_k = \sum_{l=1}^{n-1} (C_{l+1,k} - p_{l+1,k} - C_{l,k}) + C_{1,k} - p_{1,k}, \tag{2}$$

where $C_{1,k} - p_{1,k}$ is the idletime between the time zero and starttime of the first operation on the k^{th} machine. We can express completion time of operation $o_{l,2}$ on the second machine [1], page 152, in final schedule as $C_{l,2} = \max\{C_{l,1}, C_{l-1,2}\} + p_{l,2}$ for $l \in N - \{1\}$ where $C_{1,k} = \sum_{u=1}^{k} p_{1,u}$ for $k \in M$ and $C_{l,1} = \sum_{u=1}^{l} p_{u,1}$ for $l \in N$. We can write idletime measure on the second machine as

$$I_2 = \sum_{l=1}^{n-1} (C_{l+1,2} - p_{l+1,2} - C_{l,2}) + C_{1,2} - p_{1,2} = C_{1,2} + C_{n,2} - \sum_{l=1}^{n} p_{l,2} - \sum_{k=1}^{2} p_{1,k}. \tag{3}$$

5. Exact Solution

We can write workload balancing and the idletime minimalization as the following problem [2]: For a real $2 \times n$ matrix $\mathrm{A} = (p_{ij} \in \mathcal{R})$ where values p_{ij} are processing times of operation o_{ij} and for an ordered n-tuple $\psi = (\psi_1, \psi_2, \ldots, \psi_n)$ of permutations of the set $\{1, 2\}$ and for permutation π of the set $\{1, 2, \ldots, n\}$, let $\mathrm{A}^{\psi\pi}$ denotes the real matrix whose element in the j^{th} row and i^{th} column is $p_{l,k}$, where $l = [i]$ and $k = \psi_l[j]$

$$\mathrm{A}^{\psi\pi} = \begin{pmatrix} p_{[1],\psi_{[1]}[1]} & p_{[2],\psi_{[2]}[1]} & \cdots & p_{[n],\psi_{[n]}[1]} \\ p_{[1],\psi_{[1]}[2]} & p_{[2],\psi_{[2]}[2]} & \cdots & p_{[n],\psi_{[n]}[2]} \end{pmatrix}$$

Let $\mathcal{L}^{\psi} = (L_k^{\psi} \in \mathcal{R})$ denote the real m vector whose k^{th} element is k^{th} row-sum of the matrix A^{ψ}, $L_k^{\psi} = \sum_{i=1}^{n} p_{i,\psi_i[k]}$. Given an real matrix $\mathrm{A} \in \mathcal{R}^{2\times n}$ and a real function $f : \mathcal{R}^2 \to \Re$ we can workload balancing and idletime minimalization write as follows:

$$\min \left\{ f(L_1^{\psi}, L_2^{\psi}) + I_2 : \psi = (\psi_1, \psi_2, \ldots, \psi_n) \in \Psi, \pi \in \Pi, L_k^{\psi} = \sum_{l \in N} p_{l,k} \right\}$$

where f is the irregurality measure, I is the idletime measure, Ψ is the set of all n-tuples ψ and Π is the set of all permutations π. Next bivalent linear mathematic model can be writen for the workload balancing and the idletime minimalization problem. Objective function is the sum of irregularity measure (1) and idletime measure (3). Both these measures can be transform to a linear form. Variables f_{dif}, f_{max}, f_{min} represents the irregularity measure and the variable I_2 represents the idletime measure.

$$\min \rightarrow \quad f_{dif} + I_2 \tag{4}$$

$$s.t. \quad \sum_{l \in N} (x_{il} + y_{il}) = 1 \quad \text{for} \quad i \in N \tag{5}$$

$$\sum_{i \in N} (x_{il} + y_{il}) = 1 \quad \text{for} \quad l \in N \tag{6}$$

$$\widetilde{p}_{1l} = \sum_{i \in N} (p_{i1} x_{il} + p_{i2} y_{il}) \quad \text{for} \quad l \in N \tag{7}$$

$$\widetilde{p}_{2l} = \sum_{i \in N} (p_{i1} y_{il} + p_{i2} x_{il}) \quad \text{for} \quad l \in N \tag{8}$$

$$\sum_{l \in N} \widetilde{p}_{jl} \leq f_{max} \quad \text{for} \quad j \in M \tag{9}$$

$$\sum_{l \in N} \widetilde{p}_{jl} \geq f_{min} \quad \text{for} \quad j \in M \tag{10}$$

$$f_{dif} = f_{max} - f_{min} \tag{11}$$

$$0 \leq I_2 \tag{12}$$

$$\widetilde{p}_{12} - \widetilde{p}_{21} \leq I_2 \tag{13}$$

$$\sum_{l=2}^{n-h} \widetilde{p}_{1l} - \widetilde{p}_{21} - \sum_{l=2}^{n-h-1} \widetilde{p}_{2l} \leq I_2 \quad \text{for} \quad h \in \{0, \ldots, n-3\} \tag{14}$$

$$x_{il} = \begin{cases} 1 & \text{if } \psi_i = (1,2) \text{ and } [l] = i \\ 0 & \text{otherwise} \end{cases} \qquad y_{il} = \begin{cases} 1 & \text{if } \psi_i = (2,1) \text{ and } [l] = i \\ 0 & \text{otherwise} \end{cases} \tag{15}$$

for $i \in N$ and $l \in N$. Variable $x_{il} = 1$ if job J_i has l^{th} position in final schedule with processing order of operations as; operation $o_{i,1}$ is processed first and operation $o_{i,2}$ is processed second, otherwise, variable $y_{il} = 1$ if job J_i has l^{th} position in the final schedule with processing order of operations as; operation $o_{i,2}$ is processed first and operation $o_{i,1}$ is processed as second. Expresions (5) and (6) models the conditions that, every machine processes only one job at a time and every job is processed on one machine at a time. Expresions (7) and (8) serves just as simplification of the mathematic model. Expresion (9) ((10)) models maximal (minimal) workload of assigned operations to the first and to the second machine. Expresion (11) models the irregularity measure (1). The last expresions (12), (13) and (14) models the idletime measure. This mathematical model was implemented using solver [4]. However, practical experiences shows, that computational time becomes extremely long as $n \geq 10$. Therefor we had to develope the following heuristic LSDSPT (Longest square difference of sqared processing times first).

6. Heuristic LSDSPT

Idletime does not only depends on the assigning of processing order of the operations through machines, but it also depends on the assigning of processing sequence of jobs to the system. Workload balancing is independent from assigning of procesing sequence of jobs to the system, however the idletime minimization depends on workload balancing.

Definition 1 (Measure of square difference of squared processing times)
We define the measure $\delta^2(x, y)$ *on the set* $R \times R$ *as* $\delta^2 : R^2 \to R$, *where* $\delta^2(x, y) = (x^2 - y^2)^2$.

Assume that number of machines is 2 and number of jobs is n.
Algorithm:

- **Step 0:** Initialization: Set $k = \lfloor n/2 \rfloor$ and set permutations $\psi = (\psi_1, \psi_2, \ldots, \psi_n)$ to $\psi_1 = (1, 2), \psi_2 = (1, 2), \ldots, \psi_n = (1, 2)$.
- **Step 1:** Find such permutation π that satisfy condition:

$$\delta^2(p_{[1],1}, p_{[1],2}) > \delta^2(p_{[2],1}, p_{[2],2}) > \cdots > \delta^2(p_{[n],1}, p_{[n],2})$$

- **Step 2:** If $p_{[i],1} < p_{[i],2}$ than $\psi_{[i]} = (1, 2)$ otherwise $\psi_{[i]} = (2, 1)$ for $i = 2l - 1$ where $\forall l \in \{1, \ldots, k\}$. If $p_{[i],1} > p_{[i],2}$ than $\psi_{[i]} = (1, 2)$ otherwise $\psi_{[i]} = (2, 1)$ for $i = 2l$, where for even n is $\forall l \in \{1, \ldots, k - 1\}$ and for odd n is $\forall l \in \{1, \ldots, k\}$.
- **Step 3:** If $L_1 > L_2$ than $\psi_{[n]} = (1, 2)$ otherwise $\psi_{[n]} = (2, 1)$, where $L_j = \sum_{i=1}^{n} p_{i,\psi_i[j]}$ for $j \in \{1, 2\}$.

7. Conclusion

In this paper, the scheduling of identical parallel machines in series with workload balancing and idle time minimization constraints was solved, with the objectives of minimizing the irregularity measure and the idletime measure. A mathematical programming model was proposed. Due to the computational complexity involved in solving the mathematical model, heuristic was developed to generate solutions within a reasonable period of time.

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CIELO – CIty, Environment and LOgistic

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Abstract. Solving of environmental and safety issues in the transport system of cities is now becoming a growing problem. University of Žilina cooperates in submission of CIELO proposal in the second call of Interreg IVC. These project aims are addressed to the problem of logistics, freight transport and the impacts of logistics services within the city.

Keywords: Interreg IVC, logistic, urban transport, environment.

1. Introduction

University of Žilina, Department of Road and Urban Transport is cooperated on CIELO proposal at the second call of the INTERREG IVC. CIELO consortium has nine members from: Italy, The Netherlands, Greece, Spain, Slovakia and Portugal. Department of Road and Urban Transport as partner of CIELO project will cooperate by solving of regional feasibility study LOSOZI – Logistic Solution Žilina.

Development of feasibility study is in order to analyse and evaluate the impact of logistic on city transport system. For this purpose the methodology will be developed and applied for Žilina transport system. This methodology will consist of measurements linked to environment, transport system and logistic within the city.

The duration of CIELO project is 36 months (September 2008-August 2011).

2. Project Background: The City Logistics Context

Freight distribution urban processes are, together with private traffic flows, one of the major sources of energy consumption, noxious gas emissions and noise levels in urban areas, provoking negative impacts on life and environmental quality of our cities. For these reasons, the importance of adequate infrastructures and systems for an efficient management of City Logistics is increasing in most developed countries, and especially in Europe.

3. Project Objectives

CIELO project aims at exchanging and disseminating City Logistics experiences based on innovative Services and Technologies which have been already developed in some European mid-size historic cities. Furthermore, CIELO aims at implementing new additional City Logistics Services in specific pilot sites supported by improved ICT platform.

The City of Lucca, an Italian mid-sized city with an important historical centre, located in the north-west part of Toscana Region, together with the Utrecht Municipality in the

Netherlands, will be the reference sites of the CIELO Project. In fact, both Utrecht and Lucca Municipality have a strong experience record in facing and managing City Logistics processes. Lucca and Utrecht will also be the main poles to transfer practices towards other Project Partners. For this reason both Municipalities will organize a study visit to let other CIELO partners know how city logistics issues are managed and carried out in this two cities.

The dissemination activities will be based on the development of a specific CIELO Web Site and European Knowledge Base on City Logistics and on the production of newsletters, e-newsletters, brochures, etc.; Furthermore, the exchange of experiences activities will be based on the organization of staff exchange, thematic workshops, training courses and local and/or international conferences. All these activities will represent the basis for the identification of needs and problems in order to develop 9 Feasibility Studies and 4 light Pilot Projects in the involved sites.

The 4 pilot site projects and overall activity results, based on a specific Good Practice Guide elaborated in the CIELO project will produce a common Best Practices for sustainable and clean urban transport to be promoted at European Regions and areas levels.

Considering the *intensity of cooperation* (as referred in Interreg IVC Programme Manual) at pilot project level:

1. **Lucca Municipality** will implement, demonstrate and evaluate an innovative additional service consisting "Remote warehouse services" for commercial activities located in the historic city centre. This service, strongly demanded by the operators, will improve and expand the current City Logistics basic services. In particular the implementation of this innovative service and its relative schemes will be set up using the current existing infrastructures (Logistic base, depots, low/zero emission vehicles) and technologies (ICT platform) with the necessary adaptations, improvements and personalization;

2. **Utrecht Municipality** will implement, demonstrate and evaluate in different city roads the best solution identified by the feasibility study for the improvement of freight traffic flow at traffic lights. Utrecht feasibility study aims to improve freight traffic flow at traffic lights on urban roads based on smart traffic control at traffic lights, focused on trucks. In its first phase it aims at implementing a good consolidation solution, consisting of market research and outcome analysis.

3. **The CATALAN INSTITUTE OF LOGISTICS** will develop a web portal defined at feasibility study level, taking into account the CIELO reference models and experiences. The feasibility study will define the structure and the architecture of a specific portal to coordinating and managing on-street deliveries with innovations at operator level, following the strategies defined in the Mobility Master Plan for the Camp of Tarragona 2006-2012, at CIM El Camp site.

4. **AMAVE - Vale do Ave Municipalities Association:** will test and implement the results of the feasibility study for medium size centers in Vale do Ave Region. The economic basis of the city centre, the cultural-historical heritage, the touristic activity and the residents are the topics to be considered in urban distribution policy.

3. Project Expected Results and Outputs

The main results of CIELO Project concern the exchange, dissemination and wide promotion of experiences from those sites which have already faced and managed City Logistics processes and problems, towards those partners/cities that are interested in following and adopting the proposed approaches in implementing sustainable and eco urban transport and mobility policies.

The results already achieved in the reference sites will allow to evaluate the transferability of the implemented approach and developed practices, in order to define City Logistics "good practices" scenarios and to provide inputs for the enhancement and improvement of current City Logistics regulation/normative framework at area, Regional and European levels. The nine feasibility sites have different characteristics and different operational environments and needs, thus allowing the investigation of energy gains, sustainability aspects and environmental effects of the proposed innovative urban freight solutions in a global manner.

Furthermore, CIELO Project will enforce the Best Practices with the implementation of new additional services and related ICT tools in the reference sites. CIELO will also allow the development of feasibility studies and/or Pilot Projects in the involved sites both in the context of a transfer of practices as required by Interreg IVC Programme.

From the environment and energy saving point of view, the promotion of the "CIELO Best Practices" for an innovative and sustainable urban freight transport policies, will allow:

- to decrease the current level of traffic congestion, pollution and noise due to the goods delivery process by reducing the overall number of circulating freight vehicles, optimizing loads and trips and utilizing clean vans fleet;
- to increase the pedestrian safety and the accessibility for tourists and residents;
- to minimize risk for historic monuments due to traffic vibrations and environmental pollution;
- to raise awareness and enhance the knowledge about environmental impacts of freight traffic and operations, in order to improve decision making and planning of future city logistics related measures.

In the end, at National, Regional and European levels CIELO Project will contribute to formulate common guidelines addressing the institutional and organizational issues.

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Methodology of Selection of Unconventional Mass Transportation System Connecting City with Airport

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Abstract. The aim of this paper is to publish the proposal of methodology for selection of unconventional transport systems for passenger transportation between the city and the airport as the one of results of doctoral thesis with the title "Unconventional systems for passenger transportation between city and airport".

Keywords: Unconventional, Public Transportation, Analytical Hierarchy Process, Methodology

1. Introduction

The unconventional systems originate as the substitution of common means of transport. Based on state-of-the-art it can be said that the unconventional systems are used on a small scale in Slovak republic despite of their indisputable advantages.

The passengers are discouraged to use mass passenger transport by decreasing level of transportation parameters and for this reason; they use more the individual cars. It can be said that the individual passenger transportation has begun to make the serious problems in the passenger transportation in Slovak republic. There are the high traffic volumes that cause the congestions on the surface routes and traffic accidents. All of this influences the system parameters of mass passenger transport such as the late lines, line sequence, transportation efficiency, quality, comfort or time of transportation. It also influences the living quality and the quality of environment in the cities or suburban areas that is still decreasing.

The passengers meet the same problems when they travel to the airport. The airports are usually located out of the cities and they are serviced by bus lines. These bus lines do not always go in the suitable intervals and they are not reliable. The problem of higher traffic volume on the roads also influences this transport. The passengers rather prefer individual car transport in that case.

Ideally together with the airport grow the share of transport modes using should be changed. The car transport will be always preferred to the small airports. With the gradual grow of airport the share of road public transport should increase while the high capacitive rail transport should be used for transportation to the large airports. The increase of mass transport share should be in the case of airports with more than 2 million passengers in a year.

The active support of air carriers and the increase of volumes are not sufficient presently. The airport administration has to provide the fast transportation for the passengers no to miss the flight. It is important mainly in the case of flights for short distances and with the high share of commercial travelers.

When the techniques, technologies, environmental impact, quality of transport and economy of unconventional for connection between the city and airport in Slovak republic are

evaluated the decision is based on the predetermined criteria. The using of multicriterial decision-making methods can be basis for selection of the best variant even in the case of huge number of criteria.

When the decision problem is under the solution all the elements influencing the result of decision process have to be considered. The intensity of elements interference has to be considered too. When the decision-making processes are more complicated it is preferable to illustrate the decision-making problem as the hierarchical structure.

2. Proposal on Methodology of Selection of Unconventional Mass Transportation System Connecting City with Airport

It is expected that all concerned decision makers will take part on decision process realized with further described methodology. These decision makers should be especially: airport managers, representatives of transport operator, investors and mass transport experts. Proposed methodology consists of following steps:

1. Composition of SWOT analysis, prognosis of passenger count progress and analysis of passengers behavior

The main goal of SWOT analysis is to analyze strong and weak sides (inner side) and to analyze opportunities and risks (outer side) of the airport. With such analysis decision maker can predict future situation of airport and thus decide which variants can be processed to short list of variants according to this prediction. This analysis helps to define goals of decision process and also helps with selection of criteria and its importance.

During realization of SWOT analysis, a prognosis of future progress of passenger count will be realized on given airport. This count influences demands for qualitative unconventional mass transportation to the airport.

2. Define goals to be reached, when connecting city with airport by mass transportation

In this step, decision maker will define goals (based on expected future development of airport) to be expected when connecting city with airport. Following criteria shouldn't be forgotten among the goals: accuracy, reliability, safety, speed, attractiveness, access for handicapped passengers, facilities of baggage transport.

3. Analysis of existing public transport network

The connection between city and airport can be realized with existing network of public transport or with a brand new mass transport system (conventional or unconventional). To make a decision if better solution is to strengthen current network of public transport routes or to build new mass transport system, it is important to recognize traffic relations in peak-hour traffic between airport and other parts of the city. With traffic direction survey, we are able to learn information about trip origins and destinations, intensities. routing of traffic flows, modal split between individual and mass transport, loads on public transport network, peak hour factor, quality of transport, travel speed, number of courses, vehicle utilization a transport outputs. Received data are than compared with goals we expect from the connection between city and airport and with demands emerged from future development of airport. These goals and demands were estimated in previous step. With the comparison we are able to learn: if existing connection between city and airport is sufficient (related to capacity, quality of transport) and if existing connection will fulfill demands given on future development of airport.

Based on this analysis, it will be decided if existing connection between city and airport will be improved or a new one will be built-up.

4. Selection of set of variants for decision

Individual variants, which will be included in decision process, are assessed after definition of goals. These variants can be unconventional from the point of view of operation, technology of transport or combination of both. With brainstorming method, a list of all variants of unconventional systems fulfilling given goals will be created.

5. Choice of criteria for evaluation of variants

Individual criteria determine the way of measuring level of partial goals fulfillment in considered variants. In process of criteria selection, decision-maker must choose compromise among the most complex, most understandable and most detailed evaluation of differences among variants and reasonable number of evaluating criteria. The more criteria we include to decision process, the more the longer and complicated the process will be.

6. Evaluation of questionnaire surveys

For evaluation of airport market analysis, it is necessary to divide travelers into smaller groups (airport employees: Flight Crew, Non-Flight Crew; passengers: Resident Business, Resident non-business, Non-Resident Business, Non-Resident, and Non-Business). According to this division, interests, objectives and needs of each group are identified. For travelers, characteristics such purpose of journey and place of residence influence the preference of specific transport possibilities when traveling to the airport.

The reason for market survey is to identify target group of proposed transportation system connecting airport, together with estimation of importance of criteria on technology of operation.

Results of questionnaire survey will be utilized for the selection of best location for transfer terminal, for modification of existing mass transport routes and for designing placement of unconventional transportation system in the area.

The questionnaire for travelers and airport employees must include at least information about trip origination, duration and purpose of journey, transport mean choice and reasons of this choice, together with questions related to statement of criteria's importance on technology of operation.

7. Choice of best location for transfer terminal, modification of existing mass transport network related to proposed transfer terminal and designing the path of unconventional transportation system

For selection of best location of transfer terminal (can be located in inner city or outside as well), it is necessary to analyze following: passenger traffic flows to airport (mass transport as well as individual transport), intensities and capacities airport access roads, public transport lines routing directions, existing parking possibilities (capacities of parking areas, distance to airport or transfer terminal) and possibilities of construction of P+R parking. Based on above-mentioned the best location for transfer terminal should be suggested.

After that, based on spatial possibility, we suggest placement of unconventional transport system track.

8. Estimation of criteria and subcriteria importance (except subcriterias on technology of operation) by expert's individual or group decision making with AHP methodology

Estimation of criteria importance as group evaluation with Analytical Hierarchy Process (AHP) methodology can be realized in two different ways.

1) Each decision maker expresses its preferences among individual criteria, subcriteria and variants separately and total weight are then determined with averaging.

2) With brainstorming methodology, where decision makers work as an integral unit, with cooperative thinking and confrontations individual preferences among criteria, sub criteria and variants are determined, and thus overall importance of criteria, sub criteria and variants are estimated.

To simplify the whole decision process, I suggest use of Expert Choice software. Hence, for estimation of criteria importance the second way from above mentioned is suggested.

Considering the first method, it is very complicated to consider importance among criteria from various fields. With the second method, confrontation of opinions is ensured and thus it is easy to find common solution. In addition, mutual control is ensured that decision makers do not evaluate criteria from passenger's point of view.

During the estimation of individual criteria weights, decision maker assigns preferences to all levels of hierarchy with exception of sub criteria on technology of operation. Weights for this group of sub criteria are to be estimated from questionnaire survey on airport employees and travelers, realized in step no. 6). Experts estimate importance of whole group of these sub criteria (criteria on technology of operation).

9. Finding preferential order of variants with AHP methodology

With AHP methodology, a group of experts expresses their preferences among individual variants, upon each criterion. Based on the importance of each criterion and given preferences of variants according to individual criteria, preferential order of variants is stated.

10. Evaluating achieved results of decision process

The order of individual variant's merit is depends especially on weights of individual criteria. Possible way to evaluating achieved results of decision process is sensitivity analysis. Investigation of sensitivity on preferential order of variants related to definition of individual criteria's weights is performed with varying weights of criteria.

11. Evaluation of risks related to realization and operation of system

The purpose of evaluation of risks is to reduce future uncertainty on economically effective level, together with elimination of potential problems, which can bring serious consequences on construction and operation of transportation system.

12. Discussion and statement of final order

During the discussion, decision makers should discuss the level of criteria's weight variation within sensitivity analysis, found risk related to realization and operation of system, and facilities leading to lower the probability of possible risk occurrence.

In terms of previous steps, final preferential order of variants should be stated.

13. Presenting results of decision process to passengers

After preferential order is stated, the best variant is presented to passengers in media.

3. Conclusion

Unconventional transportation has a great future ahead. In transportation as in every area of human activity, new systems with higher capacity and efficiency are being developed to replace the old ones. This trend is supposed to continue in the future. However, unconventional transportation systems can offer even more - with effective usage of resources, lowering costs and staff needed to operate transportation means the safety of traffic will be increased and environmental pollution lowered.

Proposed methodology is one possible solution how to choose the most suitable unconventional transportation system, connecting city with airport.

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How is Important Transport Supply of LNG

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Abstract. In 2007 total consumption in EU 25 reached 486 billion cubic meters and the forecast for 2020 reaches 675 to 730 Bcm and 140 billion cubic meters LNG. In order to ensure safety and continuity of supply for this fundamental infrastructure, the European Gas Industry has always shown a very pro-active attitude by producing internally. The European gas Industry is expecting an average annual growth of consumption in the range of +/-2.5% p.a. On the other hand the domestic production is ready declining and existing contracts are expiring. During the next two decades round about 450 Bcm and 140 Bcm LNG of gas imports have to be reordered. Against the background of this supply gap new pipeline projects like North stream, South Stream as well as the various LNG projects are attracting highest attention of the industry itself, costumers and politicians.

Keywords: Macro and microeconomic analyze, role and strategic meaning of LNG, importance of the co-operation, transport of LNG

1. Introduction

The EU projects that gas imports will increase to 80 % of EU demand by 2030 while the IEA predicts that OECD European dependence on gas imports will increase to 65 % (percent) [1] . That is the reason why agrees with the EC assessment that, in relation to gas, considering the present technology, it is better to diversify supply routes technologies, such as degasification plants and Liquefied Natural Gas (LNG) terminals [2]. LNG is set to play an increasingly important role in gas transportation worldwide over the projection period, mainly to supply Asia-Pacific and Atlantic Basin markets. In volume terms, the biggest increase in imports is projected to occur in OECD Europe. Imports jump by 280 bcm between 2004 and 2030, reaching almost 490 bcm – equal to about two-thirds of inland consumption. North America, which is largely self-sufficient in gas at present, emerges as a major importer. By 2030, imports all which are in the form LNG meet 16 % of its total gas needs. Chinese gas imports also grow from around 1 bcm in 2004 to 56 bcm by 2030. The country's first LNG terminal, with a capacity of 3,7 million tones (6 bcm) per year was commissioned in 2006. Nonetheless, gas still meets only 5 % of Chinese energy needs by 2030, up from 3 % today.

Gas continues to be traded on a largely regional basis, as there are few physical connections now between the main regional markets of North America, Europe, Asia – Pacific and Latin America. However, these markets are set to become more integrated as trade in **LNG expands**. This will open up opportunities for arbitrage, leading to a degree of convergence of regional prices. LNG accounts for almost 70 % of the increase in inter-regional trade. **Exports of LNG grow from 90 bcm in 2004 to 150 bcm in 2010 and 470 bcm in 2030** [3]. Much of the new liquefaction, shipping and regasification capacity that is due to come on stream by 2010 is either already being built or is at an advanced planning stage. Cumulative investment in gas-supply infrastructure, including upstream facilities, liquefaction plants, LNG tankers and regasification terminals, transmission pipelines and

storage facilities, and distribution networks, is projected to amount to $3.9 trillion ($151 billion per year) over the period 2005-2030. Two dimensions of European gas security, which are only just beginning to receive the attention, which they deserve, are potential problems, which can be caused by infrastructure breakdown, and the question of how to ensure the availability of adequate gas terminals and gas storage in liberalized markets. Over the next 10-15 years, availability of the European gas supply will be adversely affected by a combination of three factors:

- First, ongoing indigenous resource depletion,
- Second, political and geopolitical problems between Russia and CIS countries, within the Middle East/Caspian region and between these regions and EU countries,
- Third, the globalizing market for LNG in the Atlantic and pacific Basin.

Political constraints and increasing global competition for LNG may limit the prospects for European gas supplies particularly after 2020 [4]. EU-30 gas production is foreseen by fall (in UK, Netherlands, Germany and Italy) from 308 Bcm/y in 2006 to 250 Bcm/y in 2020. European dependence from extra EU-30 gas imports will rise from current 45 % to approximately 65 % in 2020. In year 2020 import additional requirements is 220 Bcm/y [5]. There is urgent need for investments in new import infrastructures and transport supply of LNG. The European Union is a net importer of gas and its importation needs will increase because of a growing consumption and declining production. Investment in gas and LNG infrastructure is necessary to bridge this gap and reinforce security of supply. Many national markets are still dominated by incumbents who have booked long term most of the entry capacity. Investment in gas and LNG infrastructure is necessary to effectively open the internal gas market and connect the national markets. Investment in gas infrastructure is the key to the effective competition in the internal gas market and to security of supply [6]. This is already seen in rules on pipelines and LNG facilities. Important is that the operators of gas transportation infrastructure must normally offer open access. However, long term usage and shipping contract are needed to support the financing required to build new facilities. These are allowed via exemption from open access rules, if shown to be necessary to get the infrastructure built and financed. Competitive concerns are addressed by requiring justification, an open season process, applying “use it or lose it” rules and setting limits on own use capacity [7]. On the supply side, adjusting for risk most noticeably reduces production in Iran and, to a lesser extent, in Russia. Interesting is that the risk premium in Iran is smaller than in Russia. Iran has fewer infrastructures already in place and hence the higher required return has a larger effect on overall export capacity [8].

MAJOR EXPORTERS	**2003**	**2010**	**2020**	**2030**
Qatar	19	78	126	152
Algeria	64	76	114	144
Iran	0	5	31	57
Libya	1	2	13	34
Egypt	0	10	19	28
Iraq	0	1	7	17
TOTAL	**84**	**172**	**310**	**432**

Tab. 1. Major exporters (figures are for “net trade” and are expressed) [in mld. m^3] [9]

	TOTAL EXPORTS (Bcm)			
	2003	**2010**	**2020**	**2030**
Middle East	34	102	185	244
North Africa	63	86	143	200
TOTAL	**97**	**188**	**327**	**444**

Tab. 2. Gas Export Projections Middle East and North Africa (includes UAE, Kuwait and Saudi Arabia), Source: IEA, World Energy Outlook 2005, Paris OECD 2005

2. Transport Problem LNG

Natural gas is currently experiencing a massive increase in-demand with 2.8 trillion cubic meters of the affordable alternative to petroleum being consumed worldwide in 2005 according to the Federal Institute for Geosciences and Natural Resources. The complex pipeline system now in place is no longer adequate to meet global needs. Instead, some 200 hundred tankers are currently plying the oceans of the world to transport liquefied natural gas (LNG). “Floating bombs" was the term used earlier by skeptics to describe the more than 300 meters long LNG tankers. The natural gas in the 150.000 to 250.000 m^3 (cubic meter) capacity spheres or membrane tanks must be kept at -163 degrees Celsius to ensure that it remains liquid. In the gaseous state, it would take up 600 times that space and would be highly explosive. The fact that, since the commissioning of the first LNG tanker in 1959, there have been no accidents at sea is due to the safety measures implemented, and strictly adhered to, by the shipbuilders. The tanks, especially modern membrane tanks, are insulated with layers of aluminum, balsa, plywood, fiberglass and polyurethane. Each weld is made by hand with millimeter precision and must resist extreme temperature fluctuations. While the design of highly specialized LNG tankers is steadily improving, the problem, however, is the procedure for loading and unloading. Outdated loading methods still require some manual work and carry significant risks to the ship, its crew and the loading personnel. The new and quick release coupling developed by Merkle Engineering & Partners (Heidenheim) for Emco Wheaton GmbH (Kirchain) should help to prevent future accidents and make loading more effective.

What is danger area? The Port. The tankers themselves are built so safely that it is sometimes the loading terminal itself, which is the danger point. The coupling of the loading arm must often be screwed to the shipside flange using a special hand-held tool. This is problematic if the ocean swell moves the tankers away from the jetty: the extreme forces in play are sufficient to stretch the loading arm until something finally breaks. In a worst-case scenario, the entire loading structure would collapse. The natural gas, loaded at approximately -20 °C, would leak out uncontrollably as a vapor and mix with the air. If the concentration of the gas in the air/oxygen mixture reaches 5 to 15 % a mere spark would be sufficient to cause an explosion leading to a catastrophe. In order to avoid this, traditional loading arms are equipped with two ball valves that can be closed off between which the line can be separated as a precaution in the event of danger when the complex balance of the arm becomes unstable and the entire loading terminal is put out of action for some time. One of the customers of Emco Wheaton, a company specializing in the transfer of hazardous gases and liquids, was not completely satisfied with this solution and commissioned Merkle&Partners to develop a hydraulic quick-release coupling to simplify this emergency separation.

The challenge was to develop a coupling in just three months, which would offer absolute integrity under 150 bar operating pressure and low natural gas temperatures. The

coupling not only had to comply with the standards of the Oil Companies International Marine Forum (OCIMF) but also to the more stringent guidelines of the bureau VERITAS classification company. For this project to succeed in the short term, drafting, dimensioning and the progressive modeling of the new device had to be implemented using computer simulations. This kind of calculation of forms and their behavior when exposed to different conditions represents the core area of activity of Merkle & Partners. Using their facilities, the lengthy planning phase was shortened to such an extent that product development was completed within the prescribed period and the construction of a prototype immediately begun. By then, more than 120 simulations had been carried out until the coupling functioned smoothly. The engineers, at first, created CAD models, which were subject to simulations under environmental conditions such as wind loadings or ocean swells. The resulting proposals were then discussed with the client. Finally, the resulting development was presented to experts from the Bureau VERITAS in Paris who accepted the new system. Since there had previously been no comparable solutions for such high-pressure loading, the entire construction had to be developed from scratch, starting with the material and the design right through to the force transmission mechanisms [10].

3. Conclusion

Without a pricing reference point for LNG, shipments have tended to divert to those markets with the highest natural gas prices. Last year 2008, with high gas prices in Europe, these LNG shipments were diverted to European markets. But with the crash in European gas prices over the mild winter the forward US gas prices for the autumn and early winter are now at a significant premium to European gas prices, and conventional wisdom suggests that LNG shipments that may been routed to Europe will now be directed to the US market this coming winter. This in turn has a potential impact on supply security. However, problem is transport.

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Systematic Design of Warehousing as an Important Element of the Transport Operator's Territory

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Abstract. The systematically proposed storehouse is a part of logistic chain and its task is, besides the synchronizing of time and quality unstableness between production and consumption, also providing the service in an area fulfilling the requested quality and quantity. Individual steps of optimization, when taken regardless of other chain segments´ needs, especially the needs based on the complex transport maintenance, result to long-lasting problems of the whole area.

Keywords: warehousing, store logistics, design of warehouse, criterions for the store technology, transport operator's territory

1. Introduction

The aim of systematic projecting of store management is not only designing the situation of store management itself including its equipment, technology and operation. In systematic planning of store management we need to consider also synchronizing of technological, transport, store and service operations throughout the whole process of logistic chain in such a way that a natural flow of material from provider to consumer will be achieved the shortest possible way, in the shortest possible time in requested quality and quantity and with minimum costs.

A part of systematic projection of the store management logistics is a view of area´s transport services needs. The systematically proposed storehouse is a part of logistic chain and its task is, besides the synchronizing of time and quality unstableness between production and consumption, also providing the service in an area fulfilling the requested quality and quantity.

2. Recent Problematic of Creating Warehouses

In recent times, there is a trend to create the storehouses, mainly in the distributing part of the logistic chain, based on economic criteria [1]. Among them, there is a low price of suitable yard, strong flows of goods, weak competition and an existence of highway network. These criteria do not include the overall view of the area from the point of view of the complex transport maintenance.

Another imperfection, which often co-occurs planning the storage facilities, is a weak emphasis on technical, technological and operating needs of the enterprise. Planning of the store is concentrated mainly on the architectural design of the store that can later have negative impacts on the recurrence of rationalization arrangements during operation of the store. The process itself, while projecting and planning the stores, includes the whole chain of

steps, which are performed by the subjects who are often remote from the future user of the store and his needs.

Nowadays there are many companies dealing with planning the store management that works based on their own knowledge, often without the general view of the problem. Such proposals of the store management are highly professional, realized by the most modern methods and techniques; they bring a high benefit and optimize the processes and expenses [2]. However, the problem is that often they do not cross the borders of the one segment of the chain; or they interfere into the whole optimization of flows in a logistic chain only marginally. These individual steps of optimization, when taken regardless of other chain segments´ needs, especially the needs based on the complex transport maintenance, result to long-lasting problems of the whole area.

Among the most frequent problems, we find:

- congestion of transport infrastructure,
- decreasing the environment quality,
- creating congestions,
- number of accidents increasing,
- formation of narrow places within the system.

Many negative impacts (negative externalities) come out only after some time after the realization of the steps, by which they have been caused. Some other subjects at the whole company expense often perform resolving these problems, thus, it is very important to solve systematic projecting of store management with considering the needs of the complex transport maintenance of an area.

3. Systematic Planning of Store Management Principles

Systematic planning (projecting) of the store management may be defined as an organized, generally applied systematic process of solving store management projects, with respect of logistic practices.

Systematic projecting has to explore:

- material (raw materials, products) which enters the system,
- movements (transport) necessary for material transfer along a certain route from a place of receiving to a destination place,
- methods and means needed for movement´ s realization:
  - mechanization facilities (transport equipment),
  - means of transport,
  - technical practices (systems).

Each projection of systematic planning, including the store management, is since layout until the physical realization in process of several stages [3].

The basic stages of systematic store management projection:

- external environment analysis,
- internal processes analysis,
- general design of store management system,

- ❖ detailed design of store operations´ technologies,
- ❖ realization,
- ❖ revision and regulation of the design.

4. Criteria for the Store Technology Selection

The selection of optimal storage facility, either stable or mobile, is influenced by several factors. The views which we need to take into consideration when selecting can be divided into three groups:

1) technical criteria:
   - sort and physical characteristics of the stored materials,
   - range of manipulation operations,
   - kind and technical characteristics of the means of transport,
   - floor yardage demands and demands for maintenance and recovery of mechanization facility,
2) economic criteria,
3) other influences.

Technical criteria of selection can be almost always expressed accurately. They relate especially to:

- material (sort and characteristics),
- required transport efficiency per a unit of time (a range of manipulation operations),
- place of formation and destination (routing of the material flow),
- a length of the route,
- time requirements of tie-in technology (if it concerns one direction, regularity or irregularity, continual or cyclic transport, speed of a supply at the beginning and of a removal at the end of the transport line, and so on),
- used mean of transport at the entrance or removal of the store; it means – if the supply to the store is provided by a railway or a road transport (or some other transport) and which specific means of transport are used,
- floor yardage demands; demands for the width of transport and manipulation alley.

If the technical or technical-technological sides are evaluated usually the first selection could be made, but it has to be completed by evaluating some others criteria.

The economic criteria of selection deals mainly with a providing price (capital expenditure), depreciation rate, induced costs, maintenance and repair expenses, labour costs for operation etc. Quite important economic indicators (besides those already mentioned) from the point of view of selecting an appropriate mechanization facility are operation expenses for a manipulation unit per given space of operation time (e.g. €.t^{-1}) and year's converted costs €.$year^{-1}$), which summarily express investment and operation costs.

It may happen that after considering all the economic criteria, two or more facilities appear as equally convenient [4]. Thus we need to consider also some other criteria, which cannot be specified as accurately as the technical and economic ones.

The other criteria of selection are usually of an indirect economic influences´ character. Some of them:

- provision of safety of material during the storage and manipulation,
- flexibility of projected facility in case of possible change in tie-in technology or its adaptation to automation,

- safety of work and operation of facility,
- anticipated utilization period,
- other, e.g. ecological concerns and so on.

5. Conclusion

There are apparently tendencies to, as much as possible, harmonize and cooperate the elements in the area of stores and their technical and technological equipment projection and planning. Nevertheless, it is very important to optimize the final systemic projection of storage according to individual needs of concrete customer.

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Airport Ground Access and Egress Passenger Flow Model

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Abstract. The paper describes the main components of Airport ground access and egress passenger flow model. The scope begins at the place of origin such as home or an office and ends at the arrival to the airport terminal. The model consists mainly of following components: generating the passenger distribution to the cities in Slovakia, generating of passenger groups and passenger transport mode choice. As an output it provides mainly the following information: total travel time, travel costs, arrival pattern. The model is adapted to Airport Bratislava and the Slovak Republic region as its catchment area. The programmatic part is made in Microsoft Visual Basic for Applications and the data part is stored in Excel Spreadsheets. The model will be used to deliver passenger flow data inputs to other models of passenger flows in airport terminal. The final goal is to use both integrated models to evaluate future concepts of air passenger flows.

Keywords: Airport access and egress, air passenger flow model, air passenger ground transport

1. Introduction

Our research aims of developing passenger flow model that would be able to simulate passenger flows from the place of origin (home or office) to the airport and back. This airport ground access/egress passenger flow model should simulate the flows within the Slovak Republic to and from the Bratislava airport. The output flows from the model should be delivered to the models of passenger flows within the airport terminal. Both models should constitute a door-to-gate passenger flow model which would be used to evaluate future airport concepts. In particular it should be used to evaluate the concept of passenger flows where airport airsides and landsides are geographically separated. The idea behind this concept was presented in [11] and further elaborated in [12]. The airport terminal models usually do not simulate the passenger access to or egress from the airport. Therefore we are developing an access/egress model that would complement the airport terminal passenger flow models.

2. Airport Access/Egress Passenger Flow Model

The model consists of several parts (algorithms) and requires various data about the passengers, the airport, the distances, the public transport etc. The conceptual model of the passenger flow model is depicted on the Fig. 1. The generating of the passengers starts at flight schedule [1]. The flight schedule represents all flights during the day on 15th of August 2007 which was the busiest day of the month with the most traffic at Airport Bratislava in the year 2007. For the purposes of our model we extended the information in the flight schedule. In addition to the basic flight schedule data it contains the information about the aircraft type, number of seats in the aircraft, the average load factor found in [2-6], flight type (charter/scheduled), etc. By multiplying the number of seats with the load factor the actual number of passengers for the flight is received. The passengers often travel in groups of

various sizes. The sizes are different for business and leisure passengers. Each type of passengers has a probabilistic distribution of the group size. Statistical information about passenger group size at Airport Bratislava was received from [10]. The probability distributions for leisure passengers are shown in Tab. 1 and for the business passengers in Tab. 2.

Party Size	Probability
1	49%
2	36%
3	8%
4 and more	7%

Tab. 1. The probability distribution of the party sizes for leisure passengers.

Party Size	Probability
1	65%
2	25%
3 and more	10%

Tab. 2. The probability distribution of the party sizes for business passengers.

The probabilistic distributions are used to generate passenger groups for the flight. The algorithm generates the groups in the cycle until the number of passengers reaches the actual number of passengers in the flight from the flight schedule. The model then assigns the region and the city for each group of passengers. The assignment algorithm is based on the population distribution within the country. The assignment is proportional that means if a region has higher population than another one, the probability that the passengers are from this region is proportionally higher. Once the passenger groups have their region the city is assigned to them in an analogical way to the region assignment. Once the city of origin is known for the passenger group the algorithm continues with an assignment of the transport mode. There exist theoretical models for airport ground access mode choice. The evolution started with multinomial logic models and evolved to more complex nested models [13,14]. In the current state of our research we use rather simple algorithm. In our model the transport mode choice is based on evaluation of transport costs while choosing the transport mode with lowest costs. The costs of transport consist of the financial costs and the time costs. The financial costs represent the money value needed to get from the place of origin to the airport and back including all related fees such as parking fees in case of car transport etc. The time costs represent the total travel time multiplied by the value of passenger travel time. Standard values for the time cost calculation have been adopted from [7]. Each part of the total cost requires specific data. The main factors for the calculation of costs for transport by car are the distance and the time needed for the trip. For this purpose the database of transport distances and transport times between the cities and villages in Slovakia is used [8]. In the case of public transport for the time costs the data from online public schedule have been used [9]. To retrieve the required public transport connections from the publicly available website [9] we needed to develop a separate computer program that automatically requested and transformed the transport connections data. The transport schedule contains information about the duration and track distance of available transport connections. The financial costs for public transport are approximated using publicly available tariffs based on track distances. For the return trip from the airport to the destination city it is assumed that the passenger uses the flight of the same company. However if there are several flights per day, passenger may choose which one to use to come back to Slovakia. In our model each of the available flights has equal probability to be chosen and the algorithm randomly chooses the return flight for each passenger or passenger group.

All algorithms are programmed either in the Microsoft Visual Basic for Applications under the Microsoft Excel or as the spreadsheet functions. The intermittent and output data are stored in the Excel spreadsheet.

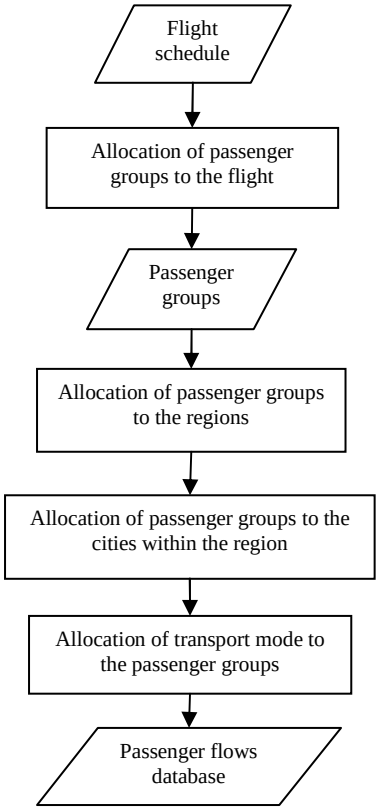

Fig. 1. Access and Egress passenger flow generating algorithm.

3. Conclusion

The main data output from the Airport ground access and egress passenger flow model is an Excel spreadsheet where the information about the passengers is stored. It includes the passenger ID, place of origin, group size, transport time etc. The most important aggregate information includes:

- Total travel time
- Travel costs
- Arrival pattern

The travel time and travel costs would be used as performance characteristics for the comparison of the baseline concept with the proposed concepts of air passenger flows. The arrival pattern is necessary information for the models of the passenger movements and processing within the airport terminal.

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Rationalization of Traffic and Range of Traffic Infrastructure on Off-corridor Lines Project "RACIO"

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Abstract. The paper deals with basic information of Project "Racio". There is described the possibility of simulation by evaluation range of infrastructure and traffic, as well as the connection between infrastructure, economical and qualitative indicators.

Keywords: rationalization, off-corridor lines, simulation, infrastructure

1. Introduction

It is necessary to find a solution for a progressing condition of traffic infrastructure in Czech Republic in a very short time. To find technical and technological solution is just one of tasks. We also need to target the financial resources. A great deal of financial resources was used to modernizing of corridor lines in last few years. So there are problems with financing modernizing, running and servicing of nationwide off-corridor lines and regional lines. They have threshold resources but it is necessary to find a compromise between range of infrastructure and traffic on it. These two things differ very often. No matter if it's overlarge infrastructure with low traffic or dense traffic on deficient infrastructure. Balance between range of infrastructure and traffic is important for economic point of view and also for qualitative point of view. Project No. 1F82A/035/910 Rationalization of range of traffic infrastructure under arrest traffic on off-corridor lines (Project RACIO) deals with solving this problem.

2. Project „RACIO"

Project "RACIO" is section of National program of researching, part "Safety and economical transport". This project has been solving by Jan Perner Institute, o. p. s. since 1st February 2008 to 31st December 2009. There are 8 employees and PhD students of Jan Perner transport faculty, who have solved this project.

Target of this project is to find interaction between range of transport infrastructure and range of traffic on off-corridor lines fix to limited financial resources. For finding interactions, we use simulation model. Project "RACIO" will result in suggesting of philosophy, which will be use to support of assessment of investment on off-corridor lines. Project "RACIO" is divided to five parts (DC).

DC	Subject	Time of solving
001	Compile search of native and foreign knowing sources and supporting documents, analyze especially foreign current trends and experiences.	1. 2. 2008 – 31. 5. 2008
002	Define qualitative and quantitative interactions between transport infrastructure and traffic including economy. Define criteria for categorizing of lines.	1. 6. 2008 – 31. 10. 2008
003	Verifying qualitative and quantitative interactions between transport infrastructure and traffic including economy by simulation model.	1. 9. 2008 – 31. 1. 2009
004	Suggesting of philosophy, which will be use to support of assessment of investment on off-corridor lines selected by category.	1. 2. 2009 – 30. 6. 2009
005	Verifying suggested philosophy by a simulation model.	1. 7. 2009 – 31. 12. 2009

Tab. 1. Parts of project "RACIO", its subjects and time schedule

Definition of new relations between range of traffic infrastructure and traffic is general contribution of the project. These relations were not solved yet or they were solved marginally. A simulation model will verify propriety of results. Conclusions will be summarizing by a philosophy form as a handbook. Results will be also present in economic relations as a major criterion for choice an appropriate measure.

Validation of the philosophy is check on six representative lines by a simulation model. These six lines were selected in conjunction with Railway Infrastructure Administration. Categorizing the line to one of off-corridor line category – nationwide line registered in European railway system, other nationwide line, regional line, was decision-making standard. Other standpoints were range and equipment of traffic infrastructure and range of traffic on advance line. [1]

Lines, which are solved:

- Tišnov – Nové Město na Moravě – Žďár nad Sázavou
- Strakonice – Volary
- Brno – Přerov
- Praha – Turnov – Liberec
- Kolín – Havlíčkův Brod
- Havlíčkův Brod – Brno

Unique benefits of simulation models are especially in analyzing rate between expended costs (e.g. for infrastructure, when financial resources are fixed) and profit, which these expended costs will bring. We must know prices of separate items of infrastructure, costs of construction works and expected range of traffic in different time horizons and different operative-technology scenarios for various periods.

Using a simulation is very suitable for projects, which are associated with viewing an infrastructure. This is normally used in practice in Switzerland. Operators (BLS A.G., SBB Infrastructure) use simulation models for variety of studies. These studies are connected with answering questions about feasibility of new conceptions in passenger traffic, goods traffic, stabilization of timetables and necessary investment to the infrastructure. With its help, it is also possible to determine a needed capacity of the system. For calculating the capacity consumption in Czech Republic is used directive ČD D24. This directive does not calculate with traffic composition, in case of using simulation models it is possible to calculate with it. On finding a solution, it is possible to go from any number of defined scenarios and they can be compared.

In Czech Republic, the simulation models are lowly used. There are few projects, which have quality processing of part connected with infrastructure, but unsuitable processing of technology part, because there were not used simulation models. If the interaction between infrastructure part and technology part is not respected, financial expenses will be spend inefficiently and unnecessary.

3. Conclusion

Project RACIO is today situated in the second half. Thanks to good cooperation of solving team with Ministry of Transport and Railway Infrastructure Administration. Railway Infrastructure Administration should become a user of philosophy, which is contained in a handbook. This handbook is a target of the project.

Piece of knowledge, which will be achieved during research of query, should result in improving the quality of services on off-corridor lines. At the same time, they should outline how to manage with threshold resources effectively. [1]

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Motorways of the Sea as a Competitive Alternative to Land Freight Transport

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Abstract. This paper explains the concept of the Motorways of the Sea as a powerful tool to increase the competitiveness of maritime transport. It presents the basic conditions for its successful implementation into navigation reality. It also points to the questions that should be urgently responded, to make the Motorways of the Sea reality.

Keywords: water transport, motorways of the sea

1. Introduction

Road transport networks developed with traditional paths, evolving first into roads and then into motorways. When we hear last named term, we imagine a road in generally good condition, with few curves, thus permitting a relatively mouth and comfortable journey. What is not very common is that when we hear the term 'motorway', we are aware that we are not talking only about a road with a specific route and road surface.

A range of complementary services such as resting areas, service stations, emergency telephones, clear signage, no crossroads, etc. enhances the quality and value of a motorway in reality. The same is happening in European maritime transport where the key routes between the Member States of the EU are frequently denominated like a motorways of the sea.

2. Concept of the Motorways of the Sea

The "motorways of the sea" concept is a new concept aimed at introducing new intermodal maritime-based logistics chains in Europe. These chains should be more sustainable and commercially more efficient, than road-only transport. Motorways of the sea should improve access to markets throughout Europe, and bring relief to the over-stretched European road system. For this purpose, fuller use should have to be made not only of our maritime transport resources, but also of the potential in rail and inland waterway, as part of an integrated transport chain.

"Motorways of the Sea are existing or new sea-based transport services that are integrated in door-to-door logistic chains and concentrate flows of freight on viable, regular, frequent, high-quality and reliable Short Sea Shipping links. The deployment of the Motorways of the Sea network should absorb a significant part of the expected increase in road freight traffic, improve the accessibility of peripheral and island regions and states and reduce road congestion."

Motorways of the sea are about making better use of Europe`s transport resources and about efficient, safe and secure shipping in Europe.

3. Conditions for Successful Implementation of the Motorways of the Sea

The market for the transport of goods in Europe is constantly growing, considering the number of tons transported every year. This increase in the demand for transport has principally favored road transport, thereby causing a significant imbalance in the market and negative environmental externalities, congestion and its associated economic costs, high accident rate and other problems with traffic safety, energy dependency from imported sources, emission of pollutants and noise and greenhouse gases. In addition, the transport infrastructure is becoming more and more stretched. It is very important to concentrate on the efforts to make the motorways of the sea attractive and easy to use.

Putting the Motorways of the Sea into effect gives rise to a number of challenges:

- reducing bureaucracy,
- promotion and marketing,
- port capacity, accessibility and efficiency,
- availability of good and non-congested hinterland connections,
- co-operation between all the players in the chain, including between ports,
- seizing the benefits from the booming container traffic,
- establishing integrated information systems,
- ensuring availability of suitable vessels,
- integrating Motorways of the Sea into a broader transport planning perspective,
- coordinating the funding instruments,
- balancing incentives for various modes of transport,
- dealing with distortion of competition,
- providing adequate training and attracting young people to the maritime profession,
- improving energy efficiency and reducing (air) pollution.

Motorways of the Sea will succeed as an alternative to conventional motorways only if they deliver services of which the quality and competitiveness is comparable with alternatives offered by other modes, in particular road transport.

The key players involved in this process are public administrations including a national governments, regional, local administrations and non-international public authorities, ports and port services including a port authorities, ports associations and port service providers such as towage and pilot organizations, ship-owners including associations of ship-owners and shipping lines, intermediate organizations including all types of shipping agents (freight forwarders, ship-brokers, transit organizations, e.g.), shippers, short sea shipping promotion centers, transport organizations including all private transport organizations not focused only in maritime transport (road and rail operators, intermodal logistics companies, eg.), civil society organizations including labor organizations (trade unions and staff organizations), environmental organizations, e.g.

4. Present Situation in the European Union

There are large differences in demand, trade patterns, types of services and markets in the various Motorways of the Sea regions and this is reflected in differences in approaches to preparing Motorways of the Sea.

This concept had been introduced in 2001 transport White Paper (European Transport policy for 2010: time to decide), where the Directorate-General for Energy and Transport proposed the development of Motorways of the Sea as a “real competitive alternative to land

transport." One of the most important aims of this document is have the network of motorways of the see services up and running by 2010.

The main roles of the Commission as a European coordinator to support the implementation of the Motorways of the Sea are:

- motivate the relevant players in the public and private sector to prepare and submit Motorways of the Sea project proposals in the framework of the TEN-T and Marco Polo programs,
- foster co-operation between the public and private sector in the preparation of the Motorways of the Sea,
- encourage Member States and regional authorities to create favorable conditions for successful deployment of Motorways of the Sea,
- help raising awareness amongst shippers of the benefits of integrated Short Sea Shipping and Motorways of the Sea,
- help identifying and solving obstacles to its development,
- help targeting financial interventions in support of the Motorways of the Sea.

The main reasons for supporting the creation of Motorways of the sea by EU are that they:

- provides more efficient, more cost effective, less polluting freight transport;
- reduces road congestion on key bottlenecks across Europe;
- provides better, more reliable connections for peripheral regions;
- plays a role in making Europe's economy stronger and more sustainable.

In accordance with information mentioned above it seems that the future Trans-European transport network (TEN-T) will incorporate intermodal logistics chains that contributes to the largest extent towards reaching objectives linked to rebalancing the modal split, constituting the central axis of the maritime transport network in the following key corridors defined by European Union:

1. Motorway of the Baltic Sea
2. Motorway of the Sea of Western Europe (Atlantic Ocean – North Sea/Irish Sea)
3. Motorway of the Sea of South-east Europe (Adriatic, Ionian and Eastern Mediterranean Seas)
4. Motorway of the Sea of South-west Europe (Western Mediterranean Sea).

By 2010 Motorway of the Baltic Sea should link the Baltic Sea Member States with Member States in Central and Western Europe (including the route through the North Sea/Baltic Sea canal); Motorway of the Sea of western Europe should connect the Portugal and Spain via Atlantic Arc to the North Sea and the Irish Sea; Motorway of the Sea of south-east Europe should link the Adriatic Sea to the Ionian Sea and the Eastern Mediterranean (including Cyprus) and Motorway of the Sea of south-west Europe should connect western Mediterranean (Spain, France, Italy and including Malta) with the Motorway of the Sea of south-east Europe, including links to the Black Sea. This situation describes scheme on fig.1.

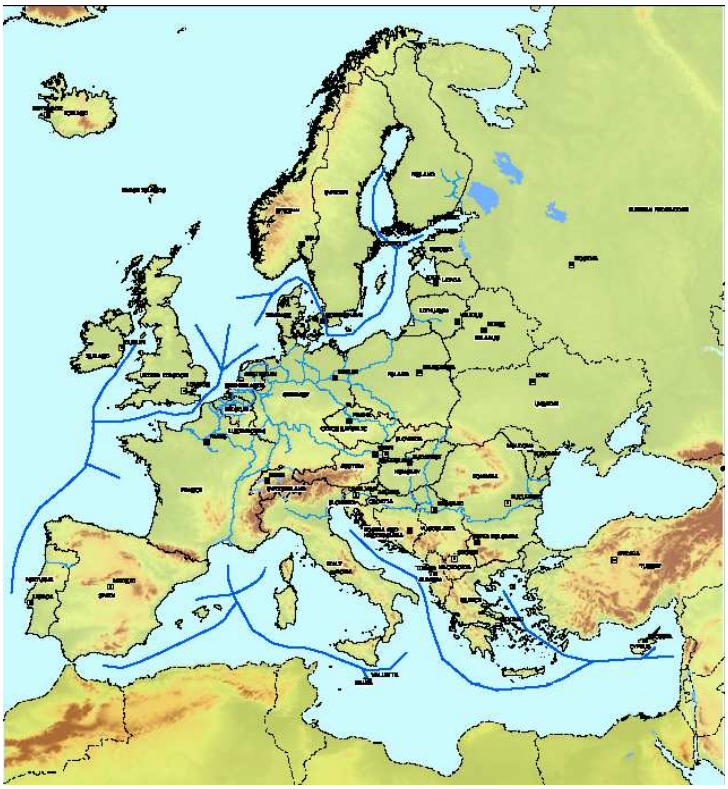

Fig. 1. European Motorways of the Sea. [3]

5. Steps to be Taken Up to Make the Motorways of the Sea Reality

There exist many challenges that must be taken up to make the motorways of the sea reality.

There is no longer sufficient have a network of services from port to port. There should be taking concrete steps towards making motorways of the sea a reality. The concept of motorways of the sea should not be limited only to a determined maritime connection between two European ports. It should include the totality of an intermodal door-to-door logistics chain. To increase the competitiveness of maritime transport are needed a series of complementary services. These services of high quality will be indispensable, as well in terms of cost as well in time, at every point of this logistics chain: transport from door to port, time at the port, journey from port to port as well as transport from port to door.

Undoubtedly, the probability that maritime transport will constitute a viable complementary alternative to road transport will depend on its ability to adapt the provision of its services to market needs. It is evident that Short Sea Shipping (SSS) has not succeeded in adapting and meeting satisfactorily these needs, given that the desire for modal shift has not materialized. The creation of motorways of the sea was intended to resolve the key inefficiencies that have prevented SSS from reaching its full potential, thus reviding users with competitive door-to-door maritime services as much in terms of cost as much as in time in comparison to road transport.

There exist several issues that question the very potential success of motorways of the sea.

Firstly, for this potential to materialize itself, the very discussion on the typology of traffic flows should not excessively emphasis the advantage of platforms (ro-ro) over containers. To the contrary, the opinion that the container will serve as the logical vehicle for the expansion of SSS is gaining more support. To this effect, an eclectic approximation that does not favor one type of traffic over another should be more commonly adopted within the doctrine of the motorways of the sea. Only this will enable us to avoid excluding a priori development possibilities.

Secondly, it is essential to consolidate a high frequency thus adequately meeting the logistics needs of the sectors, which will require bold initiatives within the field of sectorial logistics, as much for exports as for imports. These initiatives must take place simultaneously with the efforts that ship-owners will make.

Thirdly and tightly linked to the previous comment, the financial commitments of the private sector to guarantee frequency and rotations are much more significant with SSS than with road transport, which is mostly financed by the public sector. The relative lack of funds supporting the creation of motorways of the sea can constitute a determinant of a hypothetical failure, in the perspective of substantial changes in the modal split. Including the financing of vessels as part of the infrastructure and transport policy should be considered as a matter of urgency.

Fourthly, it is critical that efforts being made be concentrated in a reduced number of ports so as to assure the viability of any action. However, port experience advises that it should be the market and not policy-makers the one deciding optimally in this situation. The effort to reach a sufficient equilibrium with respect to this matter constitutes itself as a critical point in relation with the consolidation of motorways of the sea.

6. Conclusion

The motorways of the sea seem to be a very powerful concept. However, for the network to be a success by 2010, as well as for SSS to stop being considered just as a dream, the issues raised in this paper should be tackled swiftly. Otherwise, the highly inflexible reality of the current situation will continue to impose itself and motorways of the sea will be judged as another failed attempt at shifting cargo towards a balanced modal split.

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Modeling TSP by Network Flows

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Abstract. The Traveling Salesman Problem is well-known NP-complete problem by which can be formulated many practical problems. There exists a lot of literature concerning modifications of this problem and their models. In this paper, transformation of the Traveling Salesman Problem into problem of finding cheapest flow in the network graph will be introduced; construction of complete n-partite digraph from the complete graph will be presented; basic model and also modified model of this problem will be constructed. GNU Linear Programming Kit Solver was used for computational experiments.

Keywords: Traveling Salesman Problem, TSP, network flows, n-partite digraph, TSPLIB, MathProg, GNU Linear Programming Kit

1. Introduction

The Traveling Salesman Problem (TSP) is well-known NP-complete problem. Many practical optimization problems can be transformed into this problem. TSP can be formulated as follows: Traveling salesman has to visit all of his customers in sequence using the shortest possible closed *walk*. In other words, we have to find sequence (permutation) of customers (towns, vertices) that creates the shortest closed *walk* (with the smallest cost). Formulation of this problem from graph theory is: Let us have continuous edge-weighted graph $G = (\mathcal{V}, \mathcal{H}, c)$. Task is to find the shortest closed *Hamiltonian walk*[1] [1]. Note that for the complete graph or digraph, the goal is to find the shortest *Hamiltonian cycle*[2].

A lot of literature exists concerning mentioned problem and its modifications (see [2]). In this paper will be presented transformation of the problem described above, into problem of finding cheapest network flow in the network graph.

2. Basic Model

Let us have edge-weighted complete graph $G = (\mathcal{V}, \mathcal{H}, d)$ where $d(v_i, v_j)$ is the shortest path from vertex v_i to vertex v_j. Let $n = |V|$ be the number of vertices in graph G. For ease of use, we will be referencing each vertex v_i by number i, so we define function $s(i) = v_i$ and set $\mathcal{N} = \{1..n\}$. Our goal is to find the permutation of set N that will construct the shortest Hamiltonian cycle in the graph G. By fixing vertex v_1 as a starting and ending point of cycle, we will reduce our task to the task of finding the best permutation of set $N_2 = 2..n$ with respect to vertex v_1. By relaxing our task to the task of finding the best variation of all elements of set N_2 with repetition, we can transform this problem into the problem of finding the cheapest unit

[1] Hamiltonian walk - walk that contains all the vertices of the graph
[2] Hamiltonian cycle - special kind of Hamiltonian walk; contains every vertex only once

network flow in the $(n+1)$-partite network digraph where every arc of digraph has maximum throughput set to the 1 unit of flow. Every possible one unit network flow in the digraph will represent one possible variation of set N_2. We will now construct mathematical model of this new problem.

Let edge-weighted digraph $K_{1,(n-1)\times(n-1),1}(G)$ be the $(n+1)$-partite digraph constructed from graph G by following way. $K_{1,(n-1)\times(n-1),1}(G) = (\mathcal{W}, \mathcal{H}', d')$ where set $\mathcal{W}' = \mathcal{W}_1 + \mathcal{W}_2 + ..\mathcal{W}_n + \mathcal{W}_{(n+1)}$ consists of $(n+1)$ groups of vertices. $\mathcal{W}_1 = \{w_{11}\}$, $\mathcal{W}_j = \{w_{2j}, w_{3j}, .., w_{nj}\}$, $j \in N_2$ and $\mathcal{W}_{(n+1)} = \{w_{11}\}$. Vertices of the graph K are mapped to the vertices of the graph G by the function $t(w_{ij}) = v_i$ where $w_{ij} \in \mathcal{W}$ and $v_i \in \mathcal{V}$. Set of arcs $\mathcal{H}' = \{(w_{ij}, w_{kl}), w_{ij} \in \mathcal{W}_j, w_{kl} \in \mathcal{W}_l, l = j+1\}$. We will formulate weight $d'(w_{ij}, w_{kl})$ of arc $(w_{ij}, w_{kl}) \in \mathcal{H}'$ as the cost of one unit of flow going through that arc and set $d'(w_{ij}, w_{kl}) = d(v_i, v_k)$ where $\{v_i, v_k\} \in \mathcal{H}$. Every arc has maximum throughput 1 unit of flow.[3] At the Fig. 1 you can see 7-partite network

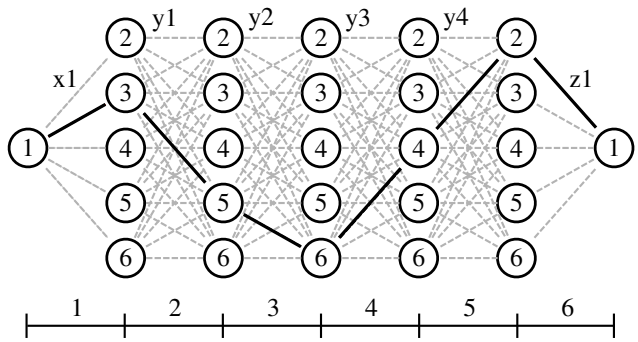

Fig. 1. 7-partite digraph $K_{1,5\times5,1}$ with highlighted cheapest flow representing the shortest Hamiltonian cycle in complete graph with 6 vertices.

digraph $K_{1,5\times5,1}$ constructed from the complete graph with 6 vertices, as described above. All arcs are oriented from the left to the right.

Formulated network model can be solved by algorithms of Graph Theory or Linear Programming (LP). Set of all feasible solutions of our relaxed model represents all possible closed walks in the original graph with n vertices. This set contains subset that represents all possible Hamiltonian cycles in the original graph. We actually need this subset to be the set of all feasible solutions. We should therfore deny flows that contain every vertex v_i of original graph except v_1 more than once to solve original problem. In other words, we should add constraints that will deny flows that contain more than one vertex of every set $\{w_{i2}, w_{i3} \dots w_{in}\}$.

With these constraints set, it would be hard to solve this problem using graph algorithms. So we will now construct LP model of this problem. In the model we should decide, if there will be flow going through arc or not. So we will divide digraph to n groups of arcs in the way that i-th group contains arcs connecting vertices from sets $\mathcal{V}_i$ and $\mathcal{V}_{(i+1)}$, as we can see in Fig. 1. We need three sets of decision variables.

$$x_j = \begin{cases} 1 & \text{if there will be network flow through arc } (w_{11}, w_{j2}) \\ 0 & \text{otherwise} \end{cases}$$

$$y_{ijk} = \begin{cases} 1 & \text{if there will be network flow through arc } (w_{ik}, w_{j(k+1)}) \\ 0 & \text{otherwise} \end{cases}$$

[3] This definition can be applied also when G is digraph. We have to change last part to $(v_i, v_k) \in \mathcal{H}$.

$$z_i = \begin{cases} 1 & \text{if there will be network flow through arc } (w_{i2}, w_{1(n+1)}) \\ 0 & \text{otherwise} \end{cases}$$

With variables declared (7), relaxed network model can be formulated by objective function (1) and constraints (2), (3), (4) and (5). By this formulation, vertex w_{ij} is part of the flow, if total flow, going through the outgoing arcs, is one. To deny flows which contain more than one vertex of every set $\{w_{i2}, w_{i3}, ..w_{in}\}$, we should add constraint that will allow maximum total flow through the outgoing arcs of set $\{w_{i2}, w_{i3}, ..w_{in}\}$ to be 1 (6).

$$\text{Minimize} \quad f = \sum_{j \in N_2} d_{1j} x_j + \sum_{i \in N_2} \sum_{j \in N_2} \sum_{k \in R} d_{ij} y_{ijk} + \sum_{i \in N_2} d_{i1} z_i \tag{1}$$

subject to

$$\sum_{i \in N_2} y_{ji2} = x_j \qquad j \in N_2 \tag{2}$$

$$\sum_{i \in N_2} y_{ijk} = \sum_{i \in N_2} y_{ji(k+1)} \qquad j \in N_2, \quad k \in R_2 \tag{3}$$

$$\sum_{i \in N_2} y_{ij(n-1)} = z_j \qquad j \in N_2 \tag{4}$$

$$\sum_{j \in N_2} x_j = 1 \tag{5}$$

$$\sum_{j \in N_2} \sum_{k \in R} y_{ijk} + z_i = 1 \qquad i \in N_2 \tag{6}$$

$$x_i \in \{0,1\}, \quad y_{ijk} \in \{0,1\}, \quad z_i \in \{0,1\}, \quad i, j \in N_2, \quad k \in R \tag{7}$$

$$N_2 = 2..n, \quad R = \{2..n-1\}, \quad R_2 = \{2..n-2\} \tag{8}$$

The objective function (1) models total cost of the feasible network flow. Equations (2), (3) and (4) ensure network flow consistency. Same amount of flow that arrives to the vertex must also depart. Equation (5) says that through the network will go flow with total throughput 1. Until this moment, it was LP model of network graph that allows relaxation of obligatory constraints. Constraint (6) breaks this fact. Fig. 1 shows the solution of LP model with 6 vertices. Model is referenced in Tab. 1 by name *TSP-NF*.

3. Modified Model

Problem of the model mentioned above is that it has many bivalent variables and also many constraints. We will now modify this model, to reduce number of variables nearly by half.

Idea of the modification is that we can construct two one-unit network flows[4] in the network digraph $K_{1,n\times p}(G)$[5], where $p = \lceil n/2 \rceil$, that will represent Hamiltonian cycle in the original model. Vertex v_1 of the cycle will be source of the network graph and the middle vertex of cycle

[4]More flows could produce two or more sub cycles in the solution of the original problem, not Hamiltonian cycle.

[5]This digraph can be formulated like the graph formulated in the previous section, only with different sets of vertices. Construction of these sets can be deducted from the symbols in the digraph's name.

will be the sink of the network graph. One flow will represent sequence of vertices from vertex v_1 to the middle vertex and second flow will represent sequence from middle vertex to vertex v_1 when followed form the sink to the source. So there will be $n-1$ possible sinks in the digraph as we can see in Fig. 2.

After these modifications, cheapest network flow in the model will represent the shortest Hamiltonian cycle. Restriciton of this model is that it can solve only symmetric TSP because of network flow representing path in TSP in opposite direction.

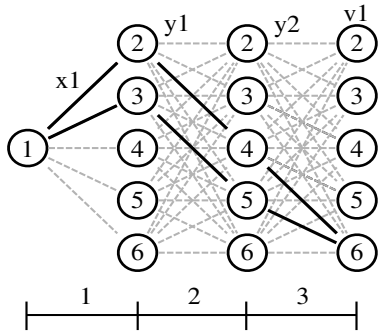

Fig. 2. Network digraph and highlighted solution of modified model, when n is even.

In this new model we do not need variables z_i, but now we need new set of variables w_i. Those would model decision, which vertex form last set of vertices will be the sink. See Fig. 2.

$$w_i = \begin{cases} 1 & \text{if vertex } w_{i(p+1)} \text{ will be the sink of network graph} \\ 0 & \text{otherwise} \end{cases}$$

Hamiltonian cycle, if exists, has the same number of edges as is the numer of vertices in the original graph. In our new model, we should be able to construct two network flows with the same number of arcs. This can be concluded from the formulation of the model.

So this problem has to be divided into two variants. First variant occures when complete graph G has even number of vertices. At the Fig. 2 is the solution of this variant with $n = 6$. The model of this variant can be constructed as follows:

$$\text{Minimize} \quad f = \sum_{j \in N_2} d_{1j} x_j + \sum_{i \in N_2} \sum_{j \in N_2} \sum_{k \in R} d_{ij} y_{ijk} \tag{9}$$

subject to

$$\sum_{i \in N_2} y_{ji2} = x_j \qquad j \in N_2 \tag{10}$$

$$\sum_{i \in N_2} y_{ijk} = \sum_{i \in N_2} y_{ji(k+1)} \qquad j \in N_2, \quad k \in R_2 \tag{11}$$

$$\sum_{i \in N_2} y_{ijp} \leq 2w_j \qquad p = \lceil n/2 \rceil, \quad j \in N_2 \tag{12}$$

$$\sum_{j \in N_2} x_j = 2 \tag{13}$$

$$\sum_{j \in N_2} \sum_{k \in R} y_{ijk} + w_i = 1 \qquad i \in N_2 \tag{14}$$

$$x_i \in \{0,1\}, \quad y_{ijk} \in \{0,1\}, \quad w_i \in \{0,1\} \quad i,j \in N_2, \quad k \in R \tag{15}$$

$$N_2 = \{2..n\}, \quad R = \{2..p\}, \quad R_2 = \{2..p-1\}, \quad p = \lceil n/2 \rceil \tag{16}$$

Objective function of this model (9) is slightly different from the (1) in the basic model. Equations (10), (11) are similar to (2), (3). Constraint (12) ensures that flows end in the chosen sink. Equation (13) says that through network will flow 2 units, because now we have two one-unit flows. Constraint (14) allows throughput only through one vertex of every set $\{w_{i2}, w_{i3}, .., w_{i(p+1)}\}$. Model is referenced in Tab. 1 by name *TSP-NFHE*.

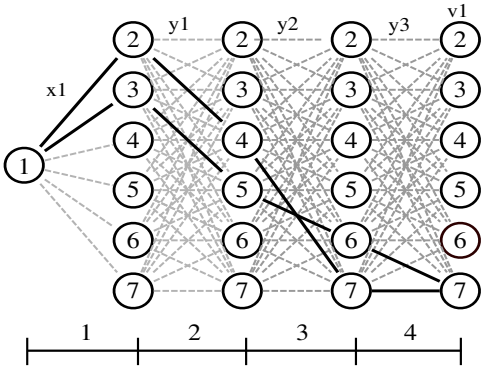

Fig. 3. Network digraph and highlighted solution of modified model when n is odd.

Second variant occures when complete graph G has odd number of vertices. Hamiltonian cycle in such graph will have odd number of edges. But we need even number of edges to be able to construct two network flows with the same number of arcs. To solve this problem, we will add imaginary loop, with the length 0, to the middle vertex of the Hamiltonian cycle. Likewise, we will add constraint to the model that will ensure that the arc $(w_{i(p)}, w_{i(p+1)})$ will be part of the solution iff vertex w_{ip} is the sink (see 18). At the Fig. 3 is the solution of this variant with $n = 7$. Bellow are shown only those constraints that differ from those in the variant above:

$$\sum_{j \in N_2} \sum_{k \in R} y_{ijk} = 1 \qquad i \in N_2 \tag{17}$$

$$y_{iip} = w_i \qquad p = \lceil n/2 \rceil, \quad i \in N_2 \tag{18}$$

Objective function (9) and constraints (10), (11), (12) (13) are the same in this model. Constraint (17) now allows throughput only through one vertex of set $\{w_{i2}, w_{i3}, .., w_{ip}\}$, because vertices w_{ip} and $w_{i(p+1)}$ will be used together, if so. Constraint (18) ensures, that there will be flow through arc $(w_{ip}, w_{i(p+1)})$ only iff the vertex $w_{i(p+1)}$ becomes sink. This is one way of modeling imaginary edge in Hamiltonian cycle, when we have odd number of vertices. Model is referenced in Tab. 1 by name *TSP-NFHO*.

4. Experiments

I have tested all formulated models on some instances of TSP problem from [4] using GLPK package [5]. Results of experiments are visible in Tab. 1. At the left column are names of instances tested. Continuing to the right are time results in seconds and remaining gaps in

percents for runs that I suspended prematurely. I have tested also classical model of TSP [6] for comparison reasons, which is referenced in table by name *TSP*.

	TSP		TSP-NF		TSP-NFHE		TSP-NFHO	
gr17	27.3	0.0	186.9	0.0	-	-	33.2	0.0
gr21	2.8	0.0	385.2	0.0	-	-	35.8	0.0
gr24	325.7	0.0	7976.2	0.0	1289.2	0.0	-	-
fri26	271.9	0.0	6475.2	0.0	1075.4	0.0	-	-
dantzig42	30200.5	6.2	-	-	47681.0	12.9	-	-

Tab. 1. Results of experiments

5. Conclusions And Future Work

In this article, different approach to model TSP was presented. Problem has been transformed into problem of finding cheapest flow in p-partite network digraph and bivalent linear programming model was constructed to this problem. Likewise, modification of the model was introduced that reduces number of variables nearly by half.

Models has been rewritten into modeling language GNU MathProg [3] and tested on some instances of TSP problem from TSPLIB[4] with opensource solver GLPK[5]. Results can be seen in Tab. 1.

Advantage of intorduced models is that there are not any integer variables, only bivalent ones. Likewise, models does not allow subcycles to be created. Disadvantage is that they require a lot of variables and that produces long computational times. Modified model partly solves this problem by reducing amount of variables by nearly half. But it is still not enough.

A lot of further research is needed concerning these models. Some of future goals are: To analyse if better computational times can be obtained for some special kinds of graphs (like planar graphs). To construct herustic or exact algorithms based on presented models. To analyse if these models are better suited for modeling of more complex problems concerning TSP, than some known models.

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Mobility Plan as a One of the Instruments of the Mobility Management

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Abstract. The paper gives an overview of the mobility management concept and presents the mobility plan as one of the fundamental instruments of the mobility management. The purpose of this plan is promotion among travellers sustainable mobility modes: bikes, public transport, walking trips and new means of private car usage (carpooling, carsharing systems). Mobility plans contain also activities and solutions which realize an idea of sustainable mobility. The concept, implementation process and results of this innovative solution was shown on the examples of the two mobility plans: "An integrated mobility plan for the Cracow University of Technology" and "An integrated mobility plan for the San Martino Hospital in Genoa".

Keywords: mobility management, mobility plan, reduction of traffic congestion, travel behaviours.

1. Introduction

Mobility management is an approach to the passenger transport, oriented on promotion of the sustainable mobility modes and the management of the demand for car usage through change of travelers' attitudes and behaviors. With help of the various instruments of the mobility management users are encouraged to reduction of one-person car trips, usage of the carpooling and carsharing systems as well as to traveling by public transport, bikes or by foot.

Change of the mobility attitudes an behaviors is very long and not easy process. There is a necessity to take into consideration specific needs and expectations of different users. That is why the mobility management concept consists of range of services and instruments corresponded to individual clients' needs that can be flexible adapted to various conditions and expectations of target groups. The core of the mobility management makes the "soft" measures like:

- Information and consulting (provision to the travelers the information about sustainable mobility modes, analysis of present situation, looking for the solutions, evaluation of the alternatives and recommendation of the concrete solution e.g. comparison of the travel time and costs of different transport modes),
- Transport services and products (this category includes not only the standard services and products like tickets, maps with city transport network but also innovative services and products: loyalty programs, public transport tickets which provide entrance to the cultural or sports events etc.),
- Products sales and reservations,
- Organization and coordination of the services and solutions (e.g. organization of the carpooling or carsharing systems in institutions, coordination of the mobility services for the handicaps),
- Educational and marketing activities.

"Soft" measures usually enhance the effectiveness of the "hard" measures related with transport infrastructure development (e.g. new tram lines or new bike paths construction). Activities within mobility management "soft" measures do not require large financial investments - in comparison to the "hard" measures.

2. Mobility Plan as a One of the Instruments of the Mobility Management

One of the fundamental instruments of the mobility management is the mobility plan (travel plan, trip reduction plan, green commuter plan). Mobility plan integrates mentioned above „soft' measures in one package of the activities. This plan includes strategies for promotion of the idea of sustainable mobility and, on the other hand, consists of solutions and measures which realize the idea of sustainable mobility.

The general aims of the mobility plans are the following:

- Change of travel behaviours of target groups towards pro - ecological transport modes (public transport, bikes, walking trips, new forms of private car usage – carpooling, carsharing systems)
- Improvement in accessibility to the institutions or to the areas
- Reduction of parking needs
- Reduction of traffic congestion

In European cities mobility plans are implemented for these places which generate and attracted large traffic flows like: distinguished city areas (city centers, housing estates, industrial areas), big institutions and companies (municipalities, schools, universities, hospitals, shopping centers etc). Activities realized in framework of the mobility plans are also appropriate to temporary events – trade fairs, concerts, sports matches – the organization of the mentioned events has a relevant impact on the urban transport system and results often in paralysis of the city. Mobility plan activities help to reduce the effects of temporary events organization.

Below examples of the mobility plans implemented in two institutions in framework of the EU CIVITAS CARAVEL project.

2.1. An Integrated Mobility Plan for the Cracow University of Technology (2005 – 2008)

First mobility plan in Poland was implemented by the Cracow University of Technology (Chair of Transport Systems). It aimed on the change of the University employees' and students' mobility behaviors towards sustainable transport modes.

University was affected by the increasing number of cars in the city - more employees and students used private cars to get to the University campuses which are located in different city areas. Alternative modes of transport are considered as less up-market and insecure.

First phase of the mobility plan realization was analysis of situation before measure implementation (2005, 2006). Mobility plan performers carried out surveys about employees' and students' travel behaviors and preferences as well as inventories concerning trips conditions to and from University campuses realized by public transport, bikes and cars. Results of analysis allowed to formulate the main activities within realization of the mobility plan.

In order to reach measure objectives, the following activities have been implemented:

- New information website www.info-komunikacja.one.pl with data concerning public transport modes, bikes and carpooling system at the University,

- Mobility Consultant post – person who gives employees and students advise and information about traveling,
- New bike policy – promotion of bikes and location of 23 new bike racks (about 120 parking places) in the University campuses – fig. 1.,
- New car parking policy – reduction of parking needs and increase in parking costs in the area of the University (in order to encourage parking users to PT traveling instead car trips),
- Concept of the bike paths between University campuses related with changes in traffic organization on several streets and improvements in cyclists safety,
- Concept of improvements in PT accessibility to the University campuses concerning implementation of the new tram lines nearby Main University Campus,
- Series of seminars and workshops among employees and students concerning sustainable mobility,
- Many marketing actions for promotion of sustainable transport modes (brochures, leaflets, happenings).

In 2008, thanks to the mobility plan activities, share of one – person car trips in traveling to the University campuses was decreased - for employees: from 45% to 41% and for extramural students: from 50% to 30%. It can be explained as a change from car trips (as a driver) to carpooling trips. Share of carpooling trips was increased - for employees: from 1% to 5%, for full-time students: from 0% do 7%, and for extramural students: from 1% to 17%. Because of increase in carpooling trips the needs for parking at the University area were reduced. In employees' traveling to the University the share of bikes had been double increased.

Fig. 1. One of the new bike parking at the University area.

2.2. An Integrated Mobility Plan for the San Martino Hospital in Genoa (2005 – 2008)

The San Martino Hospital in Genoa is one of the biggest in Italy. More than 4500 employees work in this hospital that covers more than 30.000 m2. It is located along one of the main street connecting the eastern part of the city and the centre, where the traffic flow in the morning peak hour is about 4000 vehicles. Every day the hospital generates and attracts a large number of employees, patients, visitors and students of the Medicine.

Objective of the mobility plan for the hospital was to regulate all the public and private traffic generated/attracted by the hospital and by the surrounding areas in a more efficient way.

In order to get the objective following activities have been implemented:

- Development of The Home Work Trip Plan (HWTP) for the employees of the hospital with particular focus on the testing of the carpooling system,
- Establishing of the Infomobility platform (with information about traffic and mobility) for employees and visitors – two kiosks with the access to the internet were installed in two crucial locations inside the hospital,
- Increasing the bus connections to the several departments inside the hospital,
- Extension of the public transport system (additional runs of buses) inside of the hospital area for the people coming early in the morning and late in the evening,
- Use of electrical vehicles to goods distribution inside the hospital area,
- Dissemination of the mobility plan and sustainable mobility modes through: training workshop, special bus (Infomobility Bus) parked outside the hospital days before the workshop, advertise in the notice boards inside hospital buildings and in the intranet.

Implementation of the mobility plan for the San Martino hospital allowed to obtain the following results (2008):

- The traffic flows on the street nearby hospital had been decreased (in west direction, in morning peak hours by 31%),
- The share of the car trips to the hospital had been decreased from 42% to 39%
- The share of the walking trips had been increased from 5,5% do 11,5%.

3. Conclusion

Change of the travelers' behaviors is very long and multi-stages process. But with the help of the mobility management instruments it is possible to fulfill their mobility needs and to encourage them to traveling in more sustainable way. Mobility plans allow to shape the mobility needs and attitudes through:

- Demonstration of more efficient and integrated modes of traveling,
- Influence on users mobility via development of bike and public transport infrastructure, improvement in services, information and consulting,
- Promotion of the sustainable transport via marketing and educational actions.

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Legal Aspects of Galileo

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Abstract. The paper brings brief information about Galileo. Galileo is Europe's initiative for a state-of-the-art global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. While providing autonomous navigation and positioning services, Galileo will at the same time be interoperable with GPS and GLONASS, the two other global satellite navigation systems. The paper describes administration of public sector, financing of Galileo.

Keywords: Global Satellite Navigation Systems (GNSS), Galileo, program control, financial framework of Society, financing from the budget of Society, inter-government financing.

1. Introduction

Nowadays Global Satellite Navigation Systems (GNSS) become more and more important. In air transport, GNSS services have been an additional way of navigation for a long time. GALILEO will be Europe's global navigation satellite system. It will provide a highly accurate, guaranteed global positioning service under civilian control. Receivers are now found in all kinds of electronic devices for everyday use such as mobile phones, personal digital assistants, cameras, portable PCs or wristwatches.

It will consist of the global constellation of 30 satellites in three Medium Earth orbital planes inclined at 56˚ to the equator at about 23 000 km altitude. Ten satellites will be spread evenly around each plane with each taking about 14 hours to orbit the Earth.

The fully deployed Galileo system will consist of a constellation of 30 satellites and is planned to provide services as from 2011. The first test satellite, GIOVE-A, was launched from Baikonur in December 2005.

2. Administration of Public Sector

With the aim of fulfilling EU strategy for GNSS, the EU Council has established the common enterprise Galileo by directive of the Council, no. 876/2002 – 21st May 2002 with the respect of the Contract about establishment of the society and especially its part 171, then with the respect of the Commission proposal, the communiqué of the Parliament and the communiqué of the Economic and social commission. From the point 11 of the Council directive no. 876/2002, it is originated that development phase of the Galileo project should be followed by building phase (satellite production, building terrestrial components, launching ground stations and components).

Program checking and control are always a part of programs like Galileo. Clear division of tasks and responsibilities and an effective decisive process help to prevent cost – overrun and delays at program fulfilling.

The commission has drafted simplifying structure of public administration as well as structured task division based on the clear separation of program check from program control.

2.1. The Council and European Parliament

They fulfill checking task in the form of political supervision carried out directly by The Council and European Parliament and program supervision in the form of "commission for European programs GNSS" [1], in that representatives of member countries will take part in program fulfilling and carry out general consulting function in all important aspects of the program.

2.2. The Europe Commission

This institution is subordinated directly to the Council and Parliament. It has to convey general responsibility for program managing. Besides that, Europe Commission is presented as main creator (or "sponsor") of the program. It checks all the contracts about development, public providing, running and maintaining that are connected to the system infrastructure.

2.3. Supervisory Organ over European GNSS (GSA)

As accrediting organ it is responsible for organization of certification. Besides that, GSA advises and helps at program managing in all its aspects. It needs to be said, that the breakup of negotiation about concessionary contract in terms of public-private partnership was caused by law vacuum about GSA task. This task has fully consisted in introducing concession holder, which corresponds with the current directive [2] that was the base for establishment of this organ. That is why it is important to make the GSA task stronger. It means all the proper designations concerning market preparation with the aim to enable EU to make progress in its commitments towards Galileo program.

2.4. European Space Agency

As co-agent of European programs GNSS and as a technical architect of these programs, ESA is in a great position to overtake the task of an agent for public providing and the task of a main author ("primary contractor"). ESA acts on the base of a detailed agreement between ESA and ES about GNSS programs, which designates particular duties, politics of public providing, agreement about giving reports and interaction limits of independent decisive competence of ESA and methods which determinate decisions which are agreed by Commission and in necessary situations also by the Council and European parliament [2].

3. Financing of European Programs GNSS

According to designed scenario for the years 2007 - 2013 there will be a need of finance (financial need) in amount of 3,4 milliard EUR. However, in the financial framework of Society for the years 2007 – 2013 only 1 milliard EUR is put aside. Therefore other possibilities should be analyzed in order to find other financial sources in amount of 2.4 milliard EUR during the years 2009– 2013. In the beginning, it is important to distinguish between these two possibilities with respect for the mentioned aim: financing from the budget of Society and inter-government financing, which does not concern the budget of Society.

3.1. Financing from the Budget of Society

In the inter-institutional agreement about budget discipline and proper financial budgeting (IIA) the terms are settled, according to which the budget organ is able to decide about revision of multi-year financial framework in the case of unforeseeable occasions. The fail of negotiation about concessionary contract with the private consortium is considered as one of these unforeseeable occasions.

3.2. Inter-government Financing

Inter-government financing could be realized in these forms:

a) European space agency finance half of the development phase of the Galileo program. This model of financing could be theoretically enlarged also in the phase of deployment. Choosing this solution brings a lot of disadvantages:
   - Not all member countries of EU, especially the new member states, are ESA members. Analogically not all ESA member states are EU members. That presents the problem from the point of view of material and non-material titles in terms of the program;
   - Financing by ESA is in conflict with the character of Society programs, because budget organ does not control that part, which is financed directly by ESA member states.
   - Co-financing has always great influence on public administration of program, because it is difficult to reconcile task of main author with the financial task of ESA.

b) A direct contribution of member states for the Galileo program could be from a similar source that is used by European development founds. Because of possibility of direct allowances for the program without need for member states to be guarantors, it is important to remind that in the contrary to member states ES is not allowed to receive allowance. Possibility to create these contributions needs more detailed investigating because there exists no precedence that could be used for this case.

However, because of law, institutional and program reasons, the Commission thinks that only European Union, as the owner of the system, could provide additional financial sources. However, at acceptable conditions, it could be considered also about international participation at activities such as making easier the access to the GNSS service in the entire world.

In common financial framework (2007-2013), there has been already planned the amount of 1.005 milliard EUR in the chapter of legislative proposal of the Commission [3] that concerns implementation of the phase of distribution and running of the Galileo program. It proposes increment in additional amount of 2.100 milliards EUR. Releasing this amount will be a subject of revision of common financial framework (2007-2013). In the changed proposal it will be defined the amount of 3.105 milliards EUR as the amount that should be planned in the budget of Society for 2007-2013 for European programs GNSS. In terms of the 7th framework program for research and development, there is 300 millions EUR put aside as a contribution for financing European programs GNSS. Therefore, the whole amount of the finance is 3.4 milliards EUR.

4. Conclusion

Galileo improved accuracy, integrity and authentication of the signal will allow to trigger a massive wave of new applications in key downstream markets. Galileo is likely to have a pivotal role in the development of both the upstream and downstream European GNSS based industry. The total market will be worth €300 milliards in 2020. Road GNSS revenues are expected to grow strongly in the next future. Moreover, Galileo will bring strong benefits to Europe, increasing the competitiveness of the European industry, improving the quality and the number of products/services available to users and having a positive impact on key social aspects (e.g. employment, safety, pollution). The time to act to build a successful European GNSS industry is now and EGNO is a powerful tool for grabbing opportunities arising before Galileo FOC.

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Wireless Sensor Network Experiments in Wildlife Observation

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Abstract. This contribution aims to present the abilities of wireless sensor network based systems on experiments in wildlife observation. Described experiments bring very important data concerning design issues and limitations of this technology. It is expected, that the wireless sensor network techniques would find its important place in the technology of transport as a future part of each mobile transport appliance.

Keywords: Wireless Sensor Networks, Wildlife Observation, ZebraNet, SWIM, Great Duck Island.

1. Introduction

The global effort to increase efficiency and safety of transport processes leads to experimenting and adoption of progressive solutions from various bodies of science. One of such experiments that can possibly be implemented into transport processes is the idea of the Wireless Sensor Networks. The networks of wireless sensor devices are intended to monitor and measure a variety of phenomena of interest. A wireless sensor device is typically a battery-operated device able to sense and/or measure physical quantities and capable of wireless communication. Usually the wireless sensor device is equipped with its own data storage, DSP (Digital Signal Processor) and CPU (Central Processing Unit) for limited amount of computation and signal processing.

2. Wireless Sensor Networks Design

During past few years, advances in integrated circuit design shrank the size, weight and cost of sensor devices. Modern wireless networking technologies enabled the collaboration of a large number of such sensor devices. A WSN (Wireless Sensor Network) consists of a quantity of wireless sensor devices aiming to achieve proposed results. A typical WSN has at least one base-station (sometimes called “sink”) to collect the acquired data from sensor devices. These base-stations are the interfaces to connect the WSN to the outside world.

Wireless sensor networks have a huge variety of applications nowadays. Let’s notice environmental monitoring, remote exploration, surveillance, condition-based maintenance, safety warning etc. Such applications require the network to monitor certain type of non-local spatiotemporal phenomenon, collaboratively process gathered information, and respond to external events or report results [1]. There are many different types of events or phenomena that can be monitored by a network of sensors. The basic premise of a WSN is to perform

networked sensing using a large number of relatively unsophisticated sensors, instead of the conventional approach of deploying a few expensive and sophisticated sensing modules [1]. The potential advantage of networked sensing over the conventional approach can be summarized as greater coverage, accuracy and reliability at a possibly lower cost [1].

Common principles of wireless network design cannot be applied to design of communication environment for WSN. The reason is that the traditional communication networks aim to support a diverse set of users, but in case of WSN, there is a need to design the network in a modular, interoperable and generic fashion, leading to layered protocol architecture [2].

3. Experiments in Wildlife Observation

3.1. Shared Wireless Info-station Model (SWIM) Experiment

This model intends to study the impact of changing environmental conditions on the behavior and migration process of whales. Sensor network implementation should bring necessary data to study the environmental impacts of human activities to the wildlife of whales. A SWIM-experiment measuring node is equipped with the Texas Instruments CPU with 60 KB of flash memory. The wireless communication unit of the node uses Silicon Labs Phase Lock Loop generating carrier frequency from 62 MHz to 1GHz. The node implements pulse interval coding and frequency shift keying, for data communication. This experimental node can acquire pressure, light and temperature data as well as collecting the outputs of its internal accelerometers.

The total network area is very large from the geographical point of view - covering hundreds of square kilometers of the sea. Fortunately the high mobility of the whales provides a good solution to this problem itself. In SWIM project a sensor node is directly attached to the body of a whale. Therefore the mobile nodes are in data-logger mode most of its operational time - only acquiring the data of interest. While the whale passes through the area covered by any of SWIM project base-stations, the node reports these buffered measurements. The base-stations are spread in the sea placed on floating buoys. To reduce the potentially large delay for data delivery, the sensor nodes share their measured data with each other in case of monitored whales are in close proximity. Using other words - when two sensor nodes come within communication range of each other, some or all of the stored data packets of each of the sensor nodes are replicated on the other sensor node. When a sensor node is able to communicate with a base station, it uploads all data it has gathered in any way - its own measurements and the measurements replicated from other nodes. Unfortunately this behavior also leads to increased storage requirements in each monitoring node and also negatively impacts the energy needs of the sensor nodes.

3.2. Great Duck Island Experiment

This experiment was performed by Intel Research Laboratory at Berkeley, the College of the Atlantic at Bar Harbor and the University of California at Berkeley. For purposes of this experiment a sensor network consisting of over 140 sensor nodes was built. This experiment took place on the Great Duck Island in the state Maine, US. It aimed to collect data at the nesting places of a duck for purposes of study the role of the micro-climatic factors in duck's habitat selection. The experiment was done in two rounds - one during the summer 2002 and the other in summer 2003. This experiment used Mica2Dot sensor nodes with its own operating system – TinyOS. The Mica2Dot is a sensor node developed by Crossbow Inc.

using the ATmega128 CPU and 512 KB of memory. The radio part uses the license-free bandwidth of 433.92 MHz with a data rate of 40Kbps.

This sensor node is capable of measuring light, temperature, humidity, barometric pressure and the infrared light on a single board. Two types of sensor nodes were designed for this project: nodes to be placed in nests detecting occupancy and special weather nodes for monitoring the surface microclimate. The body of all sensor nodes was sealed, but the sensing elements were exposed to the environment. The nodes were powered with lithium batteries with expected lifetime of around 100 days. This experiment became well known because of its special design of communication environment. One part of sensors communicated directly with the base-station in single-hop mode. Another part used a special routing protocol to route data packets between sensor nodes to the base-station. This approach was utilized to experimentally compare the two modes of communication. During the experiment severe weather conditions (Hurricane Isabel) forced the base station to shut down for a month. Finally it was observed, that the lifetime of the sensor nodes (the battery life) in routed part of the network was much shorter than expected/projected due to overhearing and long preambles in radio communication. The power consumption observations indicated that the overhearing issue consumed nearly eight times more energy than the power necessary in the real packet transmission. This demonstrated that the design of energy efficient media access protocol in a multi-hop radio network architecture is very important issue. In the case of a single-hop network, the packet delivery rate met the expectations, however in the case of a multi-hop network, the packet delivery rate was smaller than expected.

3.3. The ZebraNet Wildlife Monitor

The ZebraNet experiment architecture was developed to collect specific data on species of terrestrial animals in order to understand their interactions on one another and to understand the migration of wild animals affected by changes in weather and influences of human development. This experiment takes place at the Sweetwaters Reserve in central Kenya to study the behavior of zebras. The ZebraNet system uses sensor nodes designed as a collars placed around the animal's neck. These nodes in the ZebraNet system are equipped with a solar array to power their accumulators. A ZebraNet experiment collar node consists of a GPS receiver and CPU Hitachi-SH1 with 1MB of flash RAM. It is equipped with two independent radio communication modules: short-range Linx Technologies SC-PA with a range of 100 meters and a long-range Tekk data radio with up to 8 km communication range with a low data rate and higher power demands. A simple proprietary TDMA protocol is used in short-range radio. Lithium Polymer batteries are used and charged by a solar array. Main requirement of the ZebraNet experiment is to collect GPS position of its collar nodes every three minutes. The main design issues are as follows: the latency of data delivery is not important however the packet delivery rate to the base station should be close to 100%; there should be no direct human intervention for at least one year; there should be no fixed base-stations; the weight of the ZebraNet collar node should be minimal. Based on these requirements, the ZebraNet project can be characterized as a data gathering wide-area tracking application. Many objectives of the ZebraNet experiment project are similar to those of the SWIM project. The ZebraNet collars use the same data gathering protocol to the one used in SWIM project. The Dual-Radio Design brings advantages in energy consumption of the nodes, while the short-range radio is exclusively used by the collar nodes for communicating with one another and the long-range radio communicates with the WSN base station only. In case of ZebraNet project, the mobile base stations are used – driven around the monitored area non-intrusively. The ZebraNet sensor network is currently under deployment at the Mpala Research Center, in the Sweetwaters Reserve in central Kenya.

4. Conclusion

Wireless sensor networks play key role in observing and collecting information concerning vast variety of interesting phenomena nowadays. The performance of these networks depends on the design of communication environment – the I/O part and the communication protocol as well. In order to address these issues, it is necessary to apply non-traditional design principles such as cross-layer integration and application-specific design. These specific designs bring lightweight integrated protocol solutions for future purposes.

Described experiments with Wireless Sensor Networks in wildlife observation should bring useful data concerning animal behavior on one side and a deliver very important data concerning WSN design issues and limitations on the other. It is expected, that the WSN techniques would find its important place in the technology of transport as a future part of each mobile transport appliance.

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Methodology of Acceptance Feasibility Survey of Urban Road Pricing

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Abstract: Acceptance Feasibility Survey belongs to the first and important phase of urban road pricing. At this stage in the design process, it is important to obtain an accurate perception of how the road pricing concept is viewed by the general public, provide a mandate to proceed with further developmental work, and build a solid body of research knowledge to support future work. The most effective way to achieve this is through conducting a market research by questionnaire survey of acceptability.

Keywords: Urban road pricing, Acceptance Feasibility Survey, Questionnaire survey of Acceptability.

1. Overview of Public Acceptability

Different techniques are available for assessing public acceptability:

- ***Market research*** - such as focus groups, in-depth interviews and questionnaire surveys use scientific sampling techniques to determine the views of the general population.
- ***Consultation*** events are designed to obtain responses from as many members of the public as possible. Such events can include public meetings, mass distribution of leaflets incorporating mail-back questionnaires, and public displays. Such events also normally employ large scale advertising campaigns and are designed to give all members of the public the opportunity to give their view on the proposals. Such events are often required by law to demonstrate that the public have been adequately informed and consulted.
- ***Referendum*** is formal tests of public opinion conducted in an election-style voting format. Referenda are normally used to determine whether or not a policy proposal should be implemented, transferring the decision making power from the political representatives to the general public.
- ***A Public Inquiry*** investigates an event or policy proposal in hearings that are open to the public. At the conclusion of its proceedings, a publicly available report is produced. Public inquiries are usually held when there is significant opposition to a proposed policy measure. The goal is to objectively assess stakeholder concerns and fairly assess whether the project should be implemented or not.

The different techniques described above each have their own specific objectives and are appropriate at different points in the road pricing scheme design process [1].

In my contribution I focused on the beginning phase of road pricing – questionnaire survey of Acceptance Feasibility.

2. Questionnaire Survey of Acceptability

The objective of this survey is to obtain quantitative data on road pricing acceptability.

2.1. Sampling

In order to obtain study findings that are valid for the general population, a probability sampling method must be used. Probability sampling means that each member of the population has an equal chance of being included in the sample, which is achieved through obtaining a random sample. The method recommended to achieve this is to use the national electoral role as the sampling frame, as this is likely to be the most complete source of information on the population as a whole. Using this method, a random sample of people is drawn from the electoral role for each targeted area, with those on the sample list sent a questionnaire survey in the mail and asked to complete the questionnaire and return it in the pre-paid envelope. Use of this method requires that a suitable electoral role exists, and that it can be accessed for commercial purposes. Some countries do not allow the use of the electoral role for commercial purposes, while other charge for its use [3]. This method is also recommended from a cost efficiency standpoint as sample selection for each case study city can be completed at the same time, and once the samples have been selected, questionnaire distribution can also be conducted from one central location, without having to deploy questioners to different parts of the country.

The next issue is to define the geographic area to be surveyed. It is recommended that the exercise samples the population of the city itself in addition to people living in the surrounding areas. This is because the population in the surrounding areas will also be affected by a road pricing scheme and therefore their acceptance of the scheme also needs to be assessed. It is also likely that public views towards road pricing will vary by residential location, with support higher in city centres due better public transport provision and lower private vehicle usage, and lower support in the more car dependent suburbs and areas outside the city. In order to assess this statistically, it is important to obtain sufficient sample sizes in different areas of the city and surrounding area (for example in case in Žilina – 3 zones: Centre, Centre Outskirts (Solinky, Hájik, Vlčince,..), City Outskirts (Višňové, Mojš, Lietavská Lúčka,..).

The exact definition of zone boundaries will depend on such factors as natural physical delineators (rivers, coasts, cliffs, etc.) as well as geo-political boundaries (local authority boundaries or city limits). It is also important to know the population size in each zone. Once the zone boundaries have been defined, the required sample size in each zone can be determined. It is recommended that the obtained sample size within each zone should not be lower than 200.

2.2. The Survey Instrument

The survey instrument (questionnaire) should involve the following data:

- Demographic and travel behavior data for each respondent.
- Data assessing attitudes toward the transportation system and current problems.
- Data assessing views on how these problems should be addressed / objectives for a future transport strategy.
- Opinions on the concept of using road pricing to achieve certain objectives / level of support for the road pricing concept.
- Level of support for different design options and assessment of stated preference style trade-offs.

- Opinions on how the revenue generated by road pricing should be used.
- Assessment of the level of trust / confidence in the likely implementing authority (local / national government).
- Opinions on how future consultation activities should be conducted.

It is important that the same questionnaire is used in each of the case study cities so that regional comparisons can be conducted. It is also possible that a small number of region-specific questions could be added in individual cities if specific regional issues are identified in the focus groups.

2.3. Survey Logistics

Obtaining random samples from electoral roles, and then printing and distributing several thousand questionnaires, are significant tasks and can be logistically difficult if the client organization does not have experience with this type of market research exercise. If this is the case, it may be useful to subcontract a market research company to conduct this aspect of the exercise. Such a company may also have knowledge of likely response rates to postal surveys and may also have access to a national electoral role, making these aspects of the sampling process much more straightforward.

If required, the market research company may also be able to collect the returned questionnaires, enter the data into electronic format, and then clean the data to remove coding errors. Employing such a company, preferably with experience in public sector market research, is often a more cost effective approach and increases the likelihood of completing the data collection activities on time. Once all the data is entered and cleaned, the completed dataset can be simply returned to the client organization for analysis.

2.4. Survey Data Processing and Analysis

The basic process for conducting the data processing and analysis is as follows:

- Descriptive analysis of responses and response rates by area and responses across different socio-economic and travel behaviour variables.
- Comparison of sample demographics against population demographics to assess sample representativeness.
- Calculation and application of data weighting to adjust the dataset for: o variations in sampling fractions by area, and, if necessary, o non-response bias.
- Aggregate survey results by area and overall.
- Analysis assessing the influence of different socio-economic and travel behaviour variables on views towards road pricing. Further investigation of significant relationships that are also statistically likely to exist in the population .
- Elaboration analysis and / or multivariate regression to assess the relative influence of each independent variable on views toward road pricing.

2.5. Road Pricing Acceptability in other stakeholder groups

The general public is just one of several stakeholder groups. Others include the business community, special interest groups, local and national public transportation operators, automobile associations, local schools and universities, utility companies, emergency services and others. Plans also need to be made to consult each of these stakeholder organizations and consider their views in the design process. Many of these groups are designated as statutory consultees that are required, by law, to be consulted. A consultation strategy can be developed

to structure these stakeholder consultation activities, which ideally should be designed in parallel with the public consultation strategy [2].

3. Conclusion

Public acceptability is an implementation barrier because, in democratic political systems, public acceptability has a direct influence on political acceptability. Road pricing, as part of a package of transport improvement measures, often receives support when the concept is initially introduced.

The qualitative approach to questionnaire survey is extremely useful in giving investigators a clear understanding of what the public regard as the major issues, as well as providing insight into the underlying reasons why they hold the views that they do.

Acknowledgement

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Role of Traffic Accident Information System at Transport of Dangerous Goods

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Abstract. On the present is in Europe trend of creation compatible informative system, witch is function on the some basis in all countries. One of these projects is also traffic information accident system. It deals with preventive activity and emergency. His activities are partitioned to threes of the chief parts: 1.administration of information's, 2.skilled advice on crash place, 3. technical help on crash place.

Keywords: transport, dangerous goods, traffic accident information system.

1. Introduction

Actual trend in the world and also in the Europe is to make up compatible information systems, witches are function on the some base in all countries, and witches are shared on this project. One of these projects is traffic accident information system.

Basic and main role of traffic accident information system is to make up international centers network and one coordination center, witch offer help at accidents at transport of dangerous goods. In the Slovakia is situated this center (central and coordination center CCC) is located in Duslo, inc. Šaľa. Deal between ZCHFP SR and Department of Home Affairs of SR (Fire Forces) was singed in august 2001. Condition of function is compatible system with schematics in surrounding States. Basis is make up network of centers and one coordination center, witch share help in the frame of they possibilities at accidents of conveyance transporting dangerous goods. In this system is a sing 9 company of union, whereby central and coordination center is located in Duslo a.s.

2. Filling of solution area in crash activates

Preventive activities – make better some activities, some activates to solve systematic. (testing, merge, packing, markings, documentation, formation of legislative).

Crash activities – integrate traffic accident information system to activate and structures of enterprises, work in join rescue system.

3. Filling of commission activities in prevention

- Meetings of safety advisers.
- Change of experience from abroad transfers, packing techniques, markings, merge – prevention of fee!
- Formation of legislative - cooperating with Ministry of transport (ADR, RID),or with next Ministries at formation of legislative.

- Testing and merge of materials – create register of institutions and foundations for testing of materials of classis 1-9 or they merge. Stronger connection witch Search institute of chemical technologies.

- Transport documentation – Adjust bill of landing CMR for transports of more material in relation of ADR, to prepare intrastate transfer bill.

- Cooperation with carriers – mainly Česmad Slovakia - group for ADR, implementation SQAS.

- Activities of DINS – to create gradually to European norm, make better they material equipment, meetings of employed of center of traffic accident information system, change of experience, reciprocal knowing, coordination of activities by hits, cooperation with Czech TRINS.

- Cooperation with Fire Forces – change of experiences, transinformation content, and coordination of activity's at hits.

- To make better of information info bases for hits – ERI karts, Medys Alarm, others available.

4. Principle of activity of Traffic accident information system:

- 1. Step - disclosure of information: CCC finds and provides to rescue forces contact to expert with knowledge of concrete dangerous good – advisory function of expert.

- 2. Step – skilled advice on crash place: At insufficiency of experiences with removing crash consequences, CCC contract specialized technique, witch experiences and knowledge's can to use. Hit force interferes direct on crash place - advisory function of expert.

- 3. Step – technical help on crash place: CCC at necessity of next technical equipments for crash removal, it search depending up place of accident, the closest industrial Fire forces, witch ask about help – joint liability.

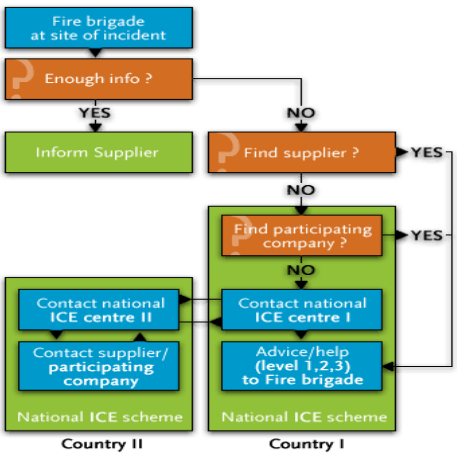

Fig. 1. Frame of support of Traffic accident information system on accident.

In year 1990 gave into practice CEFIC program ICE (International Chemical Environment), witch purport coordinate on international novae national systems of voluntary help by accidents of vehicle transporting dangerous goods in the frame international transport. In this program is integrating also our system of Traffic accident information system. In year 2002 was provided help of our centres seven times in first step, ones in second step and four

times in third step at accident of cistern transporting dangerous goods, where was out also technical help at repump the substance from damaged cisterns.

Traffic accident information system cooperate also with others components of John rescue service.

5. Conclusion

Liquidation of fire, or escape of dangerous substance introduce generally complicated hit, what is conditioned mostly to factors like extraordinary event with occurrence dangerous substance can come to being in various conditions , witch can markedly influence they process. Number of extraordinary events with dangerous substances is relative low in confrontation with number of fires at traffic accidents. At every one accident happen in specifically conditions of scene on place of hit. For all that haven't captains of hit adequate experiences.

Traffic accident information system was created with intention as more as possible make easier communication and make more effective support of rescue elements, as also direct accident development, they liquidation and just as well prevent of creation bigger damages trough provide as exact as possible information, what to do in the case, if occurs accident of vehicle transporting dangerous good. In the headquarters are available contact-persons, witch provide to hit forces contact to expert, with knowledge's about concrete dangerous good, or is expert direct recall to the accident place. There are direct spent his knowledge's at liquidation of accident, or its provide technical help if its necessary next technical equipment.

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Information Systems of City-Parking Intelligent Dynamic Navigation and Extending of their Possibilities

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Abstract. High growth in road transport at present day results in many negative externalities which become evident increasingly and particularly in towns and city centers. Reducing the negative impacts of transport is possible in many ways. One of them is the usage of intelligent transport systems. This article deals with reducing the intensity of unnecessary movement of vehicles in the cities which is generated by searching for free parking spaces. It outlines the current situation and offers solutions to improve existing dynamic vehicle navigation systems to parking combined with other information systems which are now relatively expanded, such as satellite navigation, or by using other possibilities of today's computer technologies.

Keywords: intelligent, transportation, system, parking, searching, dynamic, navigation.

1. Introduction

Road transportation is at present a strongly expanding economy department. High growth of its density over the last years is a proof of this and in the near future it will surely be increasing. Expansion of road transportation brings about many negative features too, e.g. generating large congestions, emission production, excessive noise, traffic accidents – many times with tragic consequences, problems with parking etc.

With respect to these facts, the tendency of reducing individual automobile transport to a level respectable to our road conditions is currently becoming increasingly obvious.

The opportunity to reduce the negative consequences of road transportation is the use of intelligent transportation system and different telematic applications. They enable controlling traffic in the frame of actual situation and can increase the throughput in a given area. Apart from this, they mediate information to drivers about road and traffic conditions several kilometres ahead and offer the possibility to respond appropriately in the given case – for example with the weather status information, road conditions, traffic accident or another traffic restriction.

Problems with parking in cities do not mean only specifically troubles with parking spaces insufficiency but mean also troubles by searching for free spaces too. Transport density in cities is increased by vehicles looking for free parking spaces; they roam along roads and so cause excessive environment damage, raise the probability of congestions, traffic accidents, cause energy waste and in eventually result in loss of money for many of us

These problems are partially solved by intelligent transportation systems, which are relatively widely distributed already in cities in Slovak republic. It is the dynamical parking navigation system for vehicles where the electronic boards show the number of free spaces in certain parking area including information on location of given parking space (direction arrow, etc.).

This paper deals with the way of making the reduction of negative city-transportation externalities more effective, without using different regulatory tools, such a city-entry toll.

2. Dynamic Vehicle Navigation

Dynamic vehicle navigation always has to provide actual and exact information about parking spaces and optimal way to the nearest parking not only by access roads but by the important crossroads too. In respect to this, it is necessary that local information systems of parking areas cover the enter and leave vehicle count monitoring, immediately forward this information to the central (managing) system which processes the data and calculates the number of free parking spaces. Also, the central managing system sends this information to electronic boards. They are located along roads and show the actual parking status.

2.1. Present Condition

One of the biggest European projects, dealing with urban management, ROMANSE (ROad MAnagement System for Europe) showed positive effect of navigation system to the traffic in cities. It utilizes 28 variable information boards for navigation to the parking spaces. Exact information about free and occupied count of parking lots, capacity of parking area or another detailed information are available in Internet under graphic user interface or in the table. Such an information system definitely simplifies the decision-making of drivers by parking area choice.

At present, there is similar system of dynamic vehicle navigation in operation in Bratislava, the capital of Slovakia. However, not all parking areas are integrated into this project and thereby it causes certain situation falsification. Accordingly, this system (like that in Southampton) provides the information in a website.

2.2. Intelligent Dynamic Navigation

Systems mentioned in previous subchapter are still relatively limited because the free spaces number information exists only on the information boards, respectively on web servers. After initial information has been provided to driver, the situation during first and second board passing alters (if more boards exist). In a worse case the extent of changes is so huge that the parking area fills up completely and the driver has no other possibility than looking for another parking space in neighbourhood and so the mentioned excess traffic is generated.

An alternative to this is building extensions to system like this which provide the constant contact with parking areas to the drivers and thus have actual occupancy information. This solution demands the co-financing by users – drivers but considering the final effect and already current high penetration of different information systems in vehicles, it is eventually an option that is effective and implementable in short time.

At present, there are so-called POI objects in the navigation systems which define some important points on the map. There are parking areas to be found too, of course, but without information about free spaces number. It is possible to update the software and achieve that navigation system can receive the occupancy information and thereafter show that to the user as necessary. Many devices which are sold now allow for (from the hardware point of view) communication with neighbourhood whether via WLAN, Bluetooth, GSM/GPRS, UMTS or TETRA modules. Connection via Bluetooth and TETRA are not suitable for given problem due to short connection range (Bluetooth – in tens of meters) or the cities coverage is insufficient (TETRA – covered only some cities in Slovakia).

So, data will be only acquired via one of above listed ways where if necessary, the software contacts the information centre, gives a request for free spaces count on specific parking areas and thereafter this data shows to the user respectively adjust the optimal way.

Basic design of system topology is shown in Figure 1.

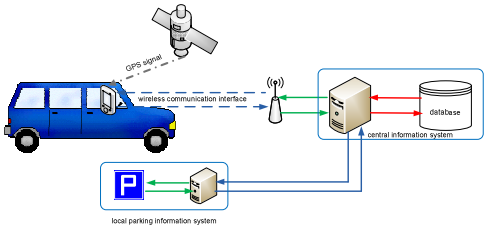

Fig.1. Basic topology of parking areas intelligent dynamic navigation

Central information system will contain all information which is needed for imaging, processing, saving and mediating. System has to be two-levelled so that communication of the vehicle devices with central system, just like the communication of local information parking systems with central system is not executed directly by lower – database level but via communication server.

Today's technologies offer wide possibilities of wireless communication – from local WLAN (Wi-Fi) solutions to mobile network based solutions (GPRS, EDGE, UMTS) which cover almost entire territory of the Slovak Republic, or Europe respectively. A new system of wireless communication is WiMAX which works on similar principle as WLAN Wi-Fi – IEEE 802.16.

Some comparison is demonstrated in the following table:

	GPRS/EDGE	**UMTS/HSPA**	**Wi-Fi**	**WiMAX**
Communication Price	middle	high	free	low/free*
Signal range/coverage	entire area	much of area (most of bigger cities covered)	tens of meters	40-70 km (sufficient for a single city)
Security	high	high	middle	higher

Tab. 1. Communication technologies comparison

* depends on communication band used (licensed/not licensed)

At present, resources of (commonly) available GPRS signal (there are devices with integrated GPS and GSM/GPRS modules in shops) appear to be the most advantageous and simplest solution of communication interface usage, or 3rd generation of mobile services which is now enforcing. However, the WiMAX-based technology has good perspective to the future. When modules of this type are expanded, this will be the best choice for new system of intelligent navigation. Of course, the price of communication via mentioned ways cannot be overlooked.

Communication interface between central system and local parking information system needs no special attention because of permanent Internet connection possibilities.

3. Reservation Services and Entry Authorisation

It is necessary to deal with extended, or "higher", version of designed system at its implementation. Extension can provide a guarantee of a parking lot to the user in case the system is enhanced with a reservation layer. This will be able to identify the vehicle which has reserved the parking space, and thus co-operate with administration systems of entry devices

of parking areas. The system topology extends with identification module and parking entry-system module of parking area, namely as follows:

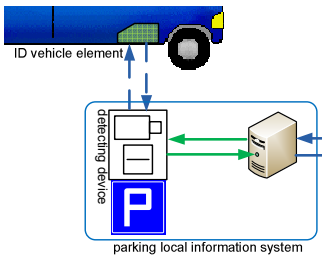

Fig. 2. System extending by reservation and entry-management

In this case the driver requests a parking lot reservation. Navigation system executes the communication with central information system (as described in Chapter 2.2.) and after capacity verification, the central system provides (or refuses) a parking space, calculates new actual occupancy situation, replies to the navigation system and navigation system navigates the driver to reserved parking lot. When the vehicle arrives at the parking area, it is automatically identified, consequently the authorisation communication between local information system of parking area and central system is performed and finally the vehicle is allowed to drive into the parking lot.

There are two main ways of identifying the vehicle. Both of them are in use in our country as well as in the world at present. First one is the wireless system RFID, the second one are camera systems. Second one would enable the identification without additional ID (only by vehicle registration plate) but there is a possibility that the system could fail if the plate is not readable for various reasons. Possibility to use the RFID method to identifying is more favourable from this point of view – there is no direct line of sight necessary, RFID can reach up to 6 meters, and chip is easily portable. In combination with its anonymous ID (is not dependable on registration plate), this technology is attractive for further development.

4. Conclusion

Information systems of city-parking intelligent dynamic navigation and reservation can make life easier to many of drivers who look for free parking space in the city under full traffic. If prices (for devices and services) are properly set then the system, if extended enough, can positively affect the transportation in cities, help reduce congestions and other negative externalities which are multiplied by excess driving around city. It is necessary to remark that all listed technologies are successfully operating at present. Through their proper combination, new system of city-parking intelligent dynamic navigation and reservation rises.

Acknowledgement

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RFID Technology in Postal Sector

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Abstract. The article is devoted to theme of RFID technology. In the start of the article there is a short description of RFID technology operation, its components and types. Main part is addicted to its present utilization in praxis with focusing on postal and courier sector. There are sketched new opportunities in connection with permanent prise lowering of the RFID tags and its consequences like spreading of the technology into usual postal operation and not only for quality checking reason. At the end there is a forecast of entire replacement of bar codes by RFID technology in the future and especially in connection with development of chipless RFID tags.

Keywords: RFID, tag, postal item, technology.

1. Introduction

Fast data collecting and accurate object identification are very important in many sectors. In some sectors such as postal and courier one, accurate identification of postal item is cardinally important because it has direct impact on quality of postal service in many aspects. Development of Radio Frequency IDentification (RFID) represents another step in item identification and brings with it another undisputed advantages in comparison whit present item marking by bar-codes. Therefore this fast developing segment attract big attention and especially in the age of globalization and liberalization of postal service market.

2. Description of RFID Technology

RFID is abbreviation from word Radio Frequency IDentification, as it was previously mentioned. This technology uses radio frequency to identify marked items. It is assumed that in the future RFID technology will replace bar-codes identification. At the beginning this technology was applied in military and security area but in recent history it spread in common life. In comparison with bar-codes RFID technology offers higher scan speed, easier manipulation and utilization in automatic systems.

RFID system always consists of three parts. Two of them have “hardware” character a one is represented by software needed to its utilization. Hardware components are represented by RFID interrogator (reader) and RFID tag that carries the information. RFID interrogator can be static or mobile in dependence on application specifications. It covers two main tasks. First task is broadcasting of radio-frequency signal and second one is receiving information from RFID tags. Broadcasting of signal is realized because of two reasons. First one is detecting of RFID tag and second one is important in systems that are using passive tags. In those systems electro-magnetic field created by interrogator’s broadcasting is utilized by RFID

tag antenna to induce enough energy to power up and transmit a response. Main task of RFID tag is to respond with its identification to an appropriate signal when it is in range of the interrogator.

3. Present RFID Utilization

The present time shows us evidence about positive aspects of RFID technology using in praxis. Most common advantages shown by these companies were saving of costs (usually labour costs) and increasing of labour productivity. A recent survey of companies that already have on-hands experience with the technology made by ABI research indicates a positive return of investment may come quickly, within 18 months or less.

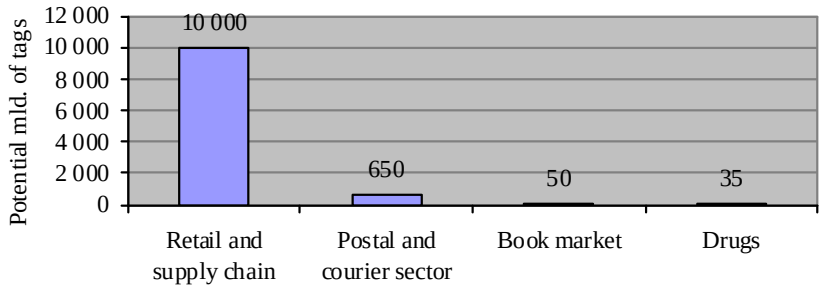


Fig.1. Potential global market in billions of RFID tags

Of course, this technology brings advantages especially in those sectors where the fast and correct item identification and data collection is cardinally important. Forecast of potential global market of RFID tags presented by IDTechEx is shown in a figure no. 1.

Main reasons for forecast shown at figure 1 are strong possibilities of stock management automation and other aspects of whole supply chain, increasing of velocity of automated processes, decreasing of manual operation and related expenses (mostly labour costs), elimination of mistakes caused by manual operation and expenses related with their reparation. Another significant moment consists in increasing of item security in whole retail and supply chain. Present and close future show us another advantages of RFID technology utilizing, for example: intelligent shopping basket, quick payment without waiting in a row.

Present price of RFID tags are very low and it approaches to the low threshold of RFID tags price which is estimated for 5 US cents per tag. According to this fact the predictions can be very positive for mass adopting of this technology. As it is shown on figure 1 the postal and courier sector is the second largest area of potential using of this technology. IDTechEX estimates that the global market for RFID systems, including tags, in this sector will rise from 50 millions USD in year 2006 up to 3 milliards USD in year 2018 and there exists more optimistic predictions that proclaims sooner year 2016. Efforts to mark each postal item with RFID tag were presented also by European commission therefore optimistic predictions can be filled in sooner time period.

First use of RFID technology in postal and courier sector was mainly connected with postal quality service measurement. RFID tags are used to check term of delivery and reliability of postal item delivery. IPC (International Post Corporation) is an association of 23 national postal operators from North America, Europe and Pacific area. This association permanently measures mentioned quality indicators. This continuous measurement allows locating weak spots in postal delivery chain. Measurement and data collecting is operated by

AMQM (Automatic Mail Quality Measurement) network that was provided by company Lyngsoe Systems in year 1994. [1]

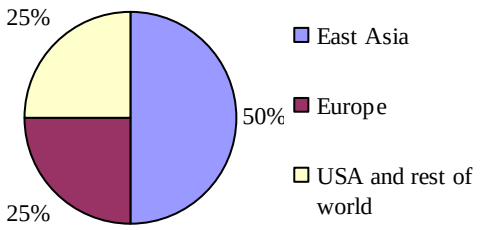
Universal Postal Union (UPU) approved IPC technology for postal quality measurement in year 1999. In present this technology is used by 52 countries. Delivered postal item and RFID tag are designed in such way that they cannot be observed by postal staff so objectivity and trustworthiness of results is guaranteed. Results are utilized to detect “narrow necks” of postal item flow. These results have strong feedback on postal technology process improvement. This fact is proven by increase of mail delivered within 3 days from 64% to 93% in 10 years period.

4. RFID Technology in Postal Operation

4.1. Experiences with RFID in Postal Operation

Australian post implemented RFID technology for postal item monitoring. This decision was made because of the law that order to deliver at least 94% of mail in delivery term. Australian post accommodated 12 000 letters with RFID tag in first phase of the project. This shows problematic spots in postal delivery process and helps to solve them. All post offices will be upgraded with new software and hardware in connection with this project.

In China post, RFID is used for express mail identification. The project starts in Shanghai district and enables to observe postal items all the while. This solution has big advantages in comparison with bar-code marking of postal items. Identification by bar-codes is too slow and too dependent on human factor.



Main task of this project consist in acceleration of mail transit. Another positive result of RFID technology implementation consists in enormous productivity increase. This fact leads to decision of RFID implementation to other divisions of China post in the future. Not only China but whole Eastern Asia will be significant player in this sphere as it is shown on the figure no. 2.

Fig.2. Territorial split of dollar spend on RFID tags in 2016 in postal and courier sector

4.2. Slovak Post

Slovak post uses RFID technology for quality monitoring of postal technology process in the present. Mail monitoring is performed by AMQM system that was bought by Slovak post from Denmark Company Lyngsoe Systems. This system is used for monitoring of certain parts of mail transport process in interstate operation. [2]

5. RFID and Bar-Codes in Postal Operation

Each relevant postal and courier operator should use RFID tags for marking of parcels and in-plants distribution tools such as mailbags, containers etc. in the present. There are many reasons to do this. Some of the reasons are very similar with those of retail supply chain such

as security of items, data collecting, great automation possibilities and saves of labour payment costs. But in postal operation there are bigger possibilities in automation of some processes, for example there are parcel sorting machines that can be operated without human labour after that. No human labour should lead to any mistakes of parcel routing and this induces saves of costs caused by re-routing of packet.

Another advantage of RFID technology versus bar-codes is evident in track and trace postal service. Bar-codes are used for mail tracking in the present. It means human labour is needed to read bar-codes from postal item. This part of work disappears after RFID employment which makes whole process faster and less faulty. Another possibility of this service consist in placing another interrogators on the route and that way make track and trace service more accurate or let us say more real-time and attractive for customers. This has also positive externalities in better data collecting of transport process and they can be used for postal process improvement.

According to some studies bar-codes should perish in next 20 years. This forecast can be too optimistic for bar-codes in connection with tendencies of some postal operators and recommendations of European Commission to mark each postal item with RFID tag, so mentioned 20 years can shrink.

Phenomenon of so called “chipless” RFID tags can be another great accelerator of wide-spread expansion of RFID technology. These tags are designed on non-silicon technology so they miss silicon chip. Although the price of classic silicon-based and chipless RFID tag is comparable in the present the low threshold of chipless RFID tag price is estimated for 0.1 US cents per tag according to used technology. There are many chipless technologies but only a few of them achieve standardization but there are many promising technologies in second generation of chipless tags for the future such as SAW (Surface Acoustic Wave), TFTCs (Thin Film Transistor Circuits) and printed tags (printed stripes of conductive ink). Each of them has some advantages and some disadvantages like frequency band, memory type, read/write options, range of signal, endurance, sensitivity of frequency band to external environment etc. But when the price for one tag approaches to low threshold (already there exists low-cost chipless tags sold for 1 cent per tag) not just each postal item but everything can be tagged. From this moment bar-codes become history.

6. Conclusion

RFID technology presents next step in item marking and data-collecting. It offers many significant advantages in comparison with present bar-code item marking. Nowadays praxis brings many proves of positive effect on company economy. This technology has enormous potential for postal and courier sector, therefore all relevant postal service providers should use or start to use this technology sooner than it will be too late if they want to hold their position in global competitive market.

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Mixed River - Sea Navigation Vessel Concept

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Abstract. As a consequence of globalization, the value of transport optimization is constantly increasing. The acceptance of European Offshore Waterways and Unified Deep Water System of Russia – UDWS into European Agreement on Main Inland Waterways of International Importance AGN, has opened new space for mixed river – sea navigation application. Mixed (without transload) river – sea navigation can be a great contribution to the change of the current unfavourable European transport situation.

Keywords: mixed river – sea navigation, hull, inland navigation system, AGN

1. Introduction

Current modern trend of globalisation determines conditions of development almost in all fields of human society. One of the most important fields is of course transportation. Constituent countries unite into bigger economical and political unions what is a consequence of higher necessity of (goods, persons) transport and also a need of optimal transport utilisation. In certain conditions, the optimal transport could be a mixed river-sea navigation technology. From the mentioned process arises a need of a wide inner market creation within Europe with progressively stronger linkage with Asia. From this point of view, there is a very important effort to make a closed circuit pan-European waterway system, around the whole Europe. Creation of a Unified Deep Water System (UDWS) in the European part of Russia linking five seas through the construction of the White Sea-Baltic Canal, Volga-Baltic Canal, Volga-Don Canal and Moscow Canal has motivated the construction in the sixties of the twentieth century of a unique transport fleet consisting of mixed river-sea shipping vessels of 1.4 – 5.5 thousand tons carrying capacity. These vessels are able to operate not only on inland waterways and lakes but also at sea areas. European transport community should pays better attention to the development of the transport water corridor Volga–Don–Danube. This water route will provide for connection with countries that have no direct access to the sea and will connect the largest inland water arteries such as Rhine–Main–Danube–Dnieper–Don–Volga. The significance of the Danube–Don–Volga route is highlighted by the involvement of countries of the Caspian Sea basin. The aforementioned corridor can serve more than 15 countries of Western, Central and Eastern Europe. Pan-European water transport ring could be formed by usage of the Baltic Sea, the Black Sea and the Azov Sea coastal routes.

2. Role of River-sea navigation in the pan-European inland navigation system

At the various international meetings relating to the further development of cooperation among the member countries of the Economic Commission for Europe (ECE) in the context of

the AGN Agreement, attention is always given to the important role of river-sea navigation in developing the Pan-European inland navigation market. A number of studies suggest that the establishment of efficient coastal routes would have the following benefits: Transfer of foreign-trade freight traffic to river shipping; Completing the circle, currently broken in places, of category E waterways, linking the deep waterways of the European part of Russia to the network of European waterways of international significance and establishing a pan-European ring of trunk waterways around the whole of Europe; More effective use of the Rhine-Main-Danube trans-European trunk waterway and the pan-European transport corridors; Rendering transport operations more environmentally friendly and economically advantageous, since freight will be conveyed by inland waterways directly into the hinterland; Use of new transport and fleet management technologies and closer cooperation among the member countries of ECE in these matters; Promoting river-sea navigation on the waterways of France, Portugal, Spain and Italy.

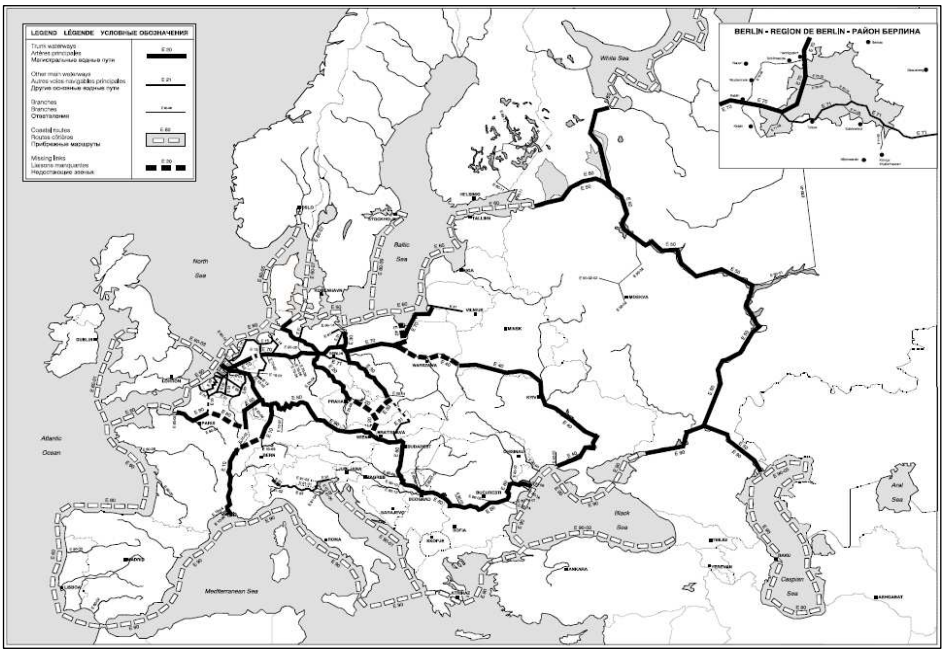

Fig. 1. Scheme of inland waterways and coastal waterways of international importance

The sea section of Don-Dnieper-Danube route is already widely used by Ukrainian and Russian combined river-sea navigation vessels, thanks to the favourable navigation and hydro meteorological conditions along the route during most of the year. Both in Ukraine and in Russia, river-sea vessels have basically been constructed in accordance with the class rules set down in the register of inland navigation vessels in the Russian Federation (the Russian River Register), although there are also a number of models of river-sea vessels which have been built to classes of the Russian maritime register and those of other classification societies. The following table sets out the main specifications of Russian and Ukrainian river-sea vessels.

Vessel specifications	Vessel type							
	Sibirsky	**Volgo-Balt**	**Slavutich**	**Amur**	**STK**	**Volgoneft**	**Lenaneft**	**Volgo-Don**
Displacement [t]	5 536/ 6 141*	4 420	4 533	5 013	2 700	6 984.3	3 680.4	6 517/ 6 923
Cargo capacity [t]	3 245/ 3 850	2 900	3 120	2 900	1 314	4 620.0	2 100.0	4 544/ 4 950
Length [m]	129.5	114.0	108.1	115.8	82.0	137.8	122.8	138.3
Beam [m]	15.8	13.2	16.2	13.4	11.9	17.0	15.3	16.7
Draught at maximum load [m]	3.2/3.55	3.8	3.2	4.0	3.1	3.7	2.5	3.33/3.52
Speed fully laden [kn]	9.5	11.0	11.3	10.0	11.0	19.0	19.0	10.3

Tab.1. Basic characteristic of existing river-sea vessels

Thought the closed circuit pan-European waterway system lays also at western part of Europe, the river-sea navigation does not have any tradition there, except in Netherlands. The most of classification organisations of Europe, Germanisher Lloyd, Norske Veritas or Buro Veritas does not have any vessel class designed for mixed river-sea navigation. They have very sophisticated system of classification, but only for river, or maritime vessels.

In the report of the standardization of ships and inland waterways for river-sea navigation, the Permanent International Association of Navigational Congresses (PIANC) recommended the following classes of vessels:

River-sea class	Maximum permissible dimensions of vessels			Air clearance [m]
	Length [m]	**Beam [m]**	**Draught [m]**	
1	90	13	3.5 or 4.5	7 or 9.1
2	135	16	3.5 or 4.5	> 9.1
3	135	22.8	4.5	> 9.1

Tab. 2. Recommendation of basic dimensions of new conception river-sea vessels

In fact, the Russian and Ukrainian vessel types listed above correspond fairly closely to those suggested by PIANC, although a draught of 4.5 metres is unacceptable for the inland waterways along the route in question. Most of the river-sea vessels operated in the Russian Federation and Ukraine do not fully comply with all the height and draught limitations on certain waterways along the route of the future waterway ring around Europe. Accordingly, there is a need to develop new types of river-sea vessels with dimensions that meet the requirements for navigation both along the combined deep-water network of the European part of Russia and the Dnieper, and along the Rhine-Main-Danube route.

On the basis of calculations in dissertation work: Strength Problems of mixed river-sea vessels, was achieved, that an approach in designing of river-sea vessel structure is very important. By appropriate choice of certain ship class it is possible to reduce significantly a weight of a hull structure. There were compare approaches of two classification organisations GL (Germanischer Lloyd) an RRR (Russian River Register), it the mentioned dissertation.

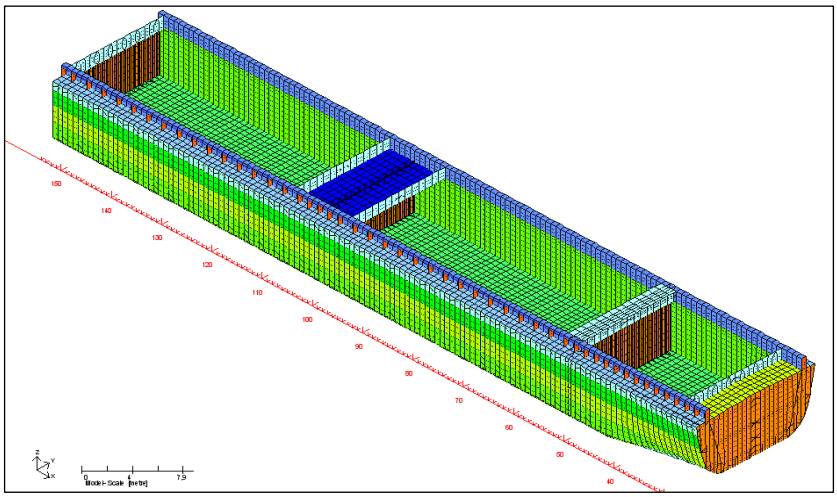

Fig.2. 3D model of a compared part of the solved vessel

Hull structure of an existing river-sea vessel Amur MNL designed by RRR, was recalculate in accordance with GL rules K(50). The model of resolved hull structure is shown at fig. 2. If the model should meet the GL rules requirements, there was a need to enlarge the width mostly of longitudinal structural element of the hull by couple of millimetres (bottom plating, flat keel and garboard strake, bilge strake, side plating, sheerstrake, strength deck, inner bottom, coaming, center girder, etc.). After modification of all important structural element, the weight of hull structure of the model has arise about 38t, what represents about 7% weight enlargement. It means less transported cargo of approximately amount of 38t.

3. Conclusion

Rise of structural weight impinges on many character of the vessel (draft, deadweight, capacity, operation economy etc.), especially in restricted navigation conditions of shallow waters. During a process of Europe uniting, there is forming circuit pan-European waterway system, offering great conditions for utilisation of river-sea navigation technology. Accordingly, there is a need to develop new types of river-sea vessels and it is necessary to approach this problem very sensitively.

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Fine-Grained Cooperative Multi-Threaded Ant Colony Optimization with Asynchronous Communications for the Vehicle Routing Problem

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Abstract. In this paper we study behaviour of Ant Colony Optimization algorithm for solving the Vehicle Routing Problem implemented by Posix threads in parallel cluster environment. The algorithm is based on a fine-grained parallelism strategy which uses asynchronous communication for cooperation in finding solutions. Our aim is to analyze the effect of proposed method on speedup, execution and communication time with respect to the quality of solution.

Keywords: Ant Colony Optimization, Parallel Metaheuristic, Vehicle Routing Problem, POSIX threads.

1. Introduction

In the field of combinatorial problems, the Vehicle Routing Problem (VRP) introduced by [1] is one of the most challenging. This optimization problem and its variants have multiple applications in telecommunication, transportation and logistics. Unfortunately the majority of these applications belong to NP-hard problems so in worst case the exponential time is required to find the optimal solution. The VRP problem determines a set of vehicle routes starting and ending at the depot where each customer is visited exactly once. The demand of each customer is satisfied and both maximum tour lengths and vehicle capacities cannot be violated. The objective of the VRP is to minimize the total travel costs. The formulation of the VRP can be found in [2]. Exact algorithms can be used only for relatively small instances. In practice, all known solutions of larger instances come from heuristic or metaheuristic algorithms. It seems that especially metaheuristic methods produce quality solutions in relatively shorter calculation time.

The Ant Colony Optimization method (ACO) developed by [3] has become very successful for solving the VRP problem. The idea of the method is inspired by behaviour of real ants where each ant deposits pheromone on ground as information that other ants should follow him. Deposited pheromone evaporates in time. Successfulness of ant causes that path is passed more often and more pheromone is deposited. Therefore it is more likely that other ants choose the same path as well. This behaviour is in computer science modeled iteratively by repeatedly called procedures which create solutions by exploring fully connected graph of customers. The artificial ant makes decision about the way it will continue in every vertex. This decision making is specific for concrete problem and is influenced by two factors: joint memory and heuristic information. When created, best solutions are used for updating of common memory according to achieved quality. This updating is done after all artificial ants

have found their creating process. The whole procedure is called repeatedly as many times as required.

In our work we have rewritten the parallel Savings based ACO algorithm for the VRP described in [4] using synchronous communication model with Message Passing Interface to a thread based asynchronous model. We study characteristics of algorithm on two larger instances C5 [2] and G19 [6] when decentralized asynchronous communication is used. Both instances still do not have exactly calculated optimal solutions.

This paper is organized into four sections. In following section we describe shortly the ACO parallelization strategies and propose the asynchronous algorithm. In Section 3 gained computational results are shown. We present dependence of the gained speedup and efficiency on the number of threads used, whereby the solution quality, execution and communication time are also presented. The last section concludes with several remarks and outlooks concerning the future work.

2. Parallelization of ACO

Interesting feature of the ACO is its feasibility of parallelization. Each ant makes relatively simple and independent task. The only dependence is caused by using pheromone matrix and the best solution has been found so far. The first issue is required for decision making process and second for measurement of quality of generated solution. We can identify several goals that can be achieved by parallelization of the ACO as reduction of calculation time, increasing of solution quality or speed of convergence. To achieve reduction of calculation time we can split ants between processors and let each processor calculate its part of colony. This approach is known as functional decomposition. Instead of this we can apply domain decomposition by dividing customers into subsets and let processors calculate solutions of sub problems. Generally there are possibilities of synchronous or asynchronous communication between processors. Classification of parallelization of the ACO for the VRP can be found in [4], and [5]. In short, we can use: fine-grained, coarse-grained and mixed parallelization. First splits ants of one colony between processors which often communicate when update pheromone matrices and solutions. Second parallelization calculate whole colony on one processor and exchange only specified part of information between them. The mixed approach is a combination of the first two.

We have used fine-grained parallelization strategy with decentralized approach whereby ant population is proportionally divided among computing threads. Execution thread is a fork of a computer program into more tasks which can run concurrently. Those threads share memory and other resources but run independently. Considering shared memory of threads does not need change of address space, inter-process communication of threads is faster as processes. We suppose that all threads in our implementation have the same behavior and calculate homogeneous sets of ants. Number of threads is specified by the number of the processor's cores used. Each core runs exactly one thread. Every thread computes its own pheromone update by using information received from other processors. When possible, an inter-thread communication is done by using shared memory, otherwise network is used. Concurrent access to shared memory is secured by critical sections which are implemented by Pthread mutexes. Instead of using shared files proposed in [7] we have used the user datagram protocol as communication layer. If a thread has found better solution and has to use the network layer, the user datagram packet is sent only once per cooperating node. All received packets are stored in system buffers and are processed by first thread which reads them. After the packet is processed the thread publishes appropriate solution to all threads in its group in

shared memory. This approach does not require dedication of separate thread for communication. The pseudo algorithm can be formulated as follows:

1: Initialization;
2: For i = 1; i <= It do:
    For Ant = 1; Ant <= n / Threads + 1 do:
        Create Savings based Ant solution;
    Select elitist Ants;
    Download received solution if exists;
    Update and spread solution if better solution is found;
    Update pheromone matrix and Savings if needed;
3: Finalization;

The speedup is defined for measurement of parallelization quality by the following formula:

$$S_p = T_1 / T_p \quad (1)$$

where p is the number of processors, T_1 is the execution time of the sequential algorithm and T_p is the execution time of the parallel algorithm with p processors. Similarly efficiency is a performance metric defined by the following formula:

$$E_p = S_p / p = T_1 / pT_p \ . \quad (2)$$

This value is typically between zero and one and estimates how well-utilized in solving the problem are processors, compared to how much effort is wasted in synchronization and communication.

3. Computational results

In our experiments we have used the cluster consisting of 72 SUN X4100 nodes with two 64-bit dual core processors, each. Therefore we could use at most 4 threads per node working over the common shared memory. Reported results are average values gained over independent 15 runs for both instances. The number of customers is denoted as n and configurations mentioned below are used. Even we experienced better solution quality with different configurations, we have used the same parameters settings as proposed in [8] and used in [4] to keep results comparable. We have used n artificial ants for each instance, $\alpha = \beta = 5$ and $\sigma = 6$ elitist ants, the evaporation rate $\rho = 0.95$, and the neighborhood size $\lfloor n/2 \rfloor$. We have run the algorithm for $2n$ iterations for both instances. The algorithm has not sent whole pheromone matrix between cores. Only the best σ solutions were chosen, compared with the best solutions found so far and spread between nodes every time better solution is found.

In Table 1 we can see that the time spent by communication does not increase linearly with using more cluster nodes. We can see that efficiency decreases with increasing of threads. For 32 cores we have achieved the efficiency 0.59 and 0.73, respectively. This value is better as it is published in [4], where the gained efficiency is 0.37 and 0.39, respectively. So we can conclude that asynchronous communications are more suitable for the ACO as synchronous, especially for larger instances. Reduction of speedup for instance C5 again G19 is caused by the fact that time required for creating solution is smaller. Therefore the ratio between communication and calculation is higher. Efficiency greater than 1 on the C5 instance is caused by caching effect, where both threads run on separate cores of one processor. We can see that solution quality is decreasing with more threads; this is about 4% on the C15 and 3% on the G19 when 32 threads are used.

Instance	Threads	Nodes	V	t_c[ms]	t_r[s]	Speed	Efficiency
C5	1	1	1377,68	7,96	440,70	1,000	1,000
	2	1	1376,14	16,78	219,11	2,011	1,006
	4	1	1384,03	34,06	113,03	3,899	0,975
	8	2	1396,19	36,52	61,73	7,139	0,892
	16	4	1418,81	36,43	35,48	12,422	0,776
	32	8	1435,79	36,88	23,40	18,834	0,589
G19	1	1	1498,71	16,77	5825,99	1,000	1,000
	2	1	1501,60	38,45	2929,19	1,989	0,994
	4	1	1495,88	80,55	1470,60	3,962	0,990
	8	2	1509,38	86,44	790,26	7,372	0,922
	16	4	1521,93	86,81	420,89	13,842	0,865
	32	8	1546,23	85,74	250,26	23,280	0,728

Tab. 1. Calculated average results according to the number of threads of each measured instance, where V denotes calculated quality solution, t_c denotes the time spent by communication and synchronization calculated per node, t_r denotes the overall execution time including communication.

4. Conclusion

We have presented parallel Posix threads based implementation of the ACO method using asynchronous cooperative approach for solving the VRP. We have measured its speedup and efficiency in comparison with synchronous approach published in [4]. We have shown that asynchronous communication increases efficiency of the ACO algorithm.

In our future work we would like to apply presented asynchronous approach to the mixed, multi-colony ACO parallelization with focus on increasing of the solution quality. We would like to test algorithm with different configurations. We would like to test dependency of data amount on efficiency and the solution quality.

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The Process of Tariff Integration in Integrated Transport Systems

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Abstract. This paper deals with the tariff integration in the conditions of Slovak republic. It is focused on the basic parts of tariff integration that have to be considered when the integrated transport system is planned. This paper also gives the view of up to now development of experiments to implement the integrated transport systems in Slovakia.

Keywords: integrated transport system, tariff integration, tariff structure, tickets.

1. Introduction

The integrated transport systems have become the solution of problems how to support the using of public transport and how to make it competitive with the individual automobile transport. There are two main parts of integration which are very important for making the public transport more attractive for inhabitants. The transport integration is the first one and it includes the coordination and optimization of timetables and lines of haulers involved in the system. The tariff integration is the second very important part. It consists in creation of unified tariff system comprehensible for all passengers. It includes dividing the area into the zones, unifying the tariffs and tariff conditions of all involved haulers, unifying the tickets, creation of ticket range.

2. The process of tariff integration

2.1. The area size definition

The area size definition is the basic step in the tariff integration process. In the most of integrated transport systems the size of area was extended continually.

The main city in the area is the base for the integration because it forms the centre of integrated tariff system. The area is usually extended gradually during the following years. It is usually after so called the first phase of system existence when the experiences are already available.

In the case of Slovak republic the government decree about the transport policy proposes that integrated transport systems should be created in two levels of covering the area. First level includes the urban and suburban area; the second level includes more extended area, whole region if it is possible. It means that the first steps would include the integration of urban public transport, suburban bus transport and regional railway lines. In the next steps of integration the area would be extended on the area and lines in the whole region.

The Slovak republic is divided into the 8 regions and 79 rural districts. In the process of integrated system creation this dividing could be used as the base when the main city of region or district would be central zone and the integrated transport system would cover the area of district or whole region. It would depend on the strategy if the integration would be prepared and used for whole area from the “first moment”, or “per partes”. For example in the prepared conception of integrated transport system of Bratislava the covering of whole region from the beginning of system operation is considered. It could be said that the area of region equates to the area of future integrated transport system. But it does not have to be the rule. There is another possibility regarding to proximity of centers of two regions as it can be seen in the case of Prešov and Košice in the East of Slovakia. Each of these cities is the center of separate region but the distance between them is only 34 km. It means that there is quite strong connection between these two cities. There are a lot of people who travel from one region to another region every day because of school, work and other duties. This is the reason for which the both regions should be included from the first phase of preparing the integrated transport system.

2.2. The tariff structure choice

Because there should not be the substantial change of tariff structure during the first years of integrated transport system existence, the choice of right tariff structure is very important. It is possible that some changes will be necessary for example in the number of zones, but the significant change of whole tariff structure is not desired.

The tariff structure depends on the monocentric or polycentric area arrangement and on the other factors. As it was already mentioned above there are the regions with one dominant center in Slovakia (Bratislava region) but there are also the regions with two centers (Košice, Prešov). In the first experiments with the integrated transport systems in Slovakia (Bratislava, Žilina) the tariff structure was taken over from the urban mass transportation systems. This is possible when such tariff structure is also suitable for other parts of area that will be covered by integrated transport system.

2.3. The tariff integration

The tariff integration means that the different tariffs and tariff conditions of all involved haulers have to be integrated into the one unified tariff which will be valid for the passengers traveling by any line under the integrated transport system. The haulers have to agree on the unified tariff what is the key phase in the process of tariff integration.

The zonal and kilometric tariff is the most used by the haulers providing the public transport in Slovakia. In the case of the companies providing the suburban bus transport the fare depends on the tariff distance determined by the kilometric distances. The similar method for calculating the fares is used in the railway services. In the urban mass transportation the zonal tariff, time tariff or their combination is used.

But not only the integration of fares but also the integration of tariff conditions, discounts and free transportation has to be unified. In generally it can be said that the basic discounts are related to the same or similar passenger categories over the all involved haulers. There are mainly the differences in their levels and in the conditions and forms of their providing.

2.4. The unified tickets

The one of the most used definition for integrated transport system is that it enables to travel with only one ticket regardless of transport mode and hauler. It means that the unified ticket is one of the most important benefits of integrated transport systems for passengers.

The process of unified ticket range creation is of longtime character. In the first phase of ticket integration the haulers usually agree on mutual recognition of tickets.

The longtime process can be seen in the case of many integrated transport systems in Europe. For example German VRR (Verkehersverbund Rhein-Ruhr – Transport association Rhein-Ruhr) was established in 1980s. In that time the single ticket was created but the time ticket was created in 1991 and in 2000 the large tariff reform was made. The different evolution was in French STIF (Le syndicat des transports d'Île-de-France – transport association). In the first year of its existence the weekly, monthly and yearly tickets were already offered to passengers. The single tickets of involved haulers were unified only in 1995, almost 20 years after the system startup.

Generally the whole range of tickets and the fares of single and time/season tickets is very important and it is the way how the passengers can be attracted to use public transport for their everyday or occasional journeys. Too wide range of tickets can be confused for passengers but on the other hand varied ticket offer with discounts can make the use of public transport more attractive for present but also potential passengers.

2.5. The tariff integration in the existent integrated transport systems

Presently there are two integrated transport systems in Slovakia, the first one in Bratislava, the second in Žilina.

In the capitol of Slovakia Bratislava the integrated transport system integrates the urban mass transportation and only some lines of suburban bus transport and railways. In term of tariff integration the involved companies decided that as the ticket the season-ticket valid for whole net covering the integrated lines will be used. Passengers can buy it as the monthly, quarterly or annual ticket.

It can be said that in the case of Bratislava the tariff integration was not fulfilled in the all aspects which tariff integration demands. It is only about the unifying the tariff for some lines. It does not cover the determinated area; there are no zones, not unified tariff conditions of involved haulers.

The new concept of Bratislava integrated transport system was presented in 2007. It supposes that the zonal tariff structure will be used on the whole area of Bratislava region. The area of Bratislava city will create so called city zones and the rest of area will be divided into the regional zones with different size of each zone. The concept supposes three basic types of tickets:

- City - valid for the area of Bratislava city,
- City + Regio – valid in whole region including the Bratislava city,
- Regio – valid in whole region excluding the Bratislava city.

The concept also includes the integration of tickets of all involved haulers, creation of unifying single and season tickets, unifying of tariff conditions relating to free and discounted passenger transportation.

The Žilina regional integrated transport system integrates the urban mass transport and the railway transport on the one railway line with direction to the town Rajec. The special tariff for this system is valid. The area/direction is divided into the seven tariff zones whereas the two zones cover the area of town with urban mass transportation. The passengers can buy the special single tickets for their journeys when they travel in this direction using both urban mass transport and railway transport. Also they can use the season tickets for determinated number of journeys for limited time.

From the information above it results that the tariff integration of integrated transport system in Žilina is more complex than in Bratislava. But from the wider point of view it is not already the integration in the full sense of the word. There are not integrated all mode of

transport, the suburban and regional bus transport is not integrated in the system. The integration does not cover the area but only the one railway line divided into the zones as the continuation of zones used in the urban mass transportation in the town of Žilina. The development of integrated transport system in Žilina and its region is not planned for now.

3. Conclusion

The unified tariff system of integrated transport system should bring the following benefits for passengers:

- balanced ticket offer,
- unified tickets enabling the traveling with one ticket by the all means of transports involved in the system,
- simplified orientation in the ticket range,
- social bearable fares,
- unified social discounts,
- unified tariff conditions.

The right set tariff system can be the key element that will make the whole system interesting for passengers.

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Level of Implementation of Digital Tachographs System in European Union

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Abstract. Tachograph is belong to On Board Recording Devices. Their development have been beginning since before The Second World War. The first on board recording devices is analog tachograph which obligatory to using to introduce in USA in 1939. This paper include main rules of function of analog tachograph and digital tachographs system using in road transport. Paper presents also possibility of future requirements of digital tachograph and authorize workshops. Those paper include information about level on implementation digital tachographs system in every country in EU.

Keywords: digital tachograph, cards, tachonet, control officers, workshop.

1. Introduction

The analogue tachograph did not satisfy the relevant requirements as owing to its construction certain frauds and counterfeits concerning the drivers' real work were possible. For this reason the European Union has developed an inspection system based on the digital tachograph and chip cards used for recording the data and identification of the system users.

The legal basis for the introduction of such system is Council Regulation (EEC) No 2135/98 of 24 September 1998 amending Regulation (EC) No 3821/85 of 20 December 1985 on recording equipment in road transport. Annex 1B of this Regulation contains the technical specification for digital tachographs.

Commission Regulation (EC) No 1360/2002 of 13 June 2002 replacing the Annex 1B is an actual detailed technical specification for digital tachographs. In accordance with new regulations the inspection system consists of the following elements:

- a digital tachograph VU (*Vehicle Unit*), recording the driver and vehicle operation performance,
- a speed sensor, supplying the vehicle unit with relevant data concerning the vehicle speed and distance travelled,
- chip (data) cards intended for recording the data and identification of the system users.

For the conformity reasons all admitted (*approved*) equipment must fulfil three stages of tests:

- security test – test verifying the fulfilment of all requirements concerning the security,
- functional test – test verifying the requirements concerning the functionality of the equipment,
- interoperability test – test for verifying the abilities of a considered equipment to interoperate with others equipment.

2. Running of authorized workshops

Since the installation of the recording equipment in the vehicle up to a moment of its commissioning some actions must be done which result in the introduction of a new vehicle-tachograph set to an European digital system. According to the provisions of the European regulations (Council Regulations (EEC) Nos. 3820/85, 3821/85, 2135/85, and Commission Regulation (EC) No 1360 with Annexes) every digital tachograph before entering the system is subjected to the activation and calibration procedures. Moreover, the installed and activated vehicle-tachograph set must be periodically checked regarding its conformity with the metrological needs specified in the relevant regulations (Annex 1B to the Commission Regulation (EC) No 1360/2002). It can happen that during the operation of the recording equipment a necessity of repair or replacement, and, in an extreme case, even withdrawal of its damaged elements occurs. For these reasons a network of the professional workshops is needed, which will provide a satisfactory basis for the digital tachograph servicing.

The authorised tachograph workshop is an organizational unit approved and certified by the Member State authorised for performing the procedures and functions as follows:

- installation of the recording equipment and its activation;
- tests of the recording equipment;
- inspection of the recording equipment;
- displaying the information data (stored data of the vehicle unit);
- withdrawal of the recording equipment elements.

A basic duty of the authorised workshop is to guarantee that every vehicle-tachograph set leaving such workshop could meet the requirements specified in the Regulation (EC) No 3821/85 of 1985.

According to the Annex 1B of the Commission Regulation (EC) No 1360/2002) of 2002 an installation process is defined as an assembling the recording equipment (a vehicle unit and speed sensor with a necessary wiring (*cables*)) in the vehicle.

In reality the installation procedure consists of five stages:

- a preliminary inspection of the recording equipment;
- assembling the recording equipment;
- loading the vehicle unit memory with given values of the calibration information parameters;
- sealing with leads the places of the speed sensor installation;
- assembling the installation plate (plaque).

The preliminary inspection of the recording equipment includes:

- avisual inspection – aims at a detection of any possible mechanical defects and checks a completeness of the delivered equipment according to the manufacturer's specification;
- verifying the indication errors: concerning the distance travelled, speed value and time measurement.

In case of the digital tachograph, as distinct from the analogue one, the recording errors for: a length of distance travelled, speed and duration of driving time are not subject to verification. The brand new recording equipment is delivered to the manufacturers of vehicles authorised for servicing the inactive digital tachographs. It means that all parameters have default values. For that reason a person installing the recording equipment is obliged to perform a preliminary calibration of the tachograph – i.e. to enter the setting values and the vehicle identification data. In case these parameter values are not determined (*available*), the chain type parameters will be marked with "?", and the numerical ones with „0".

The installation is the only action when the setting the calibration data without the necessity of using the workshop data card is possible.

After completing the operations necessary for assembling the recording equipment, all connections, breaking of which can cause an undetectable interruptions in recording or data loss, should be sealed with leads.

The last stage of the tachograph installation is documenting the results, i.e. printing and assembling the so called descriptive plaque. The installation plaque must be also sealed with leads unless it is placed in a way making its removal without visible traces impossible.

The tachograph installed in the vehicle should be subject to the activation procedure before leaving the place of installation. The activation of the digital tachograph is a set of actions (operations) resulting in:

- readiness of the recording equipment for operation (i.e. recording the driver's work time performance);the functions for recording and storing the data are being activated;
- activating the tachograph safety functions.

The tachograph activation is automatically performed by the first insertion of the valid workshop data card into the card reader and entering the correct PIN code. During the activation process the matching the speed sensor and vehicle unit occurs. All actions relating to the activation procedure should be carefully performed as repeated use of an incorrect PIN can result in a permanent interlock of the workshop data card.

The measuring stand for determining the characteristic coefficient of the vehicle (fig. 3):

- the calibration certificate (period between the consecutive calibrations should exceed two year);
- the expert opinion certificate in case the usability of the instruments or measuring methods is not proved in another way.

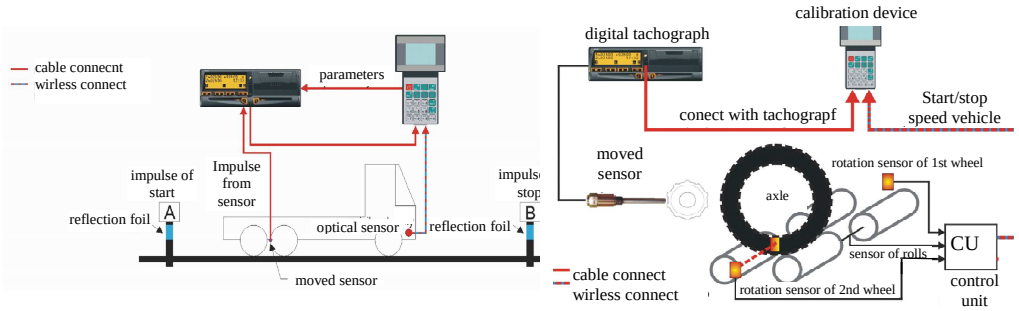

Fig. 3. Diagram of calibration of digital tachograph on road base and on work station

3. Level of impelmentataion of digital tachograpf system

Level of introducing the system of the digital tachograph, leading him was divided in the following elements:

- issue digital tachograph's card,
- connected do TACHOnet system,
- approved digital tachograpf's workshop,
- trained and equipped control services,

States which aren't still issuing cards in the system of digital tachographs:

- Croatia ,
- Serbia,
- Kosowo (the first half of 2009 will begin issuing cards),

- Cyprus.

Satates don’t connected to the tachonet: system

- Czech Republic,
- Denmark,
- Greece,
- Hungary (are in the test phases),
- Portugal,
- Bulgaria (are in the test phase),
- Kosovo,
- Serbia,
- Croatia,
- Cyprus.

States, which didn't start methods of checking and calibrating digital tachographs:

- Greece (it passed requirements determining functioning of methods of the digital tachograph),
- Malta (he adopted the Italian system, drivers are going to Italy to carry checking and calibrating digital tachographs),
- Kosovo,
- Serbia,
- Croatia,
- Cyprus.

At present they are being led widely snitch works above introducing the system of digital tachograph in such states as Russia, Ukraine or Moldova.

4. Conclusion

A certain group of vehicles is excluded from this obligation (these exclusions are stated in the Regulation (EC) No 3821/85 of 20 December 1985, Article 4). Such exclusion can be considered as a certain departure of the Annex 1B provision no 243 which states. That the manufacturer of a vehicle or the workshop are obliged to activate the installed recording equipment before a vehicle leaves a place where installation has taken place.

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Roads Damages on Undermined Area and their Maintenance

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Abstract. Roads in undermined area are affected by the influences which come from deep mining. On these affects depends type of roads damages and their development. The paper contents about roads in Moravian-Silesian region. It handles about the damages origin, types of their repairs and possibilities of the repairs and maintenance planning. The maintenance planning and management is necessarily for makes better the present roads pavements condition and for lower maintenance costs in the future.

Keywords: Maintenance, pavement management system, undermined area, roads disturbances.

1. Introduction

At present time there are two types of undermined areas in the Moravian-Silesian region. The Ostrava district, there is the deep mining finished and the mining influences are judged as faded. Whereas the Karviná district is always active in deep mining and the influences are expressed.

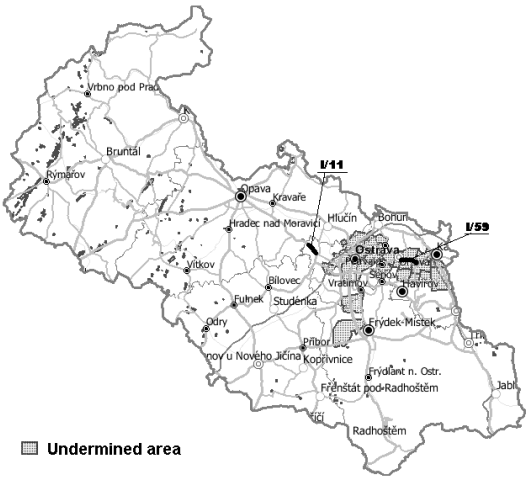

Fig. 1. Undermined area in Moravian-Silesian region [7].

These effects can have matter impact on roads as on linear constructions. Damages can be shown as a result of continuous or discontinuous strain of terrain. Type of the strain depends on the deep of the allotment under the terrain. The continuous strain has not expressive influence on roads, because the strain development is very slowly and easily predictable. Vice versa discontinuous strain, as result of mining in small deep, it is causing of for example ground waves. These terrain strain the road copy an there are deformed and damaged.

2. Influences of mining

For simple comparison the deep mining influence on roads were chosen sections of first class roads in Ostrava and Karviná. In Ostrava it is part of road I/11 and road I/59 in Karviná (Fig. 1.). Road I/59 goes through the most affected area in the district. The roads sections choice was not easy, it is important to choose roads with quite similar parameters. The chosen parts are 3.7 km long with the traffic intensity approximately 14 000 vehicles/day and quite similar intensity of heavy trucks 1650 vehicles/day. Structure of the pavement is not fully known, but the wearing course is in most causes from asphalt concrete. The inputs are more or less same and climatic conditions are same in one region to.

The data for comparison was from Roads Databank Ostrava. In the databank system there are damages designed with codes (see Tab. 1.)[1].

Code	Damage type	Comment
01	Asphalt putty waste	
02	wearing course deep fretting	
03	pothole in surfacing, pothole in wearing course	
04	cross or local hump	width is not monitored
05	surface deformation	
06	wide cross crack	width is not monitored
07	wide longitudinal crack	width is not monitored
08	alligator cracking, block cracking	
09	spalling	
10	ridge in wearing course from mastix asphalt	
11	macrotexture waste (wearing course bleeding)	
12	slurry seal fretting (EKZ)	
13	narrow cross crack	width is not monitored
14	mosaic cracks	
15	cross or local subsidence	

Tab. 1. Types of damages.

In mutual comparison of damages frequency on both roads we discover that the differences are not big, on road I/59 in Karviná there are little more damages. The dominate damages are nr. 10 and 14. Damages which are effect of undermining (4, 5, 15) are not discovered in these sections

The conditions classification by the technical conditions TP 87 [2] both parts of roads are classified that they are in good level.

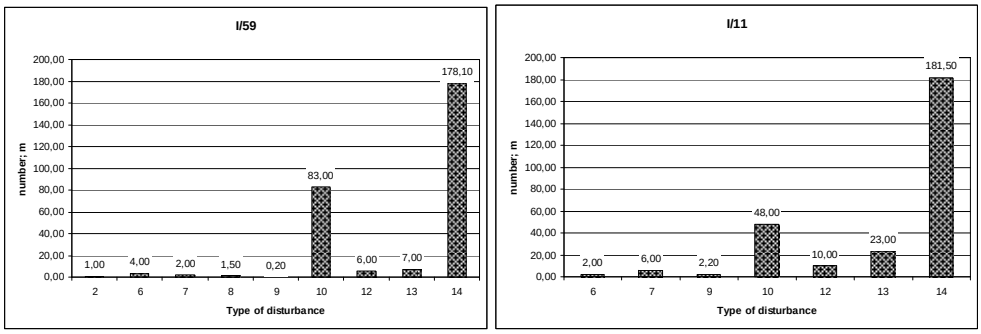

Fig. 2. Damages on road I/59 in Karviná and I/11 in Ostrava.

From upper text is not clear the level of deep mining influence on roads net. As was shown, it is not easy to find roads sections with same inputs conditions, also the problem is in the damages collecting. Last damages collecting on first class roads in undermined area was realized in 2006. If we take a look on made repairs actions (type of building activities), which Roads Databank collecting, and which are not regularly actualized to, we discover that repairs of damages from undermining were realized on first class roads I/59 and I/67.

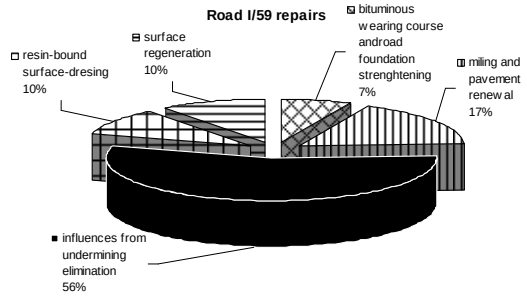

Fig. 3. Repairs on road I/59 in Karviná.

3. Maintenance

The roads designing in this areas solve the Czech technical standard ČSN 73 0039 [3]. The most important for repairs in these areas is the choice of materials, which have to be supple and have to enable roads transformation together with terrain (with so small resistance as is possible). From this ensue that materials with hydraulic binder (cement) are totally unfit. When the terrain is transformed these materials are able to resist small strain, when the compressive strength limit is broken the small alligator cracking are raised. These can be easily repaired by surface dressing or by micro-topping. In case of hump or depression the roadway is leveled by milling first (typically, 40-50 mm of roadway is milled away) and a new asphalt topping is laid. More extensive damages, such as a depression of vertical alignment, there are corrected by widen repairs and new filling (or over filling) is made.

4. Planning and management

To make the maintenance effective, planning is necessarily. From the humps maps is possible to find localization, hump value, or determine speed of terrain changing. Based on this information it is possible to set suitable correction and make a decision if it is better made easy repair (with lower costs,) because the humping will be continued, or expensive correction with longer design life.

For planning, can be used pavement management system. In this system we can take into account development (degradation) of damages and to the each damage we can insert suitable correction technology. Than, based on the inputs (damages, traffic intensity, and structure of pavement) can be set so called financial plan. This plan can be defined as optimal technical-economical plan of repairs and maintenance. It is the best usage of financial sources based on type of chosen repair and repairs design life. Plan can be set for any design life; most often it is for 10 years. The plan can be used also as supporting document for financial requests on repairs which the mining company is duty by law to cover. Also by this financial plan can be made budget for maintenance.

5. Conclusion

Roads comparison do not discover measure of undermining influence, because the sections were damaged quite same (with same damages). But still, the undermining has affect on roads and if the deep mining ends the damages will be still exert on roads pavements (the deep mining effects fading continuous 20 years). This comparison can show that deep mining effect does not need to mean huge growing of damages, but only different type of damages or different damages character.

If the maintenance is well planed, not only in undermined areas, it will bring less financial costs on repairs and roads maintenance in future and also the pavements condition will be better to. The biggest problem is to overcome needs of inputs investments to set the roads in good condition for further easy conceptual maintenance. By the continuous repairs by small parts this aim could be reached.

Acknowledgement

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The Method of Mathematical Model Plotting of System Functional Reliability

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Abstract. A modified statistics and analytic method of functional system reliability on the basis of conception use of Poisson inputs failure is being considered in the given article. This method presupposes that simultaneously two or more failures can not exist in a system. The method also allows to evaluate the functional system reliability and the more exact it is, the higher is the engineering reliability of the extended system elements, namely the parallel pipe-lines.

Keywords: method of zones of breakdown and repair (ZBR), functional reliability, coffer-dam, gate valve, main pipe-line transport system (MPTS).

1. Introduction

The designed pipe-line systems possess sufficient reliability and do not cause much anxiety, concerning possible unfo reseen faults of the transport system in target product supply to a consumer. For current reliability determination it is necessary to have corresponding methods, mathematical models and engineering techniques of their adequate evaluation. The comparative analysis of the network pattern influence on the system functional reliability bases itself upon statistics and analytic method use, that is stated in reference [4]. However in a number of cases the network pattern use of the given method does not seem possible because of uncommon transfer of ZBR graph to the calculation model of functional reliability. Namely for these purposes the modification of statistics and analytic method of functional reliability calculation of the system on the basis of Poisson inputs failure conception use is suggested. The method allows to evaluate the system functional reliability and the more accurate it is, the higher is the engineering reliability of the extended system elements, namely parallel pipe-lines.

2. Statistics and Analytic Method Modification

The modification of the ZBR method [4] on the basis of Poisson inputs failure conception, that provides more accurate meaning of the functional reliability is offered. As it is well-known, one of the peculiarities of Poisson inputs failure is the statement, that two or more inputs can not occur in a system. The given statement is a prerequisite of the new modified method of ZBR.

The modified method of ZBR includes all the stages of mathematical model plotting of functional system reliability, typical to the method of ZBR. Let us enlist these stages:

1. Mathematical model making of the parallel pipe-line transport system in the form of a weighted graph.

2. Breaking-up of the initial weighted graph of the parallel pipe-line transport network in the sub-graphs, each of which corresponds to one ZBR.
3. Engineering reliability calculation of ZBR.
4. Transformation of the initial weighted graph of the network into the weighted graph of ZBR (equivalent change of ZBR into one node of a graph).
5. Functional reliability calculation model plotting of the main network considering particular consumers.
6. The calculation model analysis for the purpose of revealing and removal out of the model of non-existent connections between zones of breakdown and repair and the zones themselves, not affected with the functional reliability.
7. Mathematical model making of the network functional reliability with the help of classical methods of reliability calculation of engineering systems

The modified method of ZBR presupposes carrying out of the first four stages of ZBR method without any changes or additions. The modified method of ZBR consists of the cardinal changes of the 5th and 7th stages.

At the 5th stage hypotheses, that make up a full group of incompatible events, are suggested. A number of hypotheses should be one more than a number of zones of breakdown and repair, considering pipelines of non-zero length. The hypothesis H_i (where i=1,2,…,k-1) presupposes, that a failure in a pipeline ZBR №i occurred in the system, and the system H_k is operating failure-free. Other hypotheses are not considered, as under the condition of Poisson inputs, more than one failure in a system does not simultaneously occur. Later on the probabilities of suggested hypotheses $P(H_i)$ where (i=1,2,…,k), and k is a general quantity of hypotheses, are being determined.

The probability of the last hypothesis $P(H_k)$ is determined with the help of the well-known engineering reliability p for each of the two parallel pipe-lines of the system. As the probability of a failure for any of the pipe-line is equal to (1-p), the probability of a failure in two of the parallel pipe-line will be 2 times more, than 2(1-p). Hence the probability of free-failure operation of the system as a whole (hypothesis H_k) will make 1-2(1-p), or

$$P(H_k) = 2p - 1. \qquad (1)$$

The statement (1) is valid for any kind of a coffer-dam in a system of two parallel pipe-lines while having Poisson nature of inputs in a system.

The hypothesis H_k, and the sum of hypotheses H_i are opposite values, for which:

$$Đ(Í_k) + Đ\left(\sum_{i=1}^{k-1} H_i\right) = 1 \cdot \qquad (2)$$

As all the suggested hypotheses are incompatible, than

$$P\left(\sum_{i=1}^{k-1} H_i\right) = P(H_1) + P(H_2) + ... + P(H_{k-1}) = 1 - P(H_k), \quad \text{or}$$

$$Đ(Í_1) + Đ(Í_2) + ... + Đ(Í_{k-1}) = 2(1-p). \qquad (3)$$

Statement (3) is also valid for any type of coffer-dams. Thus, the added hypotheses probability 2(1-p) is distributed between the hypotheses H_k,H_k,…,H_{k-1} that vary with the lengths of pipe-line parts, corresponding to ZBR.

Later the conventional probability of free-failure operation of the system $P(A/H_i)$, (i=1,2,…,k) is determined, that is the probability of the system operation under condition of hypothesis Hi. Here A is the event, that consists of continuous supply of the ultimate product to a consumer, that is of serviceability of the system. Naturally, the conventional probability of

the latter hypothesis is determined with the equity $P(A/H_k)=1$, which is correct for all the types of coffer-dams.

Conventional probabilities $P(A/H_i)$ for other hypotheses (i=1,2,…,k-1) are determined with the help of ZBR method, applied to a considered system with a cut-off i of ZBR. Practically it is done by way of plotting according to have been constructed graph ZBR of the calculated schemes of the functional reliability under condition, that all the existing coffer-dams of i of ZBR are in a "closed" position.

At the final stage of a modified method on the basis of the theorem "of the full probability " statement (4) a desired mathematical model of the system functional reliability is constructed (being independent from the type of a coffer-dam) as follows:

$$P_{2+\text{п}}^{f*} = P(A) = \sum_{i=1}^{k} P(H_i)\, P(A/H_i). \qquad (4)$$

Here, the upper index "star" denotes, that the mathematical model of functional reliability has been got on the basis of Poisson inputs failure conception.

According to the stated method, mathematical models of the system reliability for two parallel pipe-lines, connected with coffer-dams of all types were synthesized.

3. Conclusion

Thus, a modified method use of ZBR is expedient only in cases, when other methods do not work or allow to get an obvious calculation model of the system functional reliability. By the way, one should always consider, that the result of a modified method is an understated evaluation of functional reliability.

The merit of given method is obtaining of a more accurate result in contrast to the other methods. Besides, if the initial reliability of pipe-lines tends to one ($p\to1$), then the calculation value of the functional reliability according to this method tends to the veritable value.

Acknowledgement

The outcomes, received with the help of modified method of fully conforms the statistic data of observations for the ZBR behavior of the operating systems and are proved with the calculation experiments. The suggested method does not contradict to the famous method of ZBR, but is more universal, as it allows to make calculations for bridge structures.

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Analyses of Risk

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Abstract. The contribution deals with risk analysis and of safety-related control systems. The authors describe actual quantitative methods and as they are applied in the railway field. This paper represents an introductory survey of knowledge necessary to start solving topic of PhD thesis.

Keywords: safety related system, risk analysis, quantitative methods, THR

1. Introduction

This paper represents an introductory survey of knowledge necessary to start solving topic of PhD thesis of the first given author that should deal with *Control of process with define level of risk.* The concept of Safety Integrity Levels (SIL) has been applied in several standards that are used in different areas of technology. The basic safety standard IEC 61508 defines a SIL for electronic control systems. Also, the SIL is introduced into railway technology by EN 50126 [1], 50128 and 50129 [2]. The SIL is a main characteristic for safety equipment. It describes requirements for the design and manufacturing process. A definition of the SIL starts with the definition of the Tolerable Hazard Rate (THR). The railway safety standards EN 50126 and EN 50129 refer to three quantitative methods. In this presentation, I will restrict us to these methods as they are applied in the railway field.

2. Different methods to derive tolerable hazard rates

Generally in the world the tolerable rate of dangerous failures can be derived using different principles.

- **GAMAB** (Globalement Au Moins Aussi Bon), "All new guided transport systems must offer a level of risk globally at least as good as the one offered by any equivalent existing system." GAMB is practiced in France.
  The complete formulation of this principle is as follows:
  "All new guided transport systems must offer a level of risk globally at least as good as the one offered by any equivalent existing system."
  This formulation takes into account what has been done and requires implicitly a progress to be made in the projected system, by the requirement "at least". It does not consider a particular risk, by the requirement "globally". The transport system supplier is free to distribute allocation between the different risks inherent to the system.
  The GAMB principle can be explained in a very simple way. If $\lambda_{\text{dangerous old}}$ and $\lambda_{\text{dangerous new}}$ are the rates of occurrence of dangerous event for the old and new systems, respectively, then the GAMB principle requires

$$\lambda_{\text{dangerous, old}} \leq \lambda_{\text{dangerous, new}} \quad (1)$$

Although this inequality is very simple, one aspect shall be noted. Assume a system, as e.g. a train protection system is operated on demand. Then, the rate of dangerous failures is defined as a product of the rate of demands (number of trains over time, λ_{demand}) and the probability of failure on demand (P_{fail}) i.e.

$$\lambda_{dangerous,\ old} = \lambda_{demand} * P_{fail.} \quad (2)$$

- **ALARP** (As Low As Reasonably Practicable), "Societal risk has to be examined if there is a possibility of a catastrophe involving a large number of casualties." The ALARP principle is practiced in UK. The principle may be represented by the diagram **Fig. 1**.

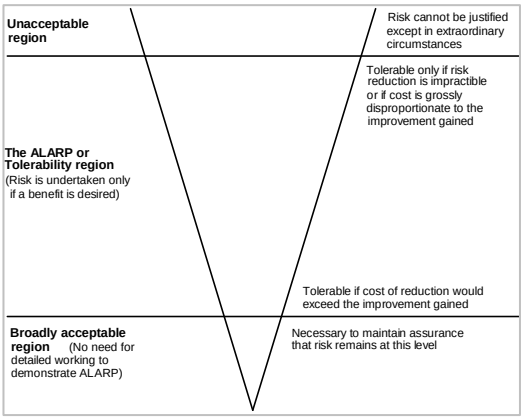

Fig. 1 The ALARP principle

Some risks are so large and some outcomes so unacceptable that they are intolerable and cannot be justified on any grounds. The upper bound defines levels of risk that are intolerable. If the level of risk cannot be reduced below this bound then the operation should not be carried out. The lower bound of the diagram defines the broadly acceptable region where risks are considered to be so low that strenuous efforts to reduce them further would not be likely to be justified by any ALARP criteria. The area between the upper and lower bounds is called the ALARP region. It must be stressed that it is not sufficient to demonstrate that risks are in the ALARP region. They must be made as low as reasonably practicable. There are various ways to demonstrate ALARP. It may be sufficient to show that the best available current standards and practices are being applied. For novel operations, or where the adequacy of current standards or practices are in doubt, the concepts of cost benefit analysis and value of life can be introduced. Societal risk has to be examined if there is the possibility of a catastrophe involving large number of casualties. The dislike of large accidents is termed "Differential Risk Aversion" (DRA). This may be expressed by a slope of (-1) in the log F-N curve, where F is the frequency of occurrence (year -1) and N the number of casualties for an occurrence.

- **MEM** (Minimum Endogenous Mortality), "Hazard due to a new system of transport would not significantly augment the figure of the minimum endogenous mortality for an individual." MEM is practiced in Germany. This principle has been derived in the following manner.

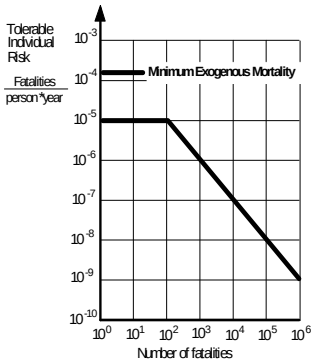

Fig. 2 Differential risk aversion

Death will result from many different causes. One such group of causes is termed "technological facts" e.g.

- –entertainment and sport (surf, trial, etc.);
- –do-it-yourself activities (lawn mowing, etc.);
- –work machines;
- –transport.

The following are not included:

- –death by illness or disease;
- –death by congenital malformation.

This group results in a certain percentage of death per annum that varies according to the age of the population being considered. This risk is referred to as "Endogenous

Mortality" "R". In well developed countries, R is the lowest for the age group 5 to 15 years. This lowest level of Endogenous Mortality, known as "Minimum Endogenous Mortality" denoted by "R_m" has been determined as:

$$\mathbf{R_m = 2 * 10^{-4}\ fatalities/person*year} \quad \mathbf{(3)}$$

From the above the following rule is formulated: "Hazards due to a new system of transport would not significantly augment the figure "R_m". For systems that may result in large number of fatalities, "differential risk aversion" (DRA) is introduced by a decreasing slope as presented in the curve in this section.

3. Risk level Assessment

At the moment the railways come up to agreement in methodology of safety assessment of all systems used in the rails (not only interlocking). The tool is risk analysis. That is why it is necessary to classify frequency and importance of occurrence of hazardous situations. Safety standards EN 50126 establish for the interlocking systems the procedure on the assessment risk levels in the table format. **Tab. 1** provides, in qualitative terms, typical categories of probability or frequency of occurrence of a hazardous event and a description of each category for a railway system. The categories, their numbers, and their numerical scaling to be applied shall be defined by the Railway Authority, appropriate to the application under consideration. Consequence analysis shall be used to estimate the likely impact. **Tab. 2** describes typical hazard severity levels and the consequences associated with each severity level for all railway systems. The number of severity levels and the consequences for each severity level to be applied shall be defined by the Railway Authority, appropriate for the application under consideration.

Category	**Description**
Frequent	Likely to occur frequently. The hazard will be continually experienced.
Probable	Will occur several times. The hazard can be expected to occur often.
Occasional	Likely to occur several times. The hazard can be expected to occur several times.
Remote	Likely to occur sometime in the system life cycle. The hazard can be reasonably expected to occur.
Improbable	Unlikely to occur but possible. It can be assumed that the hazard may exceptionally occur.
Incredible	Extremely unlikely to occur. It can be assumed that the hazard may not occur.

Tab. 1 Frequency of Occurrence of Hazardous Events

Severity Level	**Description**	
	Consequence to Persons or Environment	**Consequence to Service**
Catastrophic	Fatalities and/or multiple severe injuries and/or major damage to the environment.	
Critical	Single fatality and/or severe injury and/or significant damage to the environment.	Loss of a major system.
Marginal	Minor injury and/or significant threat to the environment.	Severe system(s) damage.
Insignificant	Possible minor injury.	Minor system damage.

Tab. 2 Hazard Severity Level

3.1. Risk evaluation and acceptance

Risk evaluation shall be performed by combining the frequency of occurrence of a hazardous event with the severity of its consequence to establish the level of risk generated by the hazardous event. A "frequency - consequence" matrix is shown in **Tab. 3**.

If the qualitative indicators are added by quantitative indicators (which is indicated in **Tab. 3**) there should be obtained practical instruction for use for defining risk. So far the mentioned congruence does not reach, which is obvious by fact, that quantitative indicators are added by factors x and y, which can gain the values ...0,1 ; 1 ; 10 ; ... And which the individual rails can define in their own responsibility targets which they try to achieve. That's why is this sequence present as certain trend and method, which is possible in some measure to apply also in interlocking equipment as complement for that area of interlocking systems, which is by fulfillment of all qualitative requests expressly to quantify.

Tab. 4 defines qualitative categories of risk and the actions to be applied against each category. The Railway Authority shall be responsible for defining principle to be adopted and the tolerability level of a risk and the levels that fall into the different risk categories.

	Frequency of occurrence of a hazardous event	**Risk Levels**			
$y.10^{-2}$	Frequent	**Intolerable**			
$y.10^{-3}$	Probable				
$y.10^{-4}$	Occasional	**Undesirable**			
$y.10^{-5}$	Remote				
$y.10^{-6}$	Improbable			**Tolerable**	
$y.10^{-7}$	Incredible			**Negligible**	
		Insignificant	Marginal	Critical	Catastrophic
		Severity Levels of Hazard Consequence			
		$x.10^{-1}$	**$x.10^{-2}$**	**$x.10^{-3}$**	**$x.10^{-4}$**

Tab. 3 Frequency - Consequence Matrix

Risk Category	Actions to be applied against each category
Intolerable	Shall be eliminated
Undesirable	Shall only be accepted when risk reduction is impracticable and with the agreement of the Railway Authority or the Safety Regulatory Authority, as appropriate
Tolerable	Acceptable with adequate control and with the agreement of the Railway Authority
Negligible	Acceptable with the agreement of the Railway Authority

Tab. 4 Qualitative Risk Categories

4. Conclusion

Safety of interlocking systems can directly or indirectly affect reliable parameters equipment. It is expected that increasing failures of equipment will be related also with increase of general frequency occurrence of hazardous state, but also frequency of occurrence of hazardous state in thought time window (second failure). In the second case when the interlocking system will be by any reasons unable to work, the trains will continue to go operated by alternative way, probably only by human decision. Because the number of human failures is many times higher than the number of dangerous failures of interlocking systems, the indirect reduction of total safety of system will be reached.

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Actual Trends in Functional Specification of Safety-related Control Systems

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Abstract. The contribution deals with functional specification of safety-related control systems. The authors summarize actual trends notable in the field of railway signalling applications seen in the context of standardisation and legislation framework too. The special attention is paid to UML-based semiformal specifications. The paper results from introductory survey of the state-of-art inevitable for future work of the first author over his PhD. thesis.

Keywords: functional specification, safety related system, UML, SysML

1. Introduction

This paper represents an introductory survey of knowledge necessary to start solving topic of PhD thesis of the first given author that should deal with *Use of formal and semiformal methods in safety-related system assessment.* At first the problems of functional specification are presented from a general point of view, and then the standardization framework is briefly discussed. The main attention is paid to semiformal specification methods potentially usable in functional specification of safety-related control systems. Knowledge presented below reflects the very introductory stage of solving the indicated problems.

2. Safety-related system and its specification

System with safety responsibility is a system whose incorrect function (failure) may have very serious consequences such as loss of human life, severe injuries, large-scale environmental damage, or considerable economical penalties. Many safety-control systems are typically fail-safe systems, i.e. once a fault has occurred the system must remain in the previous state (provided that this state does not represent a hazard to the controlled system) or must enter a pre-defined safe state.

Safety is the freedom of unacceptable risk of physical injury or of damage to the health of the people, either directly or indirectly as a result of damage to property or to the environment.

Functional safety is a part of the overall safety that depends on a system or equipment operating correctly in response to its inputs.

During the life span of a system, one of the most delicate steps to be accomplished is translation of needs and requirements into specifications. The drafting of specifications and the possibility of evaluating these specifications are very important advantages, in particular

for safety-related software. Mistakes made during specification phases are often detectable as late as during the integration tests. Then their removal often requires additional extra cost. If errors remain undetected, they become potential sources of systematic faults during system operation. This is confirmed by a study performed by the HSE concerning the primary causes of failures, based on 34 catastrophic incidents, which shows the primordial proportion (44.1%) caused by poor specifications. A mistake at this stage will be carried through the entire development process and will be very expensive to correct later.

The "good" system specification should meet the following properties: Every requirement should be unambiguous (that is admitting only one possible interpretation), the specification should be complete. It should include the entire customer's and other stakeholders' requirements and those required by the context (standards, legislation and so on). Each requirement should be stated in full and any constraints or process requirements that affect the design should be completely specified. The specification should include both what the system must do, and what it must not do. The specification should be correct. As a minimum every requirement should have been verified by both the stakeholder it comes from and someone capable of judging that the system specified is safe. The specification should be consistent. There should be no conflict between any requirements in it, or between its requirements and those of applicable standards. Every requirement should be verifiable. There should be some process by which the developed system can be checked to ensure that the requirement has been met. The specification should be modifiable. Its structure and style should be such that any necessary changes to the requirements can be made easily, completely and consistently in a controlled and traceable manner. Every requirement should be traceable. Its origin should be clear and it should have a unique identifier so that it can be referred to properties of them.

The problem is that properties of the „good" specification given above are often contradictory and thus the real specification must be result of a certain compromise.

3. Standards in developing safety-related systems

Existing software engineering techniques provide structured methodologies for design, implementation, testing, verification and validation of software. These methodologies were standardized.

The overriding world standard is IEC61508 - Functional safety of Electrical / Electronic / Programmable Electronic safety-related Systems. However, railway industry currently relies on the group of CENELEC sector specific related standards. Their review is in next table.

EN 50126 Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS	addresses system issues on the widest scale, is applied throughout all phases of the lifecycle of a railway application, to develop railway specific RAMS requirements and to achieve compliance with these requirements of complex railway applications
EN 50128 Railway applications – Communications, signalling and processing systems - Software for railway control and protection systems	identifies requirements, life cycle issues and documentation, gives detailed descriptions of objectives, input documents, output documents and software requirements specification, architecture, design and implementation, verification and testing
EN 50129 "Railway applications - Safety related electronic systems for signalling	addresses the approval process for individual systems which may exist within the overall railway control and protection system

Tab. 1. European standards for railway signaling applications

EN 50128 requires a Software Safety Requirements Specification and a Software Requirements Specification for safety related software.

The Software Safety Requirements Specification plays a key role in almost each phase of the software lifecycle, therefore must be complete, precise, and intelligible to both those developing the software and those applying it. Of course it is also desirable for the Software Requirements Specification to have all these attributes, or indeed any other Requirements Specification.

Different types of specification languages may be distinguished: specification in ordinary language, semi-formal specification and formal specification. Standard EN 50128 highly recommends formal and semi-formal methods for development of software in a way that is based on mathematics (this includes formal design and formal coding techniques) and their use for writing specifications and for verifying the safety.

4. Specification methods

Generally, natural languages and similar informal notations are said to have many disadvantages when used for technical descriptions, it is generally incomplete, incoherent, ambiguous, contradictory and erroneous.

4.1. Unified Modeling Language (UML)

To avoid disadvantages mentioned above, object-oriented modelling can be successfully applicable, particularly the *Unified Modeling Language* (UML) that is one of the most wide-spread and often used standards of OO modelling. The standard UML 2.0 offers various modelling and visualisation elements to capture and model system requirements and defines 13 diagrams classified into 3 categories:

- Structure diagrams – *Class Diagram, Object Diagram, Component Diagram, Composite Structure Diagram, Package Diagram, Deployment Diagram;*
- Behaviour diagrams - *Use Case Diagram, Activity Diagram, State Machine Diagram;*
- Interaction diagrams – *Sequence Diagram, Communication Diagram, Timing Diagram, and Interaction Overview Diagram.*

The Unified Modeling Language is implemented and supported by many SW-tools that make possible source code generation directly from the diagrams, animation of the model. The way of UML application is demonstrated in Fig. 1 which shows fragments of most often used diagram types – statechart, sequence and class diagram. In this case the application domain is railway interlocking and signalling. Due to limited size of the paper the Figure contains only fragments of diagrams, each representing a view of a different professional on the same problem - here design of control of switch point.

4.2. System Modeling Language (SysML)

SysML is a visual modelling language extending the UML to support the specification, analysis, design, verification and validation of complex systems that include HW, SW, data, personnel, procedures, and facilities. SysML is developed for Systems Engineering by the OMG, INCOSE, and AP233. SysML represents a subset of UML 2.0 with extensions – some of diagrams are the same as in UML 2.0, some UML modelling constructs SysML re-uses from UML 2.0 and there are also new type diagrams. The diagram taxonomy is following:

- Structure diagrams – *Package Diagram, Block Definition Diagram, Internal Block Diagram, Parametric Diagram;*

- Behaviour diagrams - *Use Case Diagram, Sequence Diagram, State Diagram, Activity Diagram;*
- *Requirement Diagram.*

SysML includes a graphical construct to represent text based requirements and relate them to other model elements. The requirements diagram captures requirements hierarchies and requirements derivation, and the "satisfy" and "verify" relationships allow a modeler to relate a requirement to a model element that satisfies or verifies the requirements. The requirement diagram provides a bridge between the typical requirements management tools and the system models.

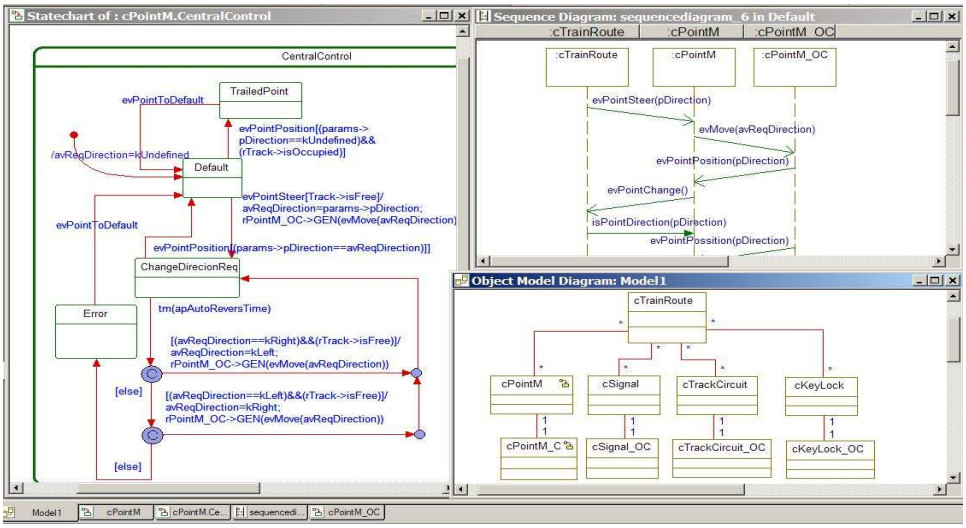

Fig. 1. Fragments of UML diagrams (State machine, Sequence and Class Diagram) performing the point control

5. Conclusion

Object oriented approach to design of safety-critical systems gives a chance to check correctness just before creating of the system itself. It produces an environment suitable for communication not only between development teams, but also towards other subjects involved in the process of system verification and approval. This approach to system design makes the process of design, development and approval of new systems significantly more effective, increases their quality and is in accordance with requirements of European standards.

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Parameters of the Quality of Service at a Bus Stop Utilized by Various Operators

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Abstract. Development of individual operator services attributes to an ever more intensive utilization of city bus stops. It is becoming necessary to determine the principles of functioning of various operators at the common bus stop. Service quality assessment parameters at a bus stop are utilized in order to determine its practical capacity. This study contains an analysis of these meters for city transportation vehicles and intercity communication based on measurements from the common bus stop.

Keywords: Public transport, bus stop, quality of service.

1. Introduction

As the result of de-monopolization of public transport, numerous private operators more and more often use bus stops in Poland. With a significant share of intercity transportation vehicles stopping at the bust stop, without a doubt there are disruptions in liquidity of city communication's traffic as well as that of other vehicles.

The purpose of this study is to analyze the parameters of the quality of customer service at the bus stop utilized by various operators. Separating the factors affecting the worsening of parameters of the quality of customer service at such bus stops is necessary in order to design their geometry and organize traffic.

Up until recently, only bus stops utilized almost exclusively by communal operator's buses have been studied. Analyses regarding the traffic processes related with functioning of a bus stop, contained within, inter alia, in works [1], [2] do not allow for the impact of stopping of private operators on the parameters of the quality of service, and thus the capacity of the bus stop.

2. Characterization of the Analyzed Bus Stop

The analyses contained within the study are based on measurements carried out at the bus stop "AGH" in Mickiewicza Street (in the direction of "Jubilat") in Krakow. The bus stop is located on a special lane for buses as well as taxis with length of the getting off and on lane amounting to 46 m in a section of the street between two crossings and traffic lights. It is a double bus stop, allowing two large-capacity vehicles to stop simultaneously in order to let passengers exchange. It has a flay-by with width of ca. 1,5 m. The other geometrical parameters have been shown in Fig. 1.

The bus traffic intensity registered at the bus stop amounts to 110 - 118 Buses/h, of which 35-37 B/h are city transportation vehicles and 75-81 B/h - intercity vehicles. The main freighter operating as city transportation in Krakow is City Transport Company. Intercity communication includes private operators' vehicles and those of Vehicle Communication Enterprises, which make intercity runs.

They differ significantly in terms of technical parameters and passenger exchange efficiency compared to that of city transportation's vehicles.

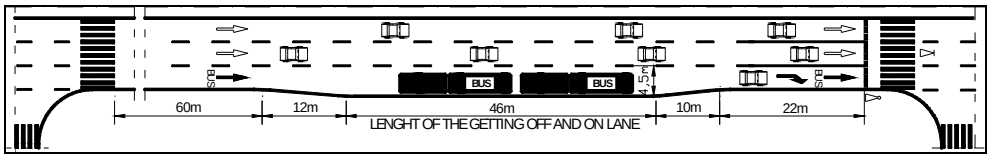

Fig. 1. Geometric parameters and location of the analyzed bus stop.

3. Carried Out Measurements

Measurements have been carried out between 3:00 - 6:00 pm at the analyzed bus stop, and these included registration of: the vehicle types, times of arrivals, commencement and completion of passenger exchange, departure times, time losses incurred because of vehicles awaiting in queues, time losses incurred due to lack of possibility of departing from the bus stop, passenger exchange posts, vehicle filling and the number of passengers getting off and on the bus.

Among the city transportation vehicles one may discern large-capacity vehicles with lengths of ca. 18 m (articulated buses) and nominal capacity of more than 115 seats and medium-capacity buses with lengths of ca. 12 m and nominal capacity of 50-115 seats, marked in the drawings presented below as a "BUS". The share of large-capacity vehicles amounts to 71%. Intercity transportation vehicles have been divided into minibuses with lengths of ca. 6-7,5 m ("MINIBUS") and midibuses with greater capacity and lengths of ca. 9-13 m ("MIDIBUS"). The share of midibuses amounted to 12 %. 99 % of passengers at the analyzed bus stop using intercity transportation services got on, and 1% got off buses.

City transportation vehicles, pursuant to the procedures of utilizing double bus stops, may stop simultaneously in two posts in order to exchange passengers. However, due to the lack of detailed provisions regarding intercity buses, these vehicles stop at the bus stop even in the 4th post in order to service passengers (Fig. 2). This often disorganizes the service process at the bus stop, although it increases its capacity, which is important especially in the case of high intensity of minibuses.

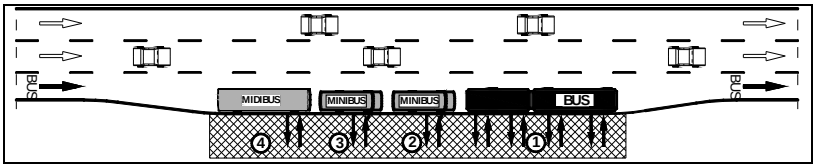

Fig. 2. Utilization of the bus stop by city and intercity transportation vehicles for the purpose of passenger service.

4. Analysis of Parameters of the Quality of Service's Standard at the Bus Stop

The parameters of the standard of service at the bus stop are: time losses incurred in queues, related to buses [s/B], time losses incurred in queues, related to passengers [s/Pass], probability of awaiting in a queue as well as an average queue length. These at the same time are the meters for analysis of the bus stop's practical capacity.

Due to various methods of utilization of the bus stop practiced by city and intercity transportation operators, among others a different number of utilized service channels, the incurred losses vary significantly in terms of value and nature. The high values of average time losses incurred by city transportation vehicles due to awaiting in queues to arrive at the passenger exchange post (19% of the immobile vehicles) and no losses when joining traffic, are characteristic of the analyzed bus stop. Intercity transportation vehicles, however, incur significant losses due to lack of possibility of departing

from the bus stop, resulting from blocking by vehicles located in the front posts, and the queue-losses are not significant due to stopping in the further exchange posts. Along with the increase of average time losses per city bus grow the average exchange time for passengers (Fig. 3a), who are the main beneficiary of the service system and the number of passengers incurring losses increases (Fig. 3b). 1 hour has been adopted as the minimum period of average losses' analysis.

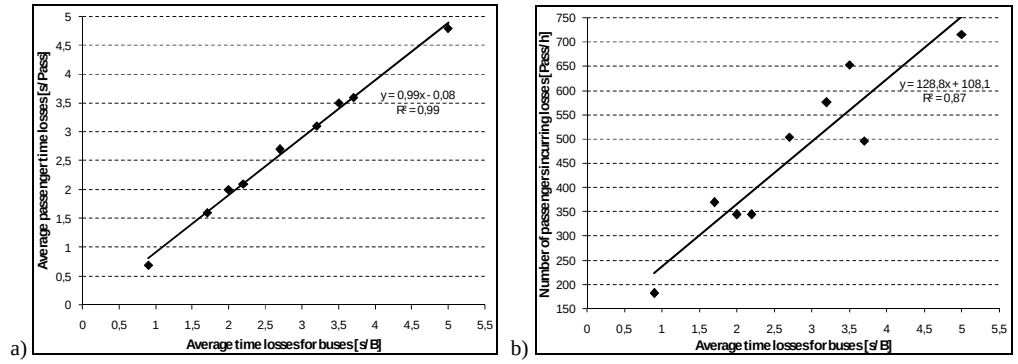

Fig. 3. Relation of: a) average passenger time losses, b) number of passengers incurring losses with average time losses for city transportation buses.

At the analyzed bus stop, the number of serviced city transportation passengers is several times higher (Fig. 4a), while the bus intensity is twice as low. On average, circa 80% of passengers (182 to 715 passengers), who incur losses due to vehicles' awaiting in queues, are the city operator's passengers (Fig. 4b). Utilization of the studied bus stop by 76 - 154 intercity transportation passengers per hour attributes to creating losses of 6,7 up to 18,1 seconds on average per city transportation passengers, who incur them. This illustrates the high cost incurred by the city operator's passengers as the result of utilization of the bus stop by a relatively low number of passengers of the remaining operators.

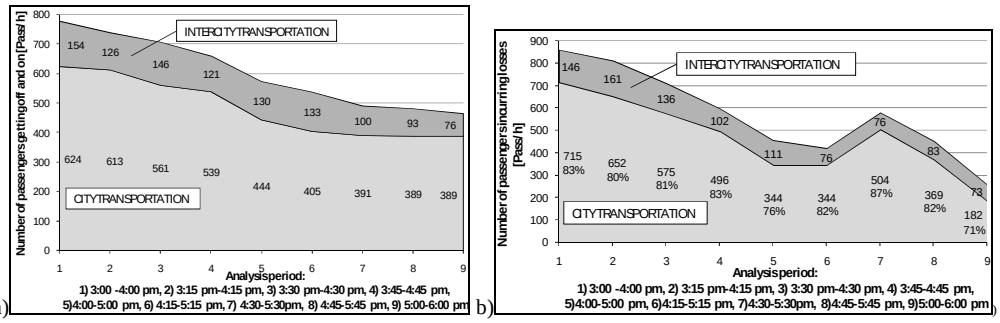

Fig. 4. Passenger intensity: a) getting off and on, b) incurring losses during vehicles' awaiting in queues, in the analyzed periods.

34 % of intercity transportation vehicles incurred losses resulting from inability to depart from the bus stop after completion of passenger exchange or due to lack of such during the analyzed period of three hours. This affects the size of average time losses of buses of the city operator incurred in queues.

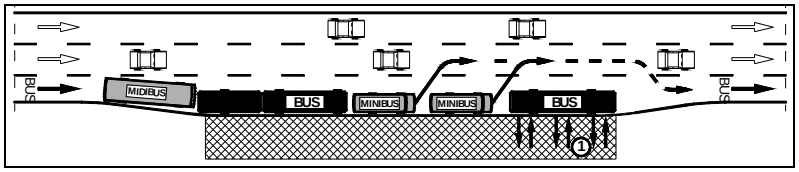

Fig. 5. Maneuvers of bypassing of the vehicles standing at the bus stop by intercity transportation vehicles.

Intercity transportation buses, in order to bypass a standing vehicle, must join traffic through the adjacent lane, which often results in disruptions also in passage of other vehicles (Fig. 5).

Making it possible to bypass any standing vehicles would allow avoiding any time losses incurred by buses due to their inability to depart and thus decreasing the losses in queues (Fig. 6).

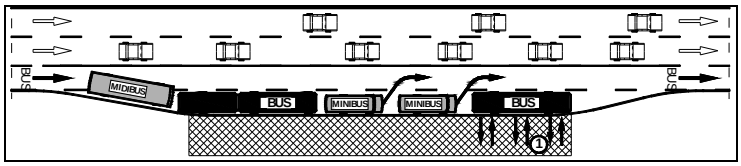

Fig. 6. Maneuvers of bypassing by intercity buses at the bus stop after changing the geometry.

In order to check how the above-mentioned solution would affect the average time losses incurred by buses, an analysis of losses in traffic situations, in which vehicles experienced losses, was carried out for three variants: 1) current situation, 2) inability to bypass, 3) all blocked vehicles can join traffic uninterrupted, for three periods of analysis (Fig. 7).

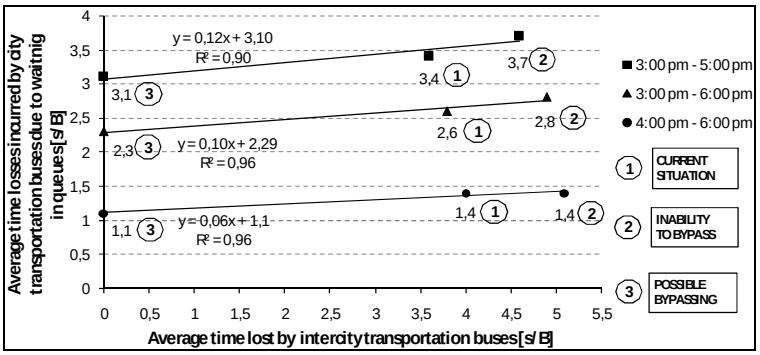

Fig. 7. Regression line for the average time losses incurred by the city operator's vehicles due to waiting in queues depended on the average time lost by intercity vehicles for 3 traffic cases.

Based on calculations one may conclude that there is a strong connection between average time lost by intercity vehicles on joining traffic and the average losses incurred by the city freighter's vehicles due to waiting in queues. The larger the share of blocked vehicles, the greater the significance of introducing changes in the bus stop's geometry, enabling uninterrupted bypassing of standing vehicles for decreasing the time losses.

5. Conclusion

Experiencing significant time losses by the city operator's vehicles resulting from awaiting in queues as well as losses for intercity transportation vehicles' resulting from joining traffic is characteristic of a bus stop utilized by various operators.

Introducing changes in the bus stop's geometry in order to enable uninterrupted bypassing of standing vehicles may affect decreasing the values of average time losses incurred by intercity transportation buses due to joining traffic as well as city transportation vehicles resulting from awaiting in queues. The higher the share of queued vehicles and intercity transportation buses, which exchange passengers or are characterized by short service times, the higher the significance of such solutions. An analysis of the effectiveness of introducing changes to the geometry of bus stops based on qualitative criteria should include a greater number of study areas with various geometry-traffic parameters.

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Optimizing Airport Terminal Facilities Utilization by Means of Controlling the Arrival Earliness Pattern of Passengers

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Abstract. This paper deals with the problems of optimizing airport arrival earliness pattern by means of coordinated and synchronized airport ground access. Our research proved that there is strong link between passenger arrival earliness pattern and efficiency of passenger flows within the airport terminals. It means that arrival earliness pattern directly influences load on terminal infrastructure and utilization of terminal facilities. We assume that ground access synchronized and coordinated with air traffic can be an efficient tool for modification of arrival earliness pattern and consequently for controlling the load on terminal infrastructure. The main aim of this paper is to demonstrate the impact of arrival earliness pattern on efficiency of passenger flows and on utilization of airport terminal resources.

Keywords: airport access, arrival earliness pattern, air-ground intermodality, airport capacity

1. Introduction

The air transport in Europe as well as worldwide has been undergoing a rapid and continuous growth in the recent years and it is anticipated that the volume of air transport will double by 2025 [1]. One of the most serious problems of air traffic system that will have to be solved in the following years is the capacity issue, and that applies to both airports and airspace. The airports are generally considered principal constraint to traffic growth and increasing demand will definitely lead to congestion of airports and Terminal Maneuvering Areas (TMAs) and consequently growing delays. It is expected that despite planned airport infrastructure investments, in 2025, more than 60 airports will not be able to handle the typical busy hour without generating delays or un-accommodated demand [2].

However, this trend does not necessarily mean that duplication infrastructure will be required to accommodate the demand in 2025. Implementation of measures that lead to more efficient traffic flows and better utilization of existing infrastructure (ACE, CDM, TAM etc.) seems to be the right approach for solving the current capacity issues. In fact, thanks to these measures Europe's most congested airports are still able to accommodate the growing demand although these have been considered as saturated for years [3].

Nevertheless, most of research and development has recently been aimed at airport airside capacity enhancement and landside related problems are being underestimated. However, after the September 11th and after security alerts in UK during summer 2006, the airport security became a priority and it has affected passenger flows within the terminals. The security procedures that were introduced at European airports after summer 2006 caused the 35 % dwell time increase [4]. Needless to say new security procedures are not the only landside related problem airport operators have to face. Traffic jams on the access roads, lack

of parking places and long queues at check-in desks and security checkpoints are the main problems of many European airports, especially during peak hours.

Taking into account forecasted traffic growth and above mentioned problems, the airport terminals can become major air transport system bottleneck that will generate enormous delays in near future. In order to avoid forming principle bottlenecks, all capacity studies should consider both airside and landside including airport ground access.

The passenger air transport could learn a lesson from the concept of express carriers (so called integrators). The business of these companies is based on totally integrated intermodal transportation of consignments door to door to guaranteed time limits [5]. Airports thus have a function of links between air and ground transport modes. All integrators' activities are coordinated and synchronized in order to reduce total transport time. Similar approach could be used in passenger air transport, which could potentially lead to significant reduction of major airport terminals congestion.

2. Optimal Arrival Earliness Pattern

Before starting to deal with air-ground intermodality itself it is necessary to analyze an existing arrival earliness pattern and try to determine what would be an optimal arrival earliness pattern at the particular airport. The main aim of introducing synchronized airport access should be to control the arrival earliness, approximate to the optimal one and thus improve efficiency of passenger flows within the terminals. Taking the inspiration from highly efficient logistic chain of express carriers, the theory of optimal arrival earliness pattern could be simply described as "just-in-time delivery of passengers".

Determining the optimal arrival earliness pattern is quite a complex problem. It differs from airport to airport and is influenced by number of factors (e.g. fleet mix at particular airport, terminal layout, terminal bottlenecks, traffic flows, types of operation etc.). However, we assume that every single airport has its optimal arrival earliness pattern.

2.1. Bratislava Airport Case Study

We have analyzed passenger flows at Bratislava airport. Using the theory of Markov chains we have experimentally determined arrival earliness pattern. The pattern is considered to be close an optimal one. Our results were then validated using PaxSim, which is sophisticated fast-time simulation tool designed for modeling passenger and baggage flows within the airport terminals.

During our experiments we assumed that the passenger check-in is the critical part of passenger handling process and that the check-in counters are operated using "flight check-in" concept.

The main aim of our analysis was to determine the arrival earliness pattern that would improve passenger flow efficiency and increase utilization of available resources. The arrival earliness pattern was defined separately for each aircraft type used at Bratislava airport. We were not able to determine generic arrival earliness pattern for all the flights but this will be the subject of further research in this field.

The following chart (Fig. 1) compares actual arrival earliness pattern with one that we consider optimal (in this case optimal for B737-700 aircraft which is the most common aircraft type at Bratislava airport). The optimal arrival earliness pattern is designed to reduce overall time spent by passengers in the terminal and at the same time to maximize utilization of check-in counters dedicated to the flight.

As can be seen from the chart, the optimal arrival earliness pattern has deterministic behavior. The initial steep part of the arrival pattern curve shows the initial entry flow of

passenger that should stabilize the check-in processing system and create certain queue length (buffer) which ensures that the processing system remains stabilized. The constant part of the arrival pattern curve represents passenger entry flow that corresponds to average service time of the processing system. The service time was considered to have exponential distribution.

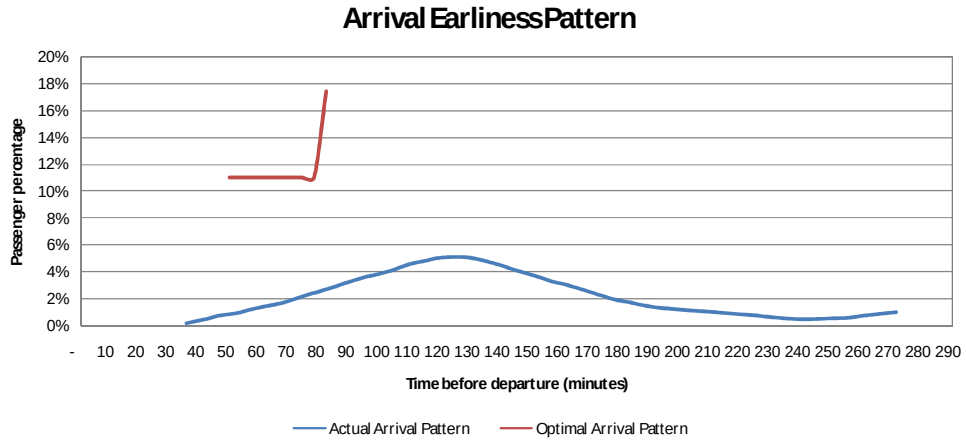

Fig. 1. Comparison of actual and optimal arrival earliness pattern.

2.2. Validation of Optimal Arrival Earliness Pattern

As it has already been mentioned the optimized arrival earliness pattern was validated using the fast-time simulation of passenger and baggage flows. The simulations proved that our assumptions were correct. The following charts demonstrate the impact of arrival earliness patterns modifications on utilization of terminal facilities as well as on efficiency of passenger flows.

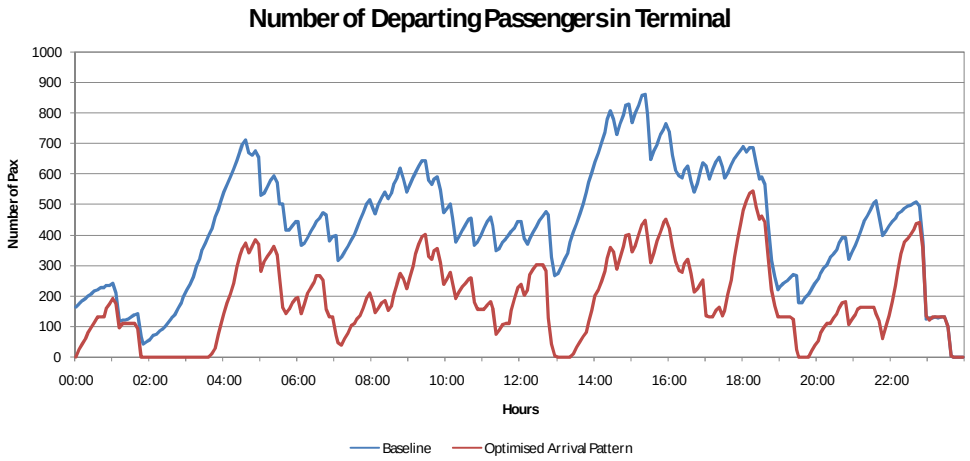

Fig. 2. Impact of optimal arrival earliness pattern on number of departing passengers in the airport terminal.

The chart depicted on Fig. 1 demonstrates that modification of arrival earliness pattern may have a significant impact on number of departing passengers in the airport terminal.

The following two charts show how the arrival earliness pattern can influence efficiency of departing passenger flows.

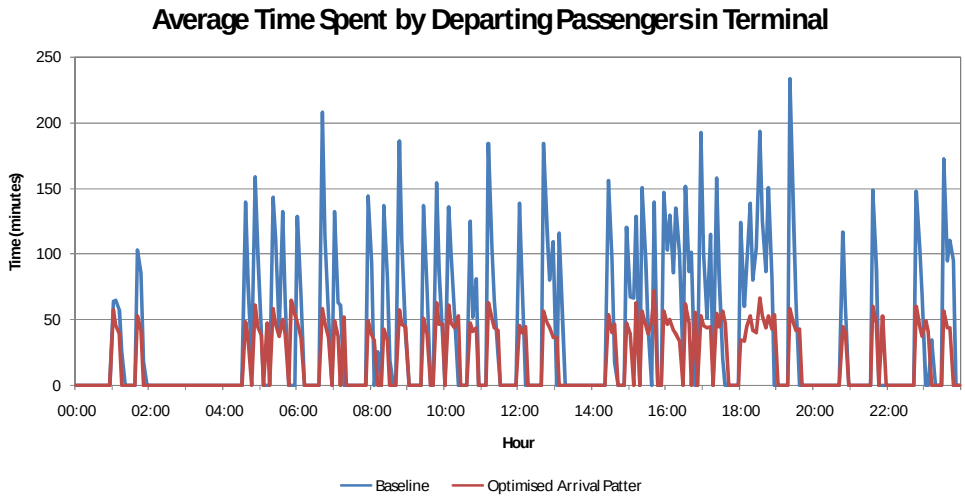

Fig. 3. Impact of optimal arrival earliness pattern time spent by departing passengers in airport terminal.

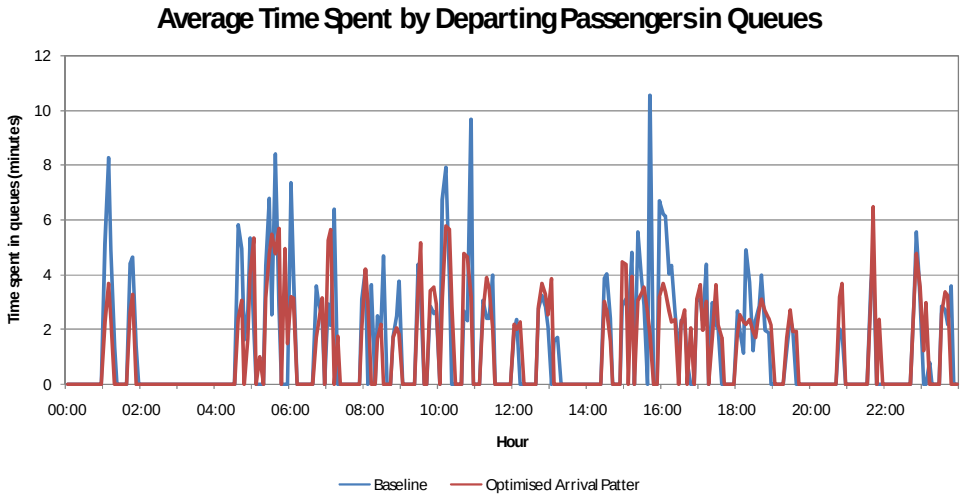

Fig. 4. Impact of optimal arrival earliness pattern on time spent by departing passengers in queues at particular processing points.

Our simulations also showed that in case of check-in counters the optimal arrival earliness pattern would allow to handle same number of passenger with 36 % less check-in resources compared to actual arrival earliness pattern. This proves the fact that stabilized processing system works more efficiently.

With optimal arrival earliness pattern the average time spent by departing passengers in the airport terminal would be reduced by as much as 57 % and average time spent by departing passengers in queue would be reduced by 12 %.

3. Conclusions

Although optimal arrival earliness pattern is rather theoretical issue, better understanding of this problem could have significant benefits for further research in the field of air-ground intermodality. In our opinion, changing the frequency and capacity of public airport access is the tool for controlling the arrival earliness pattern and optimal arrival earliness pattern only defines the target. The problems of optimal arrival earliness pattern is quite unexplored area and further research in this field should be focused mainly on development of generic algorithm that would allow to define optimal arrival earliness pattern at any airport.

It is not necessary to say that actual airport operation will never reach the theoretical optimum but understanding this field can support decision-making processes when designing and operating the airport.

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Transport and Sustainable Development of Society

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Abstract. Transportation is the most essential part of stable development and human activity. People living in developed country use transport everyday means. Road traffic influences our daily life by bringing also some negative elements – loss of soil for the infrastructure development, emissions production and traffic accidents are important negative effects. The transport system needs measures to be minimized its bad impacts. We wants mention situation traffic safety in Slovak republic and reasons of accident happened in comparison to the other EU states.

Keywords: accident, reason of accident.

1. Introduction

The need to move the freight was already at the time when human communities needed to move from place to place. Sumerians, by the invention of the wheel about 5 000 years ago, simplified the shifting and they enhanced the load carried out by the individual person. Instead of using human and animal's power, the machinery has been used to transport heavy loads since 19th century. Thereby the weight of transported freight and also speed of movement increased. Transportation is the most essential part of stable development and human activity. People living in developed country use transport everyday means. Road traffic influences our daily life by bringing also some negative elements – loss of soil for the infrastructure development, emissions production and traffic accidents are important negative effects.

According to World Health Organization, each year 1.2 million people are killed and 50 million people are injured by road accidents in the world. The situation is negative in Europe, too. Therefore, the European countries discussed about accidents of transportation and published "White Paper". In this document 60 measures of ecology and transportation sector are mentioned. They took responsibility to reduce the number of killed people on the roads to a half till 2010.

2. Road Safety in EU

Table 1 provides the number of killed people by road accident in the EU member states. According to the table, 27 EU member states have reduced the number of killed people in road accidents about 19%. 15 EU member states have reduced the number of killed people about 26%.

	2002	2003	2004	2005	2006	2007
EU 27	1	0,94	0,88	0,85	0,81	0,81
EU 25	1	0,94	0,87	0,84	0,79	0,79

EU 15	1	0,93	0,85	0,81	0,77	0,74
Belgium	1	0,93	0,89	0,83	0,82	0,82
Bulgaria	1	1,00	0,98	1,00	1,09	1,05
Czech	1	1,01	0,97	0,90	0,74	0,85
Denmark	1	0,93	0,80	0,71	0,66	0,88
Germany	1	0,97	0,85	0,78	0,74	0,72
Estonia	1	0,74	0,76	0,76	0,91	0,88
Ireland	1	0,90	1,00	1,06	0,97	0,90
Greece	1	0,98	1,02	1,01	1,01	0,97
Spain	1	1,01	0,89	0,83	0,77	0,71
France	1	0,79	0,72	0,69	0,62	0,60
Italy	1	0,90	0,84	0,86	0,84	0,84
Cyprus	1	1,03	1,24	1,09	0,91	0,95
Latvia	1	0,95	0,92	0,79	0,73	0,75
Lithuania	1	1,02	1,08	1,11	1,09	1,06
Luxemburg	1	0,85	0,81	0,74	0,58	0,69
Hungary	1	0,93	0,91	0,89	0,91	0,86
Malta	1	1,00	0,81	1,06	0,69	0,75
Netherlands	1	1,04	0,81	0,76	0,74	0,72
Austria	1	0,97	0,92	0,80	0,76	0,72
Poland	1	0,97	0,98	0,93	0,90	0,96
Portugal	1	0,93	0,78	0,75	0,59	0,59
Romania	1	0,93	1,01	1,03	1,03	1,17
Slovenia	1	0,90	1,02	0,96	0,97	1,09
Slovakia	1	1,06	0,99	0,92	0,95	1,03
Finland	1	0,91	0,90	0,91	0,81	0,92
Sweden	1	0,94	0,86	0,79	0,79	0,84
Great Britain	1	1,02	0,94	0,93	0,92	0,85

Tab. 1. Index of killed people by road accidents in the EU member states.

Resource: http://europa.eu/geninfo/legal_notices_en.htm

Indeed do we really expect that number of killed people in road accidents can be reduced to 50%? Some countries are close to reach a satisfying result as it was published in White Paper. Table 1 compares only the absolute numbers. If we want to obtain real view on the situation, it would be useful to compare the results in relative values reflecting the intensity of traffic. Table 2 shows the results of EU member states which were mentioned above.

Slovakia does not achieve favorable results neither in this table and falls into the position in its lower section. The riskiness of the road traffic in Slovakia is 4- times worse than in the countries in the upper section of this table. How can Slovakia gain the better results?

million population		10 billion total pkm		million passenger cars	
Malta	25	Sweden	45	Malta	46
Netherlands	45	Great Britain	48	Netherlands	102
Sweden	49	Netherlands	48	Sweden	107

Great Britain	54	Malta	49	Germany	110
Denmark	56	Finland	53	Great Britain	116
Germany	62	Luxemburg	54	Luxemburg	116
Finland	64	Denmark	56	Finland	136
Luxemburg	76	Germany	57	France	153
France	77	France	64	Denmark	154
Ireland	86	Italy	74	Italy	162
EU 27	87	EU 27	90	Austria	175
Austria	88	Belgium	96	EU 27	189
Portugal	92	Austria	100	Spain	201
Spain	93	Slovenia	113	Ireland	211
Italy	96	Spain	117	Belgium	216
Belgium	101	Ireland	130	Portugal	228
Czech	104	Portugal	131	Cyprus	236
Slovakia	107	Czech	146	Czech	264
Cyprus	111	Cyprus	167	Slovenia	270
Romania	115	Greece	174	Greece	375
Hungary	129	Estonia	175	Estonia	389
Slovenia	131	Lithuania	191	Poland	408
Bulgaria	135	Slovakia	215	Slovakia	439
Poland	137	Poland	235	Hungary	446
Greece	149	Latvia	256	Bulgaria	484
Estonia	152	Hungary	271	Lithuania	498
Latvia	178	Bulgaria	328	Latvia	520
Lithuania	224	Romania	398	Romania	711

Tab.2. Number of killed people by road accidents in 2006 reflecting the intensity of traffic

Resource: European Commission , Directoriate-General for Energy and Transport in co-operation with Eurostat

Table 3 shows Slovakia and chosen states of EU statistic results comparison. The states reaching better results than Slovakia were chosen.

From the comparisons which have been made so far results that Slovakia needs to focus its attention on reducing the number of people killed in a road accident. Where to direct attention results from the tab. 3 show. The percentage of killed pedestrians achieves more than twice the average of the selected EU countries.

To achieve of the ratio comparable with the EU 14 average from the table 3 the number of killed pedestrians about 114 could reduce. Drivers in Slovakia behave to the pedestrians fundamentally more illiberal in compare with drivers in west countries of the EU. It is possible to assign it to the vague legislation (pedestrian waiting on the path for crossing the road) and to high driving speed in town. In given time maximum speed up to 60 km/h opposite to allowed maximum speed in other European countries was valid. The difference in braking distance is almost 9 m. In this situation obligatory identification of pedestrian with reflex elements while walking outside of the town under damped visibility could help. Legislation dictates this obligation already.

	Pedestrians		Bicycles		Motorcycles		Cars		Goods vehicle		Bus		Other	Sum
	inside urban area	outside urban area	inside urban area	outside urban area	inside urban area	outside urban area	inside urban area	outside urban area	inside urban area	outside urban area	inside urban area	outside urban area		
Belgium	0	54	34	57	67	99	89	500	5	45	0	0	119	1069
Denmark	38	22	21	10	19	26	17	121	3	23	0	3	3	306
Spain	296	317	20	55	245	543	154	1941	6	397	1	34	95	4104
France	373	162	79	102	451	655	409	2218	20	187	1	7	45	4709

Ireland	39	25	0	10	17	38	28	146	2	25	0	0	7	337
Italy	539	171	184	112	741	717	785	2039	10	99	9	15	204	5625
Luxemburg	5	1	0	1	0	0	15	25	0	3	0	0	12	62
Malta	4	0	0	0	2	0	5	0	0	0	0	0	0	11
Netherlands	64	33	114	74	77	112	78	405	10	53	0	0	8	1028
Austria	69	41	25	23	34	100	61	323	2	29	1	7	15	730
Portugal	100	56	21	19	117	93	138	237	37	80	0	1	70	969
Finland	36	13	23	6	8	31	26	177	0	10	0	2	4	336
Sweden	32	23	15	8	23	46	35	221	1	14	0	10	17	445
Great Britain	517	186	53	19	227	386	440	1244	14	84	15	13	109	3307
EU 14	2112	1104	589	496	2028	2846	2280	9597	110	1049	27	92	708	23038
%	**13,96**		**4,71**		**21,16**		**51,55**		**5,03**		**0,52**		**3,07**	
Slovakia	195		46		28		383		50		8		0	579
%	**33,68**		**7,94**		**4,84**		**66,15**		**8,64**		**1,38**			

Tab. 3. Slovakia and chosen states of EU statistic results comparison

Resources: European Commission , Directoriate-General for Energy and Transport in co-operation with Eurostat Statistical overview of road traffic accidents in the Slovak Republic

3. Slovak Results Analyse

We have achieved significant difference also in the number of killed cyclists. In Slovakia, there is no problem to see the bicycle without required lighting and with rider under the influence of alcohol. Most of them also hold a driving license. Perhaps it would help more attention from the police, which could revoke driving license of such drivers. By achieving of the results which are comparable with average of EU 14 countries 27 cyclists could survive.

Drivers of passenger cars were killed in road accidents in 383 cases, representing 66.15% of the total. But when we compare it with results of the 14 European countries (in tab. 3), we have worse results again. There is also a similar situation on vehicles and buses.

If we compare the number of killed people according to the location of the accident, in Slovakia proportion of fatalities in road accident is 46% in urban areas, while in 14 EU member states it was only 36%. From this situation, it is possible to estimate reduction of the maximum speed in urban areas at 50 km/h as a step in the right direction.

We will analyze in more details the causes of accidents in Slovakia. Inappropriate speed has an impact on the number of road accidents as well as the severity of injuries. High speed reduces the possibility to react in time on dangerous situation, because people need a long time for information processing and selection of the best variant. Inappropriate speed was the reason of 13.8% of all road accident and 198 people died in these accidents. It is 34.2%. It is the most significant reason of tragic consequences of the road accidents. Only few drivers know that the higher driving speed of the car causes less longitudinal adhesion factor μ and worse deceleration consequently. The regress of the longitudinal adhesion factor is more significant on wet road. See Fig. 1.

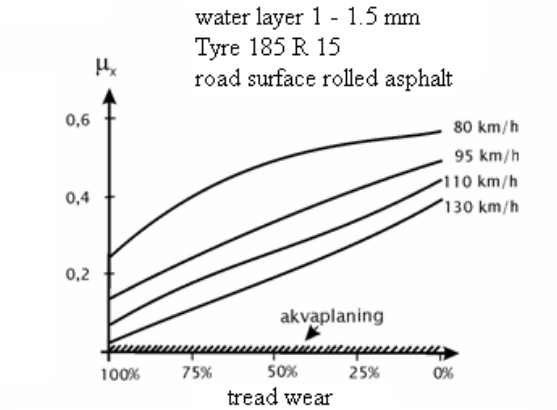

Fig. 1. Dependence of the longitudinal adhesion factor by speed and tread wear on wet road [4]

Overtaking was the reason of 2.2 % of accidents and in 4.3 % of accidents it was the reason of death. Drivers do not realize that estimate of the speed of incoming vehicle, particularly for long distances, is inaccurate. They also do not realize that for safe overtaking they need a scope for the distance up to several hundreds meters.

Unacceptable behavior on the roads was the reason of 9.5% of accidents and 68 people died in these accidents which is 11.7% of all road accidents.

Drivers often do not respect right of way because they simply do not remark it or they ignore traffic sign „stop".

Higher speed is partial reason of accidents in urban areas when a driver couldn't notice the important stimulus.

Incorrect method of driving (driving on the wrong side of the road, observance of safety distance, reverse, turning¸ change the lane, sudden braking, fault signaling) was discovered as the reason of 32.2 % of road accidents and 61 people died for this reason.

Failure of basic obligations (inadaptability to the road situation and traffic situation, aggressive driving, lack of experience with leading vehicles, incorrect placed freight,..) was the reason of 30.7 % accidents. 123 people died, which represents 21.2 %.

The significant cause of the road accidents is alcohol. For this reason, there is 4.6% traffic accidents and 49 people died in this accident, which is 8.5%. The drivers either ignore the prohibition of the alcohol consumption before and during the driving, presuming that alcohol does not influence them, or simply forget the fact, that healthy adult person can degrade only 0.2 % per hour. While 0.5 l of beer and 0.05 l of spirit cause level of 1.0 ‰ alcohol in blood.

4. Conclusions

The essential condition to decrease the accidental rate in Slovakia on the level of advanced automobile countries is the enhancing of the drivers' discipline and acquaintance.

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Optimization of Logistics Costs (expenses) by Controlling

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Abstrakt. Logistics costs are the one group of the total costs, which principally affect the performance of the business. Optimization of logistics costs requires an in-depth evaluation of in plant activities costs processes, and identify places where inefficient spending of resources appears, these costs are. Creating of appropriate system of cost monitoring is necessary to build on the controlling base, which reveals all the weaknesses in the management of costs and allow improved methods for their effective reduction in the company. Controlling controls business, therefore it is under control, so that timely signals existential crisis, take measures for its prevention and also represents the active management, i.e. management in the future**.**

Keywords: logistics costs, optimization methods, controlling

1. Introduction

Each activity of the business is linked with costs rise as an economic category what significantly affects all business processes, activities, and ultimately includes managerial decisions at operational, tactical and strategic management. Without planning, budgeting, calculating and evaluating of the costs (expenses) may come to their uncontrolled growth in the business, what adversely affects the business efficiency in terms of decrease of distributable profits.

Considering of cost structure is currently particular attention paid to minimize overhead costs, which development in recent years has seen an upward trend (statistical data) (Fig 1).[1]

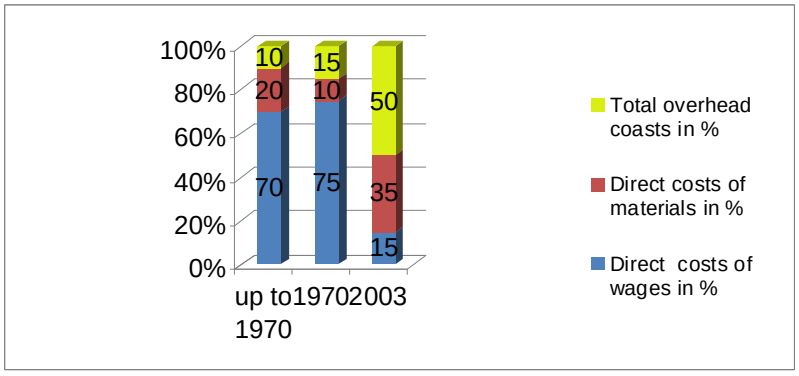

Fig. 1. Total costs development

2. Works

Logistics costs are the one group of the total costs, which principally affect the performance of the business. To resolve this management currently treats these costs through Balance ScoreCard, which allows to track them in terms of their financial prospect. The basis of this rather strategic management of the cost is to monitor their impact on the company economy outcome, ie. profit (the difference between incomes and expenses). Logistics cost management requires a change of approach in order to provide direct information flow on the emergence of generic cost of logistics processes, build an information system based on accounting and reporting, linking the system with company management systems so that information on costs were on the particular stages of management timely and feedback to operate in the individual logistic processes. The reason for these changes is to achieve optimization of logistics costs.

Company in the market economy is forced to continually improve their internal processes and systems and respond to new situations with new management features.

This helps to meet the new feature in the system of corporate governance, called controlling. Controlling is a comprehensive character functions and as a management tool supports the business processes of decision-making and management.

Quality controlling of the company is targeting to implement a cooperative style of management, and assumes operational planing and information system. Successful control of any company does not use "routine" work in management, but on the base of adequate information draws attention to the "bottlenecks" that denies to achieve torgets. Controlling represents a specific form of work with informations and its role is not to manage real processes, but the whole company through informations in the real processes.

This requires to know the company as a whole and be able to reveal the specifics of its various departments. Controlling shall the prepare informations for solving the planning, decision-making, implementation and monitoring tasks. Controlling controlls the company, therefore it helds it under control, so that timely signals existential crisis, fined solutions to prevent it and also represents the active management, it means management in the future.

The current state of monitoring costs in Slovak firms, inbefeing of the major cost items varies from company to company. In terms of individual companies up to 90% of them use a combination of cost are items and pays attention to monitor them as a separate item.

Almost all businesses dedicated to self-monitoring 'wage costs, charges, expenses for education and training of employees ", the second group of the most monitored cost items is a" cost of materials, direct energy group". Identical proportion have cost items such as "repair and maintenance“ and „rental and leasing of the equipments" [2].

Companies pursuing cost items separately (in the plan and in the accounts) but not using a management information system for the item comparison of facts with the plan and analysis of variations classificated by cost or location of their occurrence.

In terms of our companies is financial control carried out and runs a calculation and analyze of variations between the plan and the fact, but results obtained and their implications are not transferred back to individual departments, respectively, cost centers.

Most companies had actually made a comparison of the results achieved with the planned indicators only at the top of the corporate level, but as a result from stated before there is a necessity to find out whether ascertain company has selected institutional controlling as a support tool for management.

Based on the results of questionnaire survey revealed that up to 73% of companies involved in exploration has institutional control, while up to 93% of the companies as a part of a trust with foreign equity participation has controlling.

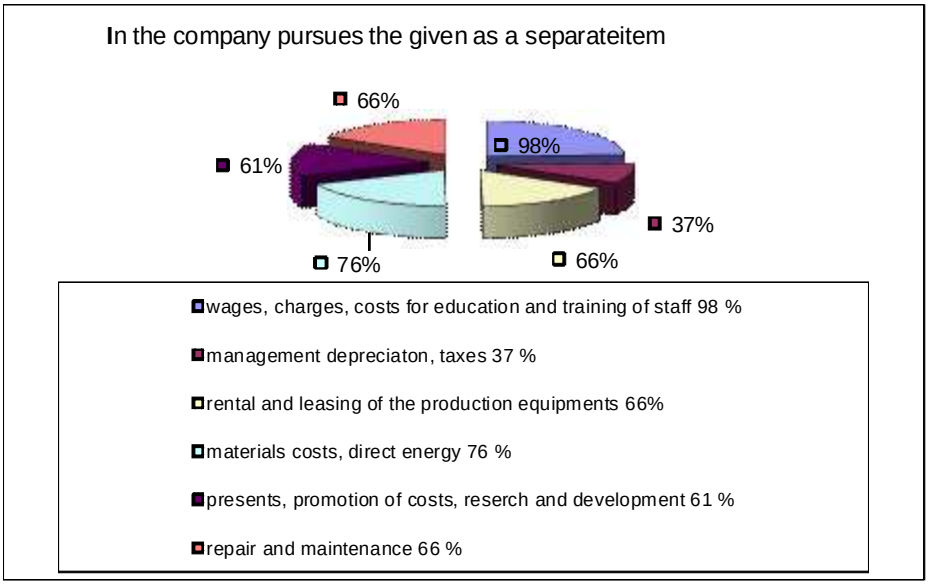

Fig. 2 Monitoring cost items

Therefore controlling is a part of the know-how transferred by foreign investors. Up to approximately 53% individual businesses does not using controlling[1].

Neither the transport companies in the Slovak Republic according to preliminary findings, are not using any separate controlling department, which would send the necessary signals and information to individual cost centers and also methods that helps to optimize logistics costs are not in use. Individual cost of logistics are an integral component of total costs. Their structure in the concept of logistics costs has the following percentage (Table 1). [3]

Cost of Supply [%]	**Storage costs** [%]	**The costs of transport and handling** [%]	**Cost per pack** [%]	**Distribu tion costs** [%]
9	36	24	5	26

Tab.1 The share of individual groups of logistics costs**.**

3. Conclusions

Optimizing i.e. reducing and reducing logistics costs requires an in-depth evaluation of in plant activities, processes. This offers us a new method of monitoring and evaluation costs. Method of ABC (Activity Based Costing), so-called calculating of costs by activities identification of points where there is inefficient spending of resources creating the expenses.The development of an appropriate system of costs monitoring is necessary to build on the base of controlling approach, which reveals all the weaknesses in the management of costs and allows to improve methods for their effective reduction in the company.

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Internet Influence on the Structure of Distribution C

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Abstract. Development of information and communication technologies (hereinafter ICT) brought about a revolution to the structure of distribution channels at the end of 20th cent. A special role was played by internet offering a new modern form of direct sale – electronic commerce (e-commerce). Internet is making the real, information and nominal flows in distribution channel simpler, more rapid and at high quality. Internet overcomes geographical distances between the producer and customer and due to the world-wide reach gives the distribution a global character. At the same time, internet is a new driver of the competition. As most companies have access to the world-wide web, information about the prices has become freely accessible. This leads to the liberalization of competition. Internet decreases the concentration in the sector of wholesalers and retailers and enables the companies to skip the blocked distribution channels. E-commerce became quickly a new alternative to distribution bodies in numerous marketing segments and often led to the shortening of distribution channels. E-commerce with virtual products contributed to the creation of the new type of the direct distribution channel. Restructuring of distribution channels is still at the evolution stage and adaptation to the development of ICT.

Keywords: distribution channels, structure of distribution channel, digital distribution

1. Introduction

Distribution politics includes decisions about the choice of the optimal distribution channel, i. e. the grouping of the distribution bodies, which bring the goods from the manufacturer to the consumer in the manner that the most consumers are reached at the lowest cost possible. The revolution in the structure of distribution channels was brought about at the end of the 20th cent. by the development of ICT with a new modern form of direct sales – e-commerce. It is a unique means as for its reach, rapidity and low costs. The principal advantages of internet are low costs of trade transaction and distribution, and practical use.

Internet enables to do business to customers at the best prices all over the world. Following the research of the French association of electronic and direct commerce Fevad, realized in June 2008 on 3152 French users of internet, the principle reasons for use of the internet in purchasing products are [7]:

- **optimisation** - more then ¾ of internet users (78%) compare the www. sites of the offered products before buying
- **flexibility** - (72%) of required internet users appreciated the possibility of buying without the time limits
- **attractive prices** - about one half of the respondents (48%) estimate the purchase of goods through internet as cheaper

Following the above-mentioned research almost 84% of respondents during last 6 months were searching out internet information before buying the goods via internet. 65% of respondents looked for product information and 53% respondents were interested in opinion

of other users [7]. Internet thus plays an important role in consumer decision-making of the internet users population. Following the research of the company ComScore Inc. the number of internet users crossed the historical limit of one billion users in December 2008. The research included the population above 15 years using the computer at domicile or at work [14]. As the number of internet users grows each year, the importance of internet and e-commerce has been constantly increasing.

2. Main determinants of internet use in distribution channel

Main determinants of the internet use as a distribution channel or communication tool which simplify the distribution process are:

- Level of technical equipment provided by ITC
- Connection costs to internet
- Distribution costs

Level of technical equipment provided by ITC – number of access points to internet and transmission speed is different with various types of internet connection. Some governments support the development of ITC, e. g. the internet providers in Slovakia allow the state subvention to some categories of internet users (e.g. some disadvantaged groups of young people). At the other hand, there are other countries, like China, which impose restrictions upon the use of internet (censoring the viewed web sites on-line).

Connection costs to internet – countries vary in the connection technologies to internet web and by its costs. The thicker the penetration of internet web, the lower its operation costs are, which gives space to enhancement of the existing technologies, which at the end results in a higher penetration again, as well as the increase of the internet web quality. Big telecommunication operators invest large sums of money to the development of internet infrastructure, they specialize in unoccupied markets, e. g. the Orange company is constructing a totally new web based on optical fibers. Its capacity won´t be used up at the beginning (the investment costs won´t be paid back), but later on the growing penetration will increase the profit turn of this high investment.

Distribution costs - internet enables to decrease either the costs of acquisition distribution, or of the physical distribution. Internet opens virtual shops which need no premises, are not subject to the opening hours and offer precise information about the products. The cost level for internet order is much lower than by telephone, e. g. following a research by P.R. Cateora, a common order costs Ford about 150 USD, while an on-line order by www.covisint.com costs only 15USD [3]. Following of goods movement via internet became a standard service for free, which is offered the customers by big shipping companies, such as at www.ups.com, www.dhl.sk.

3. Internet influence on the structure of distribution channels

Each country has its own markets with unique distribution structure enabling passing of the goods from the producers to consumers. The word structure means the way of composition, arrangement of certain elements, parts of the whole and their mutual relations, set of these relations. This concept has been recently used also for denoting an influential group of institutions, organizations, people etc [10]. Structure of the distribution channel

means the way distribution bodies are composed and organized into the distribution system, set of relations between the distribution channels bodies, their intensity and impact upon the behavior of the distribution channel as a whole. There exists a whole range of middlemen inside of this structure (such as wholesalers, retailers, etc.), whose usual functions, activities and service corresponds with the existing competition, tradition and level of economic development, as well as to other aspects of the marketing environment.

Electronic commerce has a revolutionary impact upon the structure of the distribution channel in the conditions of internationalization and globalization. P.R. Cateora refers to its as the most significant trend influencing the distribution, which influenced equally the business to customer, as well as business to business exchanges in the conditions of globalization and internationalization [3].

Internet brought the following transformations in the traditional structure of the distribution channels:

- **Simplification of flows between the members of the distribution channel**
- **Globalization of distribution**
- **Stimulation of competition**
- **Decreasing or elimination of middlemen**
- **Appearance of new middlemen**
- **Creation of the new type of the distribution channel**

Simplification of flows between the members of the distribution channel

ICT (automated system of processing price offers, orders, invoicing, on-line stock management) and subsequent flow of goods. Nominal flows have been accelerated and simplified as well (e. g. the flow of money thanks to electronic payment). Information and telecommunication technologies make the cooperation between the members of the distribution channel more efficient. E. g. on-line connection between the producer and vendor and carrier enables to shorten up the goods delivery time. For instance, in automobile production, as soon as the car leaves the production line, the information system informs about it the expedition department, the carrier, the invoice department, and the customer as well (car seller). This enables reducing the time for the car delivery to the consumer.

Globalization of distribution

Internet makes the trade transaction easier and gives the distribution a global character due to its accessibility all over the world.

A company with foreign orientation faces a multi-dimensional marketing environment, characterized by a number of uncontrollable factors, such as various cultural, social and economic, political and legal aspects, different ICT level, various types of the distribution structure). When choosing the marketing mix, the company tries to adapt to these factors. However, in the case of entering foreign markets the company must ask themselves a question, how these markets are to be segmented. Foreign markets may be divided into several homogenous customer groups, or a single „global“ world-wide segment may be applied. Then the company approaches the global customer by a uniform standard web site. This site may contain offer to choose the language, delivery and payment conditions. Global web sites have proved to work in addressing such segments as the sportspeople, teenagers, mothers, etc. These customer groups are characterized by a high degree of homogenization of needs, regardless of the geographic, cultural, political and legal background. As an example may be taken www.nike.com. Yet, customer wishes, regarding the goods, may fairly vary, according to disparate cultural attitudes and habits. That is why, it is recommended to segment the international markets for some product categories into customer groups with similar characteristics. Culture is the most important aspect in international market segmentation

(authors). That is why the web site and the product must be designed under the consideration of cultural and other differences between the individual segments.

Decrease or elimination of number of middlemen

Electronic commerce became quickly an alternative to distribution bodies in numerous marketing segments. It often led to shortening of distribution channels. Internet traders often replace the traditional traders, e. g. wholesalers and retailers. One of the most successful internet traders is the portal www.amazon.com .

New middlemen

E-commerce introduces new trading methods and a new type of middlemen which fulfill new functions and create new added value (access to electronic markets and auctions, price comparisons, customer advice, etc.). E. g. the Slovak internet trader Cargoservis offers access to their site www.cargoservis.sk at a monthly fee, providing space for the forwarding companies and other carriers to offer their transports of goods, and the transporters and forwarding companies use the site for announcing their available transport capacities.

New type of the distribution channel

A. Miklošík draws the attention to the fact that although internet has entered the category of distribution channels, it can be held as a real distribution channel only if the trade concerns the virtual product, which can be distributed by internet, e. g music, books, PC-plays downloaded from internet to computer [12]. Electronic commerce eliminates the middlemen and creates a new type of modern distribution channel.

Stimulation of competition

Structure of distribution channels was influenced in the course of the last 20 years by a high degree of wholesalers and retailers concentration. This led to disappearance of numerous trade companies which were no longer able to compete with big trade companies. As internet offers full-fledged information about products and prices, it became a new means stimulating the competition, due to which the firms are less depending on highly concentrated middlemen and can avoid the blocked distribution channels. Internet offers companies a multi-channel strategy – the strategy of building parallel distribution channels, not depending on trade floorage.

4. Conclusion

Internet expansion is one of the most important developing trends of marketing environment, which should be taken into consideration by marketers in designing of distribution channels. Internet makes the real, information and nominal flows in existing distribution channels more efficient, which can contribute to shortening of distribution channels. E-commerce enables to avoid the blocked distribution channels and enter the new markets or build stronger position in the existing markets. Building of distribution channel with the aid of internet services offers a multi-channel strategy, which decreases business risks. Internet can in case of virtual products serve as a new modern type of distribution channel.

Designing an aggressive and reliable distribution channel is the most critical task for the marketer. Failure to do this can lead to unsatisfactory entry to the new market or insufficient market coverage.

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The Development of a Dynamic Programming Technique for Solving the Large Dimension Traveling Salesman Problem

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Abstract. The paper is concerned with the testing of the dynamic programming method. The method is applied to solve a discrete problem. The modification of the method in question is proposed. The modification gives an opportunity to solve problems of lager size and to increase the accuracy of the solution obtained.

Keywords: Transport network, traveling salesman problem, alternative route, dimension, accuracy.

1. Introduction

There is a rather big amount of methods that allow the traveling salesman problem to be solved. These methods can guarantee higher or lower accuracy. Their treatment is rather complicated because the latest thorough investigation of the topic was carried in the eighties years of the previous century. The reason involved complicates estimating the speed of all precise and heuristic algorithms described in the scientific literature. Besides, there arise an acute question about the accuracy of heuristic algorithms and the connection between a problem dimension and the accuracy of these methods. During the investigation a branch and bound method [1] and the dynamic programming method [2], their calculation speeds have been tested. Both methods are believed to give the optimal solutions. The tests show that the dynamic programming method allows us to solve almost twice larger in dimension problems than the branch and bound method does. But the tests have also revealed that the dynamic programming method applied to the traveling salesman problem does not provide an optimal solution. The length of "minimal" routes obtained with the help of the method may exceed that obtained with the branch and bound method route length.

The suggested in the paper algorithm is based on the dynamic programming method for the traveling salesman problem described in [2]. The algorithm permits an increase in the accuracy of the results obtained and a solution to problems of the larger dimension.

2. The Dynamic Programming Technique and It's Modification

2.1. The Dynamic Programming Technique

This section presents a summary of the dynamic programming framework for the traveling salesman problem advanced in [2]. The problem can be set as follows. The target is to form the minimal length loop route that begins and ends in the start point *0* and passes the other *n* points precisely once where *n* is the number of the transport network points besides the point *0*.

It is supposed that there exists a path between any pair of the network points. In practice, in the case when there is no path between two points, the minimal length route between them is built.

The required route forming process is accomplished in n iterations. During each iteration n routes are formed: $M_1, M_2, \dots, M_n$, each of them contains two points more than the number of iterations. The route $M_{k,i}$ for the kth iteration, $i=1,2,...n$, $k=1,2,...,n-1$, can be described as follows. It starts at the point i, passes through k points with the different from i numbers and ends in the point 0. The route construction is based on the determined after performing the previous iteration routes. Every point should enter the new routes not more than once. The optimality criterion is stated with the aid of the function estimating the route between points i and 0 length:

$$f(i; j_1, j_2, ..., j_k) = f(M_i) = \min_{1 \le m \le k} \left\{ d_{ij_m} + f(j_m; j_1, j_2, ..., j_{m-1}, j_{m+1}, ..., j_k) \right\}. \quad (1)$$

The $f(i;j_1, j_2,\dots, j_k)=f(M_i)$ equals to the length of the route containing the points $i,j_1, j_2,\dots, j_k$;

$d_{i,j}$ equals to the length of the path between points i and j;

$\{ j_1, j_2,\dots, j_k \} \subseteq \{1,2,\dots,i-1,i+1,\dots,n\}$.

There may be a case when the route ending with the point i cannot be built when performing the kth iteration and analyzing just the routes of the (k-1)th iteration. It can occur when all the routes $M_{k-1,1}, M_{k-1,2}, \dots, M_{k-1,n}$ include the i point: $M_{k-1,1}(i), M_{k-1,2}(i), \dots, M_{k-1,n}(i)$. In this case the routes of the (k-2)th iteration are analyzed. The alternative routes $M'_{k-1,1}, M'_{k-1,2}, \dots, M'_{k-1,n}$ which don't pass though the i point are formed on the base of the $M_{k-2,1}, M_{k-2,2}, \dots, M_{k-2,n}$ routes. The required route $M_{k,i}$ is constructed with the aid of the alternative routes involved.

If all routes of the (k-2)th iteration also contain i point determining alternative routs on the base of (k-3)th iteration is performed, etc. The routes of all the steps should be saved to enable the accomplishment of the described rebuilding.

The route $M_{n,0}$ starting and finishing in the 0 point and passing through the $1,2,\dots,n$ points is formed when accomplishing the nth iteration. For this purpose the route is being chosen between $M_{n-1,1}, M_{n-1,2}, \dots, M_{n-1,n}$ for which the equation

$$f(M_{n,0}) = \min_{1 \le m \le n} \left\{ d_{0m} + f(M_{n-1,m}) \right\} \quad (2)$$

or

$$f(0;1,2,...,n) = \min_{1 \le m \le n} \left\{ d_{0m} + f(m;1,2,...,m-1,m+1,...,n) \right\} \quad (3)$$

is true.

The dynamic programming method is optimal if solving the problems with continuous data. The adaptation of the method presented in the article [2] is intended to solve the traveling salesman problem that is discrete. The fact that the "optimal" salesman routes obtained with the aid of the dynamic programming method are by 2,7% longer than the routes obtained by the branch and bound method was revealed when comparing the solutions of the two methods implementation. Apart from this, vast space of computer memory is demanded to save the routes of all steps from the beginning to the end. The next fault of the method is the increasing of the necessary amount of computation when the many steps results are reanalyzed. The last two features restrict the dimension of the problem we can solve in an acceptable time with the help of a computer.

2.2. The Modification of the Dynamic Programming Method

The modified dynamic programming method that allows the amount of data to be decreased and the precision of the result to be saved and improved is suggested in this paper.

The *k*th iteration of the suggested modification can be described as follows. Suppose that the aim is to choose the minimal length route starting with *i* point and ending with *0* point. Similarly to the original dynamic programming method, the routes $M_{1,1}$, … , $M_{1,n}$; $M_{2,1}$, … , $M_{2,n}$; ...; $M_{k-1,1}$, … , $M_{k-1,n}$ have been formed and saved by the moment of the iteration accomplishment. Some of the routes pass through the *i* point, the other routes do not. Suppose the routes $M_{k-1,j1}$, … , $M_{k-1,jl}$ contain the *i* point and $j1, ... ,jl \neq i$. Then the alternative routes $M'_{k-1,j1}$, $M'_{k-1,j2}$, … , $M'_{k-1,jl}$ are built for which the following equality is true:

$$f\left(M'_{k-1,\,j_g}\right) = \min_{\substack{1\le h\le n \\ h\neq j_g \\ i\notin M_{k-2,h}}} \left\{d_{j_h h} + f\left(M_{k-2,h}\right)\right\}. \qquad (4)$$

After this, the routes obtained on executing the (*k-2*)th iteration are reanalyzed. Those of them that contain the *i* point are replaced with the minimal length routes that don't include the *i* point. For performing this replacing, a criterion similar to (4) is used. One more set of alternative routes $M''_{k-1,1}$, ..., $M''_{k-1,i-1}$, $M''_{k-1,i+1}$, … , $M''_{k-1,n}$ is built with the use of the routes obtained. The same operation is repeated for *(k*–3)th, *(k*–4)th iterations, etc. Then the minimal length route obtained by adding points *i* to one of the routes is chosen.

2.3. The Comparative Efficiency Analysis of the Suggested Modification

The amount of calculations in the suggested modifications is equal to the number of calculations of the exhaustive search if all the iterations from the beginning are reanalyzed. To decrease the quantity of calculations, it is proposed to confine the reanalyzed iteration number. The results of the testing of the modification with different restrictions on the number of reanalyzed iterations are shown in Table 1.

The highest possible amount of iterations analyzed on the alternative routes building	Average deviation from the optimal result, %	Maximal deviation from the optimal result, %
0	7,03	25,44
1	3,63	17,93
2	3,31	16,85
3	2,73	20,85
4	1,14	10
5	1,74	10
6	1,96	14,86

Table 1. The efficiency of the suggested modification as a function of different restrictions on the number of iterations reanalyzed.

Also, a testing was implemented to find out the highest possible number of points in the transport networks analyzed. The testing was executed with the aid of a computer with a 1.5 GHz processor and a 256 Mb of RAM. The limitations for the dimension of the transport network for which traveling salesman problem can be solved by the branch and bound algorithm, the dynamic programming algorithm, and its modifications are shown in Table 2.

The technique or technique modification	Maximal number of transport network points
The branch and bound algorithm	25
The dynamic programming algorithm	45
DP algorithm modification without previous iteration recurring analyzing	170
DP algorithm modification with recurring analyzing of 1 iteration	100
DP algorithm modification with recurring analyzing of 2 iterations	95
DP algorithm modification with recurring analyzing of 3 iterations	90
DP algorithm modification with recurring analyzing of 4 iterations	80
DP algorithm modification with recurring analyzing of 5 iterations	75
DP algorithm modification with recurring analyzing of 6 iterations	65

Table 2. The limitation of the transport network dimension for which the traveling salesman problem is solved with the aid of various algorithms.

The test has shown that the modified dynamic programming method provides the highest accuracy when more than four previous iterations are analyzed. The maximal transport network dimension for the modified method is more than three times larger than the maximal transport network dimension for the branch and bound algorithm. The application of the modified method to a recurrent analysis of three and less iterations may also be useful. In the case of solving with the aid of the modified method, the results are obtained with lower accuracy, but the traveling salesman problem can be solved for transport networks of lager dimension.

3. Conclusion

This paper is about a new approach to the solution of the traveling salesman problem. The suggested in the paper algorithm based on the dynamic programming method has been compared with the branch and bound algorithm. Although the test has shown that the routes determined with the aid of the dynamic programming algorithm are on average about 2.7% longer than those obtained with the branch and bound algorithm, the dynamic programming algorithm permits the determination of salesman routes on transport networks of about twice the larger dimension than the branch and bound algorithm. Moreover, the dynamic programming algorithm modification allows an increase in the accuracy.

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Optimal Capital Structure

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Abstract. The current world financial crisis forces many enterprises to reconsider their capital structure. The possibilities to get fresh money are severely restricted by the banks and investors. The effects of the crisis are not only observed on financial markets. The purchase order situation in all industrial sectors is also negatively affected by the crisis. Because of this situation, enterprises try to optimize their capital structure and to reduce the costs of financing. The basic models of the financial theory offer a view to specify the optimum of capital structure. In practice, enterprises are faced with a lot of external factors. These factors affect and distort the models of the financial theory. This article should give a true view of practical problems in the identification of the optimal capital structure.

Keywords: Capital structure, financial leverage, cost of financing, debt-equity ratio, return on equity and return on assets.

1. Introduction

The world economic and financial crisis concerns almost all economic sectors in all industrialized countries. The capital markets have broken in and a lot of banks in different countries have gone bankrupt. Therefore, the amount of money in circulation decreases and the lack of money is clearly noticeable on the market.

But the markets need a corresponding amount of money to support all market actors with the required value of money. The shortage of the money value on the market restricts all market actors (enterprises) in their day-to-day business. This trend results in further shortage of the money value and also in the increase of credit and financing cost for all market actors.

In order not to become victims of the world economic crisis, enterprises try to optimize their capital structure and to reduce the costs of financing.

The rules of thumb to define an optimal capital structure are very different in the praxis and also different to the financial theory method. By means of the financial leverage as a basic model of financial theory the interaction between the praxis and the theory should be explained.

2. Financial Leverage

The financial leverage can be understood as a basic model to define the optimal debt-equity ratio (capital structure) and as a result of this to reduce the cost of financing. The basic principle of the financial leverage means, that through substitution of equity (e) with loan (d) the return on equity (ROE) can be increased. Provided that the rate of return on assets (i_{ROA}) is higher that the rate of interest on the loan (i_d), then the rate of return on equity (i_{ROE}) will be higher. If the rate of return on assets is lower that the rate of interest on the loan, then its return on equity will also be lower. From this it follows that the leverage allows greater potential to

return to the investor than it would have been available without a loan. But only if the first condition were met [1].

The following equation is valid [2]:

$$i_{ROE} \times e + i_d \times d = i_{ROA} \times (e + d) . \quad (1)$$

and

$$i_{ROE} = i_{ROA} + (i_{ROA} - i_d) \times \frac{d}{e} . \quad (2)$$

For better understanding and demonstration, the financial leverage will be explained at an example.

All 6 enterprises below gain a constant gross profit in the amount of 100 units. The relation between equity capital and loan shall vary.

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6
Total Capital (TC)	1000	1000	1000	1000	1000	1000
Equity (e)	1000	900	700	500	400	300
Loan (d)	0	100	300	500	600	700
debt-equity ratio (dr)	0	0,11	0,43	1,00	1,50	2,33
Gross Profit (GP)	100	100	100	100	100	100
interests on Loan (id)	5%	5%	5%	5%	5%	7%
amount of interests	0	5	15	25	30	49
Net Profit	100	95	85	75	70	51
interests (ROE)	10,0%	10,0%	10,5%	11,0%	13,0%	15,0%
fair value of Eqity (efv)	1000	947	791	625	488	319
fair value of Loan (dfv)	0	105	339	625	732	745
fair value of total capital (TCfv)	1000	1053	1130	1250	1220	1064
cost of financing (cf)	10,0%	9,5%	8,9%	8,0%	8,2%	9,4%

Tab. 1. Financial Leverage (numerical example) [3]

The interests on loan and also on the investment (equity) are from investors and the banks required interests.

At first the total cost of financing (c_f) shall be determined:

$$c_f = \frac{1}{1 + dr} \times i_{ROE} + \frac{dr}{1 + dr} \times i_d . \quad (3)$$

The fair value of total capital (TC_{fv}) shall be determined as follows:

$$TC_{fv} = \frac{GP}{c_f} . \quad (4)$$

The fair value of equity and loan can be determined with the aid of debt-equity ratio (dr) as follows:

$$d_{fv} = \frac{dr \times TC_{fv}}{1 + c_f} . \quad (5)$$

Equation (5) is fair value of loan

$$e_{fv} = \frac{TC_{fv}}{1 + c_f}. \tag{6}$$

Equation (6) is fair value of equity

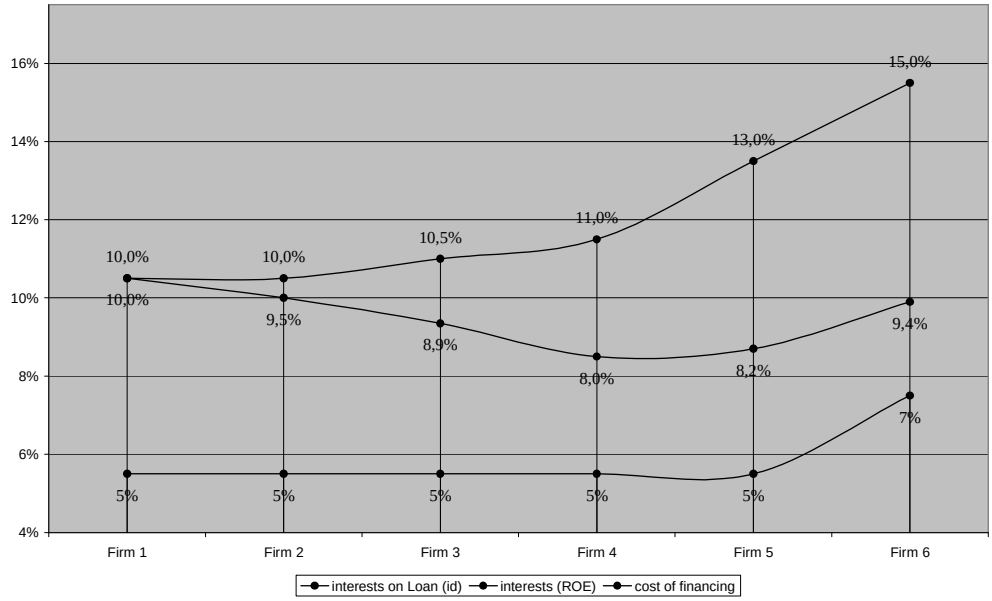

Fig. 1. Demonstration of the numerical example

The run of the financing cost (dr) shows that the firm can reduce this cost when they change the debt-equity ratio. Therefore, the financing costs will go down until optimal debt-equity ratio. After the debt-equity ratio is over the optimum, the financing costs will increase again. Consequently, we can see in the above example an optimal capital structure for the firm number 4. In this case, the debt-equity ratio equals exactly 1 [4].

3. The Financial Leverage in Practice

If the above explanations can be transferred to each firm in practice, then it would be basically possible to earn additional money by using the rules of the financial theory. But the financial leverage in form as above is a theoretical approach and must be supplemented by determinants of real economic life. The considerations of the financial theory are only selective; the enterprises are subject to permanent change in practice.

Firstly, we have to therefore clarify which condition must be given by the economic environment to be able to adopt the financial leverage in practice. The initial situation of our firm is the same as of the firm 3 in our example. To optimize the capital structure of this firm we have to increase the loan, but with the same condition as the part that we already have. The capital market is not perfect, so the market condition dictates the condition on the loan, subject to our credit rating. At the moment the credit rating of our firm is worse, so that the interest that we have to pay is much higher than before. In this case there are also the requirements of the investors higher than before.

Assumed, the interest on loan should be 8% and return on equity 13% due to the development of our company risks.

If the firm gains the same gross profit in the amount of 100 units, then the total capital of the firm is 1400, but the fair value of this total capital is just 952. Exactly the same happens with the equity, 700 units book value and 476 fair value in this case. The cost of financing also increases from 9,5% to 10,5%. Return on equity falls to 6,3%.

$$i_d = 700 \times 8\% = 56 \rightarrow i_{ROE} = \frac{44}{700} = 6{,}3\% . \qquad (7)$$

But if the firm gains a gross profit in the amount of 200 units in the next period, then the total situation can change and the fair value of the total capital increases to 1905 units. The return on equity also increases to 20,6%.

$$i_d = 700 \times 8\% = 56 \rightarrow i_{ROE} = \frac{144}{700} = 20{,}6\% . \qquad (8)$$

We can see that all determinants together and each one separately are important. Also the time factor is very important, although it is not included in the above equations. At the consideration of financial structures the focus must be directed to the total situation, not only selective to the several determinants. It is also important to consider the market development with its chance and risks.

For the practical application of the financial theory method, it is most important to take care of the debt-equity ratio. Because a leveraged company can increase the ROE in good times, but in bad times they have no possibilities to optimize their capital structure and to reduce the cost of financing.

Sustainable development of the firm can happen along with the help of financial leverage, but it cannot be exclusively supported by the financial leverage [5].

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On-line Method of Diagnosis of Motor Vehicles

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Abstract. Diagnostics is the detection of the current technical condition of equipment for the purpose of localization of critical points and the elimination of any disorder, the prevention of failure, detection of residual life, and if excessive or regular search for causes of failure.

Keywords: diagnostics, detection, system

1. Introduction

Growing number of vehicles has resulted in an increase in the exhaust heat and emissions as well as increasing number of the traffic accidents. Therefore, the roadworthiness test is becoming essential in quest of reducing each of the mentioned above aspects. The roadworthiness tests are always carried out in the specialised services of STK and EK, which are conducted according to given rules at certain time intervals depending on the age and type of the vehicle and method of preparing the fuel mixture. New vehicles are usually controlled in branded service, where the maintenance staff carries out the so-called service examinations using the diagnostic devices in the specific time intervals that dependents on the number of vehicle-miles travelled or the time interval given by manufacture, which in most cases is one year. However, most of these controls are performed only during the validity of the guarantee due to high running cost of vehicle.

As the probability of the vehicle failure is random and, in the worst scenario, a technical failure may occur immediately after leaving the service; the on-line diagnostics OBD (On Board Diagnostic), which permanently checks the vehicle during the operation, has been proposed to eliminate this kind of problems.

2. The Current State of the On-line Diagnostics

The current system OBD II is based on the OBD system (OBD I) designed first time in the USA in 1988. In Europe, referred to as EOBD II (European On Board Diagnostic). Since 2000 it is obligation to use this system for all passenger vehicles with weigh below 2500 kg.

The main task of OBD system is to record all disorders which could affect the increase production of emissions, failure of electronic systems with direct impact on safety and economy of operation of vehicle. In the event of the malfunction, the OBD system should alert the driver by turning on the light emission control on the instrument panel as depicted in (Fig.1.) or by turning on pre-defined data.

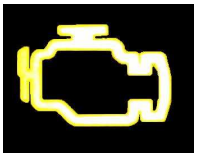

Fig. 1. Light emission MIL (malfunction indicator light)

The European on-board diagnostic is characterized by the following processes

- monitoring of emission-related components
- monitoring of engine misfire
- tracing of lambda probes
- monitoring of the fuel system
- monitor the effectiveness of catalytic converters
- monitoring of flue gas recirculation
- Management control of emissions (MIL) and the error memory
- indication of data error environment (freeze frame data)
- indication of the diagnostic preparedness (readiness code P 1000)
- determine when and how to indicate connection to the issue
- standardized output operating data (temperature, speed, etc.).
- standardized abbreviations and designations of parts and systems (SAE J 1930)
- standardized error codes for all manufacturers
- standardized communication with diagnostic equipment (SAE J 1850)
- female OBD connector pin out (DLC = data link connector) the instrument panel
- indication of failure of the usual diagnostic device
- standardization of the content of the Protocol

Diagnostic devices serve for the control or elimination of possible disturbance. The device connects using standardized 16 pin diagnostic connector shown in Figure 2.

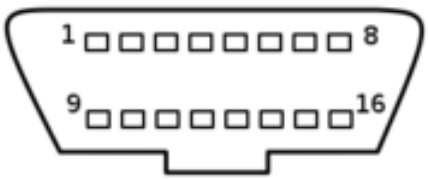

Fig. 2. Diagnostic connector EOBD

EOBD Diagnostic connector is used to read data that is stored in the memory management unit. Any error has its own error code, which is standardized (ISO / SAE). Code consists of 5 alphanumeric value. Groups P0xxx codes are independent of the manufacturers (given by ISO / SAE). Other groups of codes are freely optional for manufacturers. Solutions of the sign that were agreed by a group of manufacturers may be as follows:

- Bxxxx the body (Body)
- Pxxxx for propulsion system (Powertrain)
- Uxxxx for network systems (Undefinided)
- Cxxxx for chassis (Chassis)

The code Px is the only code required for the EOBD system. In a case of malfunctioning the following information are stored: error code MIL, rotation of the engine, vehicle speed, engine loading, temperature of coolant, the adaptive value of the formation of a mixture, and state regulation of lambda, the distance travelled from the first findings of failure, the pressure in the suction pipe, fuel pressure.

3. Conclusions

On-line diagnostics of vehicles is an important part of automotive diagnostics. Improvements of diagnostic can result in a decrease of emissions and increase the safety of traffic.

The OBD system must be able to function throughout the life of the vehicle. The manufacturer must ensure that the emission limits of new vehicle will meet the Euro III standard for at least 80 000 km or 5 year periods.

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Selected Aspects of Real-Time Passenger Information Systems

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Abstract. The main purpose of real-time information system for passengers in public transport is to provide information about delay, which is determined from actual position of public transport vehicles. Before this information comes to passengers, three basic steps must be executed – vehicle localization, delay estimation (i.e. estimation of vehicle's arrival to next stop) and distribution of information to passengers. In this article, basic methods of vehicle localization are described, together with approaches in computing delays and aspects related to delivering information to passengers.

Keywords: vehicle localization, delay prediction, real-time passenger information, public transport

1. Introduction

As the topic of author's dissertation thesis is implementation of real-time passenger information system in conditions of Slovakia, this article will point out several aspects on operation of such system. Real-time information system should provide information about delays in understandable way, in right time and in the places, where it is necessary. Before such information can be redistributed to passengers via various channels (internet, mobile devices, information displays, …), two essential steps must be undertaken – vehicle detection and delay prediction. These two steps will be described in following chapters.

2. Vehicle localization

Correct information about vehicle position is the key stone for computing of delay. Considering the fact that public transport vehicles are moving on given path, the problem of vehicle localization can be simplified to a problem of determining time of vehicle's passing through selected points on this path. When stops are selected as these points, we will obtain also information about time of vehicle's arrival to given stop. With this knowledge, estimation of arrival time to next stop can be easily calculated. Several methods of vehicle detection can be used, however when considering different transport modes or type of covered area (urban/rural) different methods or combination of them are more ore less suitable. Lets have a look on possible methods.

Manual detection. Driver or personnel at bus stops records time of vehicle's arrival. This method has two obvious disadvantages – processing is not automated and also there is a risk of cheating or errors caused by human factor.

Opened door detection. This method can be easily used to detect stops. However problem is with “on demand” stops, where driver still has to record passing the stop manually.

Problem is also when driver opens door for the second time in the same stop. Solution of this problem is simple - stop is announced only if all doors are opened.

Calculated position. This type of stop detection is based on inertial localization system, which can be typically provided by odometer. Odometer computes distance from given point with known coordinates. Unfortunately, system built on odometer principle suffers from error, which is increasing with distance increasing from inertial point. To eliminate this error, corrections must be done, e.g. this method is often combined with methods mentioned above.

Satellite navigation. Position is provided by GPS receiver. Simple a widespread method, but can be problematic in some cases (e.g. in dense urban areas). Also for some applications (e.g. recognize at which platform stop the vehicle is) accuracy of GPS is not sufficient.

Detection with roadside equipment. This type of detection is based on interaction between vehicle and roadside equipment. Communication can be provided either contact (trolleybus or trams) or contactless, typically based on some kind of DSRC or infrared communication. Two types of roadside equipment must be distinguished – passive and active. Active sensor detects passing of vehicle and uses own communication interface to provide this information for further processing. Passive sensor is based on principle that vehicle detects stop or checkpoint and uses vehicle's communication interface to provide this information for further processing.

Video Detection. Nowadays, video detection systems are able to analyze taken pictures and recognize registration plates of vehicles (either picture is processed directly in camera or is sent to processing center). This method can be used for detecting of public transport vehicles as well, together with added value of video surveillance - detection of waiting passengers or incidents detection at stops. However main disadvantage of such system will be probably higher price and also lower reliability of detection.

To conclude this part - there is relatively wide range of possibilities how to detect vehicles and it is even possible to combine these methods to reach better reliability. Which method will be used then depends on factors mentioned in the beginning, but also other ones. How often the position of vehicle should be checked and how precisely? And of course there must be a solution how to assign a vehicle to specific route. For this operation, two basic approaches can be used; assignment is done by dispatcher in system center or by driver in vehicle. Describing more details on this topic is unfortunately out of the scope of this article.

3. Delay prediction and communication infrastructure

The goal of calculating delay is to predict time of arrival to next stop as exact as possible. Such prediction can help to provide more comfortable traveling for passengers, because there is no more uncertainty about operation of public transport system. When deciding which method can give us best results we have to consider various reasons of delay, including breakdowns, accidents, dense traffic, climatic conditions, human aspects, type of vehicle. Following paragraphs describe several approaches to delay calculation.

Simple comparison. The simplest method of delay calculation is based on comparison of last known stop passing with arrival time for actual stop given in timetable. This method is

relatively exact when there are common traffic conditions. To make prediction more precise, several checkpoints between stops can be added.

Average travel speed utilization. This method can be used in combination with simple method to provide better precision on long distance routes where delay is affected by varying traffic conditions.

History based prediction. We can easily utilize information form the history to compute delay. There are two possibilities – either to compare history of same route on given path in last days or with recent history of other routes passing same parts of the path. The first method of prediction can respond to changed travel times due climatic conditions (especially in regional transport) or due high traffic density (in urban areas). The latter case can make more precise delay prediction when traffic is affected by very actual situation (congestion after accident or road works).

No matter what kind of prediction will be used, it can always happen that expected delay will change. But predicting delays brings also another aspects. Where is the prediction calculated? In vehicle or in system center? This fact can cause limited possibility of prediction algorithm. Another problem can be with sophisticated algorithms, as produced result can be interval of expected delay with certain probability. To evaluate such probability it is necessary to analyze the problem on specific route or area data, not globally for whole network.

Now when basic concepts of detection and prediction were described, it is necessary to mention that there is one more essential part of system - communication infrastructure providing connection between detection and prediction phases and also providing estimated delay information to passengers.

When designing communication infrastructure, many factors has to be considered, beginning with utilized transmission technology, covered area, number of vehicles, methods of communication (polling or communication initiated by vehicle), intervals of data exchange and amount of transmitted data. Another deal can be with reliability of communication infrastructure. Is the information about vehicle position for passengers crucial or can be provided with service, which is not guaranteed (e.g. GPRS)? Does current infrastructure will be able to deal with future requests? These and other questions are discussed in author's dissertation thesis.

4. Proposal of real-time information system for regional bus transport – vehicle detection and passenger information equipment

On the base of above mentioned facts, a proposal of system can be made. Simplified model introduced in following paragraphs is suitable for regional bus transport. Within this article, no details on this model are described, only proposal on equipment to be used for providing vehicle detection and passenger information. This equipment is divided into three parts for three different types of stops – terminals, exchange stops and other stops.

Terminals (Bus stations). A systems based on active contactless detection is considered as the most suitable for bus stations. Detectors are placed at terminal entry and exit portals and at each platform stop. All detectors are connected with optical network to control center of terminal. Such interconnection provides bidirectional channel for communication between

vehicle and center. This channel can be thus utilized for other purposes (info about reservations, transfer of advertisements to vehicle's information system, reading data from ticket printers, diagnostics, ...). Bus terminal should be also equipped with video surveillance system, but this system is supposed to be used for vehicle detection only in case when detector-based system is unable to handle detection process (e.g. unknown vehicle, …).

Exchange stops. This category covers small bus stations or stops where exchange is possible. Here, information displays will be placed to provide necessary information. Displays will be connected to system center with some kind of wireless broadband connections or optical network. This connection can be used for data transfer of video surveillance stream. Second communication interface of stop equipment will be sensors providing communication with vehicle and thus especially providing information about incoming vehicles.

Other stops. Stops situated in rural areas or places where installation of communication infrastructure would be expensive or unsuitable will be equipped only with passive detectors. These will be placed before and behind the stop, thus vehicle passes both detectors and according to time difference between these two passes it can be found if vehicle has stopped. All data exchange with system center is realized via equipment inside the vehicle. Detecting stop sensors can also initiate launching of vehicle's information and acoustic system and set ticket processor for given stop. Related to equipment for passenger information, it is expected that passengers will receive delay informations with mobile devices.

5. Conclusion

In Europe, a lot of successful applications of real-time passenger information systems have been realized. Nevertheless, there are minimal experiences with such system design and operation in Slovakia. Recently, as the tendency to implement this kind of system is increasing, with no experiences and especially with no standards defined in this area it can happen that implemented systems will not fulfill expectations and cause problems with interoperability of telematic applications. Author of this article believes that comments on real-time information systems design and operation described in his dissertation thesis can be further used for definition of telematics standards for public transport in Slovakia. Such standard can avoid inefficient money wasting and compatibility issues in the future.

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